



Ministry of Road Transport and Highways
(GOVERNMENT OF INDIA)

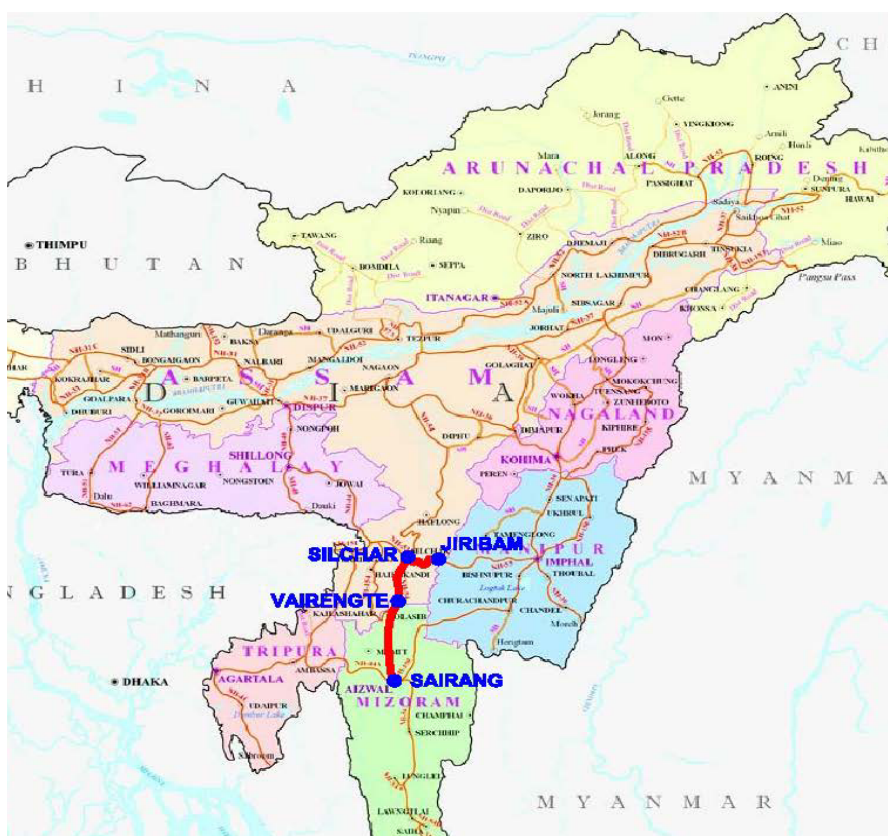


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Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).



**Draft Detailed Project Report (Silchar -Vairengte)
Package-2, mod. (From Km 20+000 to Km 49+360)
Volume-III (MATERIAL REPORT)**

January 2023



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Section: Silchar to Vairengte (Package-2, mod. Km 20+000 to Km 49+360)

DRAFT DETAILED PROJECT REPORT

VOLUME : I	MAIN REPORT	
	APPENDICES TO MAIN REPORT	
VOLUME : II	DESIGN REPORT	
VOLUME :III	MATERIALS REPORT	√
VOLUME : IV	ENVIRONMENTAL ASSESSMENT REPORT INCLUDING ENVIRONMENTAL MANAGEMENT PLAN(EMP) AND RESETTLEMENT ACTION PLAN(RAP)	
VOLUME : V	TECHNICAL SCHEDULE	
VOLUME : VI, VII & VIII	RATE ANALYSIS, COST ESTIMATE, BILL OF QUANTITIES	
VOLUME : IX	DRAWINGS (ROAD & STRUCTURES)	

Vol-III

Material Report

Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte(49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km))

Section: Silchar to Vairengte (Package - 2, mod. from Km 20+000 to Km 49+360)

Table of Contents

1. VOLUME III – MATERIAL REPORT	1-3
1.1 General	1-3
1.2 Description of the Project	1-4
1.3 Salient features of the project	1-7
1.4 Topography and Climatic Condition.....	1-7
1.5 Material Investigation.....	1-11
1.5.1 Objective	1-11
1.5.2 Laboratory Investigations.....	1-13
1.5.3 Soil classification - IS, HRB and AASHTO Soil Classifications.....	1-14
1.5.4 Bypass Section Soil Sample	1-20
1.6 Quarry and Materials Investigations	1-24
1.7 Identification of Material Sources.....	1-24
1.8 Field Visits to Quarry and Materials Sources	1-25
1.8.1 Sampling of Materials from Sources.....	1-25
1.9 Murrum Borrow Soil.....	1-25
1.10 Laboratory Tests on Borrow pit Murrum.....	1-26
1.11 Laboratory Tests on Borrow pit Murrum.....	1-26
1.12 Quarries for Aggregates	1-27
1.13 Natural Sand	1-28
1.14 Water Sources for Construction Works	1-28
1.15 Recommendation of Materials Sources	1-28
1.16 Other Construction Materials.....	1-30
1.17 Geotechnical Investigations.....	1-30
1.17.1 Purpose of Investigation	1-30
1.17.2 Scope of work	1-32
1.17.3 Geotechnical Investigation at Structure Locations.....	1-32
1.17.4 General geology of the Area.....	1-35
1.17.5 Seismicity	1-37
1.17.6 Design Criteria.....	1-38
1.17.7 Design Methodology	1-38
1.17.8 Computation	1-41



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



List of Tables

Table 1.1	Package Distribution.....	1-5
Table 1.2	Salient features of Project Highway	1-7
Table 1.3	Details of Chainage-wise Subgrade Soil Collected.....	1-13
Table 1.4	Test results of existing subgrade	1-16
Table 1.5	Details of Chainage wise soil samples collected along Bypass	1-20
Table 1.6	Test results along bypass	1-22
Table 1.7	Details of Barrow Area	1-26
Table 1.8	Details of Stone Quarries	1-27
Table 1.9	Details of Sand Sources	1-28
Table 1.10	Bore log details	1-32

Lists of Figures



Fig 1.1	Key Plan for Proposed Construction Packages.....	1-6
Fig 1.2	Soaked (4 Days) CBR vs MDD Graph of Subgrade Soil	1-18
Fig 1.3	Soaked (4 Days) CBR vs MDD Graph of Green Field Soil sample	1-23
Fig 1.4	Lead Map	1-29
Fig 1.5	Geological and Mineral Map	1-36
Fig 1.1	Seismic map of India.....	1-37

Lists of Pictures

Pic 1.1	Photographs Showing Trial Pit.....	1-19
Pic 1.2	Photographs Showing Soil samples	1-24
Pic 1.3	Photographs of Borrow Area	1-26
Pic 1.4	Photographs of Sub-Soil Investigation.....	1-31

Lists of Annexures

- Annexures – 1 - Physical Characteristics of OGL Soil and existing subgrade soil Samples
- Annexures – 2 – Compaction Test and Three Energy level along existing Subgrade
- Annexure – 3 – Compaction Test and Three Energy level along existing Bypass

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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1. Volume III – Material report

1.1 General



Bharatmala Pariyojana is a mega plan of the government and the second-largest highways project after the NHDP. Many defined highway stretches totalling about 50,000 km are proposed to be developed as "**Economic Corridors, Inter Corridors & Feeder Routes**" under "**Bharatmala Pariyojna**".

Economic corridors are integrated networks of infrastructure within a geographical area designed to stimulate economic development. These corridors are generally developed to link cities or countries, manufacturing hubs, areas with high supply and demand, and manufacturers of value-added goods, whereas 44nos of corridors are identified. Inter Corridors & Inter-connection between different economic corridors, development of first mile & last mile connectivity. Development of these corridors will help in decongesting 30 top cities in the country by building ring roads and logistics hubs along these corridors. These stretches pass through and connect major hubs of economic activities such as manufacturing clusters, ports etc. Under 'Logistic Efficiency Enhancement Programme', these are proposed to be developed by taking an end-to-end corridor view, rather than stretch-by-stretch road construction view to ensure consistent infrastructure along the corridor.

As a first step towards this task, preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana is being undertaken by National Highways Authority of India (NHAI). Numbers of consultants have been appointed by National Highway Authority of India (NHAI), to prepare the Detailed Project Report for identified economic corridors, inter corridors & feeder routes under Bharatmala Pariyojana.

The National Highways & Infrastructure Development Corporation Limited (**NHIDCL**) has been constituted through an Act of Parliament for faster, economical and quality Road Construction work throughout India.

National Highways and Infrastructure Development Corporation is a fully owned company of the Ministry of Road Transport & Highways, Government of India. The company promotes surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighbouring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p>	
<p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p>		
<p>Volume III – Material Report</p>		

East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner. An approximate aggregate length of 10,000 kms has been identified to begin with for development through this company. The company envisages creating customized and specialized skills in terms of addressing issues like complexities of geographical terrains and addressing extensive coordination requirements with security agencies. The company would also endeavour to undertake infrastructure projects including but not restricted to urban infrastructure and urban or city transport and to act as an agency for development of all types of Infrastructure. The company envisages working towards cross sharing of technical know-how and enhancing opportunities for business development with other nations and their agencies including the multilateral organizations and institutions.

The company also proposes to improve road connectivity and efficiency of the international trade corridor, by expanding about 500 KMs of roads in the North Bengal and Northeastern region of India to enable efficient and safe transport regionally with other South Asia Sub-regional economic Cooperation (SASEC) member countries. These projects are being funded by ADB (Asian Development Bank).

M/s. Transys Consulting Pvt. Ltd., has been appointed as consultants by National Highway Infrastructure Development Corporation Limited (NHIDCL), to prepare the Detailed Project Report for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India (Lot-1) **Package-III** under Bharatmala Pariyojana.

NHIDCL will be the employer and executing agency for the consultancy services and the standards of output required from the appointed consultants are of international level both in terms of quality and adherence to the agreed time schedule. The consultancy firm will solely be responsible for submission of quality work in stipulated period.

The Letter of Acceptance was issued on 22nd march 2018 vide letter ref no NHIDCL/Bharatmala/DPR/Phase-I/Lot-1/Package-III/2017/66, however the letter of commencement was issued on 02nd July 2018 vide letter ref no. NHIDCL/Bharatmala/DPR/Phase-I/Lot-1/Package-III/2017/107. The contract agreement was signed on 19.06.2018.

1.2 Description of the Project

The project corridor has been identified from Silchar to Aizawl under national highway NH-306 with total length of 185 Km. The corridor further bifurcated in to two Section as below;



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



- a) Silchar to Vairengte (Assam State)
- b) Vairengte to Aizawl(Mizoram State)

Since, DPR consultant has been assigned for DPR preparation from Vairengte to Sairang only hence, based on assessment in line with construction packages the project Corridor from Silchar to Sairang has been divided in to 8-Packages as below table with key Plan.

This Report mainly contains Improvement proposal pertaining to Package -2.

Table 1.1 Package Distribution

Sl. No.	Construction Packages	Design Chainage			Existing Chainage			State
		From	To	Length (km)	From	To	Length (km)	
1	Package-1	0+000	20+000	20.000	263+800 (Of NH-37)	12+920 of NH-306	18.820	Assam
2	*Package -2	20+000	*49+360	29.360	12+920	43+000	30.080	Assam
3	Package-3	*46+000	**60+850	14.850	43+000	59+700	16.700	Mizoram
4	Package -4	**61+000	77+500	16.500	59+700	86+000	26.300	
5	Package -5	77+500	95+500	18.000	86+000	107+850	21.850	
6	Package -6	95+500	111+850	16.350	107+850	126+315	18.465	
7	*Package -7	111+850	125+500	13.650	126+315	142+060	15.745	
8	*Package -8	125+500	136+400	10.900	142+060	158+900	16.840	
	Total Design Length			136.400			164.660	

* EQ (km 49+360 = km 46+000) ** EQ (km 60+850 = km 61+000)



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report

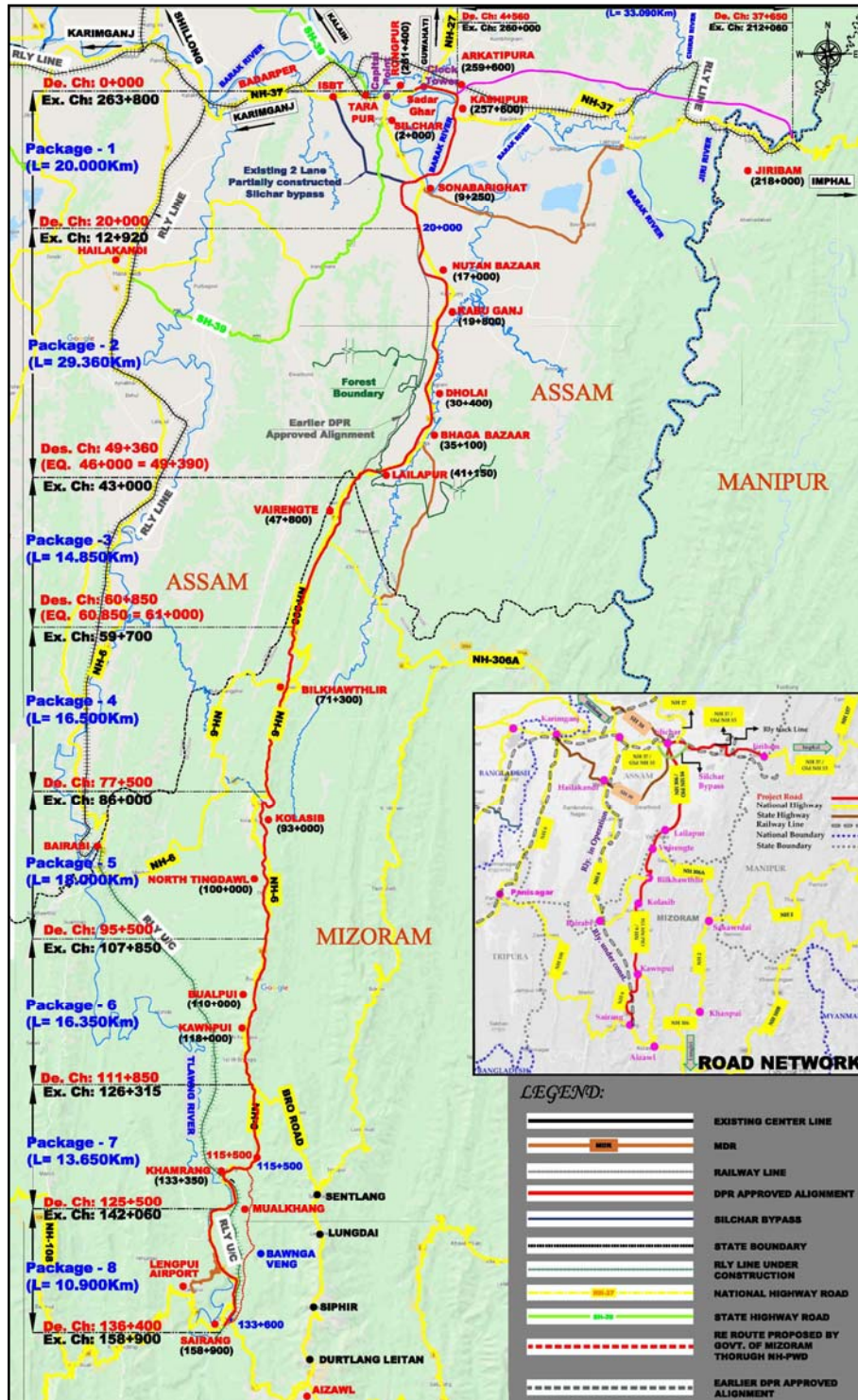




Fig 1.1 Key Plan for Proposed Construction Packages

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1.3 Salient features of the project

The salient features of the project are as under:

Table 1.2 Salient features of Project Highway

Sl. No.	Description (Prop)	Unit	Total
1	Alignment & Geometrics		
	Total Length	Km	29.360
	Re-alignments	Km	2.260
	Bypass / Short Bypass		
	Bypasses	Km	16.400
	Short Bypass	Km	2.000
	Total (Realignments +Bypass)	Km	20.66
2	Cross Section		
	4-Lane Road	No	29.360
	6-Lane Road (Approach of structures)	No	Nil
3	Bridges		
	Existing		
	Minor Bridges (Along Existing Road)	Nos	05
	Major Bridges (Along Existing Road)	Nos	Nil
	Proposed (Major/ Minor)		
	Minor Bridges (Reconstruction & New Construction)	Nos	12
	Major Bridges	Nos	Nil
	Rehabilitation Proposal of Existing Bridges		
	Existing Bridges reconstruction (1 no culvert & 4 nos of Minor Bridge proposed to Minor Bridge)	Nos	05
	Existing Bridges Repair/ Retain MJB	Nos	Nil
	Existing Bridges Widening	Nos	Nil
	Existing Bridges Abandoned	Nos	01
	New Bridges		
	a. Minor Bridges	Nos	07



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



Sl. No.	Description (Prop)		Unit	Total
	b. Major Bridges		Nos	Nil
4	Culverts			
	Existing Culverts (Along Existing Road)		Nos	34
	Proposed Culverts (Reconstruction & New Construction)		Nos	65
	Rehabilitation Proposal of Culvert			
	Existing Culverts reconstruction (to 4-Lane)		Nos	17
	Existing Culverts Widening (to 4-Lane)		Nos	Nil
	Existing Culverts Retain (4 to Retain)		Nos	Nil
	Existing Culverts Abandon		Nos	16
	New Culvert along project road		Nos	48
	New Culvert for cross roads		Nos	25
5	Major & minor Junctions (Proposal)			
	Major Junction		Nos	15
	Minor Junctions		Nos	11
6	Toll Plaza		Nos	Nil
7	Service/Slip Road (excluding Tapper Length)		Km	21.330
8	Rest Area		Nos	Nil
9	Grade Separator			
	Overpass		Nos	01
	Vehicular Underpass (VUP)		Nos	08
	Light Vehicular Underpass (LVUP)		Nos	07
10	Bus Bay with Bus Shelter and Bus Shelter			
	Bus Bay with Bus Shelter		Nos	12
11	Truck Lay bye		Nos	Nil
12	Drain			
	RCC Cover Drain	LHS	Mts	11650
		RHS	Mts	11650



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Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



Sl. No.	Description (Prop)		Unit	Total
	PCC Open Drain (On Hill Side)	LHS	Mts	650
		RHS	Mts	1070
	PCC Open Drain (On Valley Side)	LHS	Mts	1490
		RHS	Mts	1120
	Un Line Drain	LHS	Mts	16430
		RHS	Mts	16430
13	Protection Work			
	Retaining Wall	LHS	Mts	2970
		RHS	Mts	3300
	RS Wall	LHS	Mts	580
		RHS	Mts	Nil
	Fill Slope protection using Erosion Control Blankets		sqm	142183
	Breast Wall	LHS	Mts	Nil
		RHS	Mts	360
	Cut Slope using Erosion Control Blankets Compartment System		sqm	9543
	Thrie Beam Crash Barrier	LHS	Mts	7840
		RHS	Mts	8310
	RE Wall	LHS	Mts	8735
		RHS	Mts	8735
14	Additional Land requirement for the project		Km.	29.360
15	% of Land Requirement for the Project (Length wise)		%	100.00
16	Pavement Design Life			
	Flexible		Year	20
	Rigid (not used in this package)		Year	30
17	Traffic in MSA : Km 20+000 to Km 49+360		MSA	40
18	Pavement Type Proposed 1. Km 20+000 to Km 49+360		Flexible	Flexible –4L



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Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



Sl. No.	Description (Prop)	Unit	Total
	Existing Type	BT	
	<u>New 4 Lane (Main Carriageway)</u>	Flexible	
	BC(PMB/CRMB)	mm	40
	DBM (VG-40)	mm	60
	WMM	mm	150
	Geogrid		Biaxial
	Granular Sub-Base (GSB)	mm	300
	Subgrade	mm	500
	<u>Service Road (10 MSA)</u>	Flexible	
	BC(VG-30)	mm	30
	DBM (VG-30)	mm	60
	WMM	mm	250
	Granular Sub-Base (GSB)	mm	200
	Subgrade	mm	500



1.4 Topography and Climatic Condition

Terrain is classified by the general slope of the country across the highway alignment as per IRC: 73 and with these criteria the entire length of the project passes through in rolling and hilly terrain.

The climate of Assam is typically 'tropical monsoon rainfall' type, with high levels of humidity and heavy rainfall. People here enjoy a moderate climate all throughout the year, with warm summers and mild winters. In the monsoon season, the whole state comes alive with the beauty of nature. Climatic variations can be seen regionally. While the plains of Assam have a tropical climate with high humidity, the hills have a sub-alpine type of climate. There are four distinct seasons in Assam - summer, monsoon, autumn and winter. The best time to visit the place is the winter season i.e. from October to April, which is also the festive season of Assam. Let us gather some more information on the weather and climate of Assam

Climate

The summer season in Assam starts from the month of March and extends till the end of June. The season is characterized by extreme humidity and frequent showers. The average temperature during this time of the year is between 35 and 38 degree Celsius.

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In fact, the mercury level never rises more than 38 degrees, even in the hottest month of the year. So, light cotton clothes are the best option during summers.

This season brings relief from the scorching heat of the summers. The neighboring areas of Cherapunji and Mawsynram have the highest rainfall in the world. The average annual rainfall in the state is around 70 inches in the west and around 120 inches in the east. In the afternoons, thunderstorms known as Bordoicila are very common. The season covers the entire state with a green blanket.

The winter season in Assam is basically characterized by scanty rainfall and misty mornings and afternoons. It starts in November and continues till the month of February. The mercury reading at this time of the year is around 6 to 8 degree Celsius or 43- 46 degree Fahrenheit. This is the best time to visit the northeaster state of Assam.

In Assam, spring (March- April) and autumn (September- October) present pleasant seasons, with moderate temperature and rainfall. These are amongst the popular months for tourist rush. As it is neither too cold nor too hot, you don't have to carry any special type of garment for these seasons. Therefore, if you are planning a trip to Assam, spring and autumn may be your choice.

1.5 Material Investigation

The bulk of materials used in the construction of modern highway pavement are obtained from naturally occurring sources. The choice of materials for various components of highway pavements calls for rigorous investigation of both quality and quantity of material available for economical use on highway projects.



Suitable sources have been identified along the project stretch by local enquiry and the as per the details given from respective forest departments. However, consultant is carrying out the tests on selected sources to find their suitability for use and the results of the same will be submitted in further stage of submission. Sufficient number of quarries has been identified to verify availability of materials within economical leads.

1.5.1 Objective

In general, the objective of the material investigation is to analysis the material of existing pavement, identify the suitable sources of the material and their availability required for the construction of embankment, subgrade, sub-base, base and top layers (bituminous/concrete) of road pavement.

In particular, material investigation has been carried out to establish the following requirements.

- Collect all the information regarding availability of construction materials which enables better planning and economic optimization of the project.

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- To locate with all details of potential and economic borrow pits all along the project corridor for embankment and sub grade material and to ascertain their availability and suitability for use.
- To determine the nature and physical characteristics of the original ground soils along the existing embankment toe all along the project corridor and original ground soil along the re-aligned section of the project corridor, and to ascertain their suitability as foundation of the embankment/sub grade construction.
- To locate with all details of Aggregate Quarries in the project vicinity and ascertain the suitability of their use in concrete, non-bituminous and bituminous pavement layers.
- To locate with all details of Sand Quarries in the project vicinity and ascertain their suitability for use in concrete, pavement layers etc.
- To locate fly ash availability within a 300km radius of the project corridor for embankment material.
- Examine the engineering properties of the materials relevant to the project as per specification.
- Prepare the Lead Chart of Borrow and Quarry areas for rate analysis & BOQ.
- Identify the cement, steel and bitumen in project vicinity to take their lead for cost estimation purpose.

The soils and materials investigations have been divided into the following components incorporated all the above-mentioned objectives:

- Geological survey
- Existing subgrade soil and pavement material investigations
- Sub grade survey on new alignment
- Material Survey

Testing procedures listed in the section 3.7.5 will be followed for investigation, sampling and testing for soil materials are in accordance with BIS and ASTM wherever applicable to determine their suitability in accordance with MoRT&H specifications.

Soil investigations along the existing road pavement were carried out at all the test location. Since the majority part of proposed road is passing through Bypass, the trial Test sections are considered at every 2 km intervals along the existing road where the alignment is following the existing road and testing were carried out to provide a comprehensive indication for the entire study network. The investigations include several operations viz., field and laboratory testing as described below along with the approach and methodology adopted in this project. Trial pits of size 0.75m x



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Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



0.75m at every 2 Km intervals were excavated manually staggered left and right side of the existing road pavement and pavement-shoulder interface, extending through the pavement layers and to the level of subgrade and 500 mm below soil subgrade. Field Tests are also to be conducted at soil subgrade level and also at 500mm below sub grade (viz., existing embankment soil) and bulk soil samples were collected for carrying out laboratory investigations.

The details of existing pavement layers crest thicknesses, visual subgrade soil and existing embankment soil classification recorded. The existing bulk sample of Soil sub grade and packed in polythene bags, labelled, numbered and sent to laboratory for conducting necessary laboratory testing. The details of chainage wise pavement investigation carried out are given in table below.

Table 1.3 Details of Chainage-wise Subgrade Soil Collected

Sl No.	Chainage	Section	Sample Type	Remarks
1	262+000, LHS	NH-37	Subgrade	NH-306 Package-1 (263+800 to 12+920)
2	257+000, RHS	NH-37	Subgrade	
3	2+200, RHS	Silchar Bypass	Subgrade	
4	6+000, LHS	Silchar Bypass	Subgrade	
5	8+800, LHS	NH-306	Subgrade	
6	13+000, RHS	NH-306	Subgrade	
7	18+000, LHS	NH-306	Subgrade	Package-2 (12+920 to 43+000)
8	23+000, RHS	NH-306	Subgrade	
9	28+000, LHS	NH-306	Subgrade	
10	33+000, LHS	NH-306	Subgrade	
11	38+000, RHS	NH-306	Subgrade	
12	40+500, LHS	NH-306	Subgrade	

The details of crust thickness of existing pavement layers (embankment, soil subgrade, and sub-base, base and asphalt layers) is given in **Annexure 1**.

1.5.2 Laboratory Investigations

The following Laboratory tests were conducted on collected bulk soil sub grade & embankment / OGL soil as per IS SP 36-Part-2 and CBR at 3 energy levels as per AASHTO T193-93 and the results of the same will be updated in further submission.

- Grain size Analysis – by Wet sieving (24 hours soaked) as per IS 2720 Part 4
- Atterberg's limits (LL, PL & PI) as per IS 2720 Part 5

- Differential Free Swelling Index as per IS 2720 Part 40
- Compaction Tests (MDD & OMC) as per IS 2720 Part
- CBR @ 3 energy Levels as per AASHTO T 193 -93 in 4 days soaked condition
- Soil classification as per IS, HRB & AASHTO

1.5.3 Soil classification - IS, HRB and AASHTO Soil Classifications



IS, HRB and AASHTO Classifications of sub grade and embankment Soil Samples is to be carried out based on the Grain Size analysis data, plasticity characteristics and swelling characteristics. The following symbols are used to designate the type of soils.

G - Gravels	W - Well graded
S - Sand	P - Poorly graded
M - Silt	B - Clay Binder
C - Clay	Pt - Peat
I - Inorganic	O - Organic
L - Low Plasticity	W - Well Graded
H - High Plasticity	SP - Poorly graded sand
SM - Silty Sand	GW - Well graded Gravels
SW - Well Graded Sand	SC - Sandy Clay
CL - Clay with low compressibility	CH - Clay with high compressibility
ML - Silt with low compressibility	MH - Silt with high compressibility
GC - Gravelly Clay	CI - Inorganic Clay
MI - Inorganic Silt	GM - Gravelly Silt

HRB classifications are also called AASHTO classification of revised Public Roads Administration (PRA) soil classification system. In this classifications, the soils are subdivided in to seven groups A-1 to A-7 based on Grainsize analysis, Atterberg's Limits and percentage fines. A-1, A-2, A-3 soils are granular soils, percentage fines passing 0.075 mm sieve being less than 35. A-4, A-5, A-6 and A-7 soils are fine grained or silty clay soils, passing 0.075 mm sieve being greater than 35 %.

1.5.3.1 Analysis of Existing Subgrade Soil

The laboratory test results of existing subgrade soil samples are furnished as **Annexure 1** Summaries of the Laboratory test results of subgrade soil samples as discussed below.

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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A total of 12 subgrade samples were collected from Silchar to Vairengte, out of which 2 samples collected from Km 263+000 to Km 257+000 of NH-37 and 2 samples were collected along the partially constructed Silchar bypass. All the samples collected are belongs to Silty sand SM group IS soil classification system. Liquid limit varies from NP to 41.0%, plasticity Index ranging from NP to 13.65 and free swelling index varies from 26% to 33%. One of the most important components influencing the structural strength requirements of a pavement is the subgrade strength, which in turn is influenced by the moisture content and degree of compaction of the subgrade soil. Laboratory Maximum Dry Density is in the range of 1.73gm/cc to 1.996gm/cc and optimum moisture content varies from 13.36%to 17.2%. The 4-days soaked CBR values have been determined at three energy levels i.e. at three different dry density. From this relationship of CBR and corresponding dry density, CBR at 97% MDD laboratory maximum dry density have been assessed and the same are furnished and Soaked CBR at 97% varies from 6.2% to 7.1%.

The Percentage distribution of Existing Subgrade soil, variation of laboratory MDD and Soaked CBR at 97% laboratory maximum dry density along the alignment are shown in below figure.

The detailed test results (like grain size curves, compaction test curves and CBR test curves) are furnished Compaction and CBR graph is given in **Annexure 2** and the summary of the same is given in table below. The images of trail pit are presented in below fig;



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360)



Volume III – Material Report

Table 1.4 Test results of existing subgrade

Sl. No	Chainage/Location	Side	Particle Size Analysis					Atterberg Limits			FSI, %	Specific Gravity	Modified Compaction Test Results		Soaked CBR Value (3-Energy Level) at 97% MDD, %	Soil Description
			Boulders %	Cobbles %	Gravel %	Sand %	Silt & Clay, %	Liquid Limit %	Plastic Limit %	PI			MDD, g/cc	OMC, %		
1	262+000 (NH-37)	LHS	0	0	1.09	70.38	28.54	NP	NP	NP	32.00	2.66	1.94	13.76	6.80	SM
2	257+000 (NH-37)	RHS	0	0	7.53	50.43	42.05	NP	NP	NP	31.00	2.68	1.96	13.36	6.60	SM
3	2+200 (Silchar Bypass)	RHS	0	0	10.19	16.01	73.80	41.00	27.35	13.65	28.00	2.61	1.80	17.20	6.20	SM
4	6+000 (Silchar Bypass)	LHS	0	0	11.23	56.94	31.84	NP	NP	NP	31.00	2.65	1.92	13.50	6.90	SM
5	08+800 (NH306)	LHS	0	0	24.12	52.54	23.34	NP	NP	NP	32.00	2.72	1.90	14.20	7.10	SM
6	13+000 (NH306)	RHS	0	0	23.56	50.44	26.01	NP	NP	NP	32.00	2.64	1.92	14.00	7.00	SM
7	18+000 (NH306)	LHS	0	0	7.02	52.47	40.51	18.00	14.63	3.37	27.00	2.62	1.73	14.00	6.60	SM



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360)



Volume III – Material Report

Sl. No	Chainage/Location	Side	Particle Size Analysis					Atterberg Limits			FSI, %	Specific Gravity	Modified Compaction Test Results		Soaked CBR Value (3-Energy Level) at 97% MDD, %	Soil Description
			Boulders %	Cobbles %	Gravel %	Sand %	Silt & Clay, %	Liquid Limit %	Plastic Limit %	PI			MDD, g/cc	OMC, %		
8	23+000 (NH306)	RHS	0	0	28.50	41.36	30.15	21.00	19.55	1.45	26.00	2.61	1.87	14.10	6.90	SM
9	28+000 (NH306)	LHS	0	0	20.79	49.57	29.65	NP	NP	NP	33.00	2.70	1.88	14.40	6.80	SM
10	33+000 (NH306)	LHS	0	0	3.40	49.38	47.22	NP	NP	NP	31.00	2.69	1.87	14.00	6.70	SM
11	38+000 (NH306)	RHS	0	0	12.12	44.29	43.60	NP	NP	NP	32.00	2.66	1.87	13.90	6.90	SM
12	40+500 (NH306)	LHS	0	0	6.62	50.77	42.61	NP	NP	NP	31.00	2.65	1.85	14.10	6.80	SM



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49

+360360) Volume III – Material Report

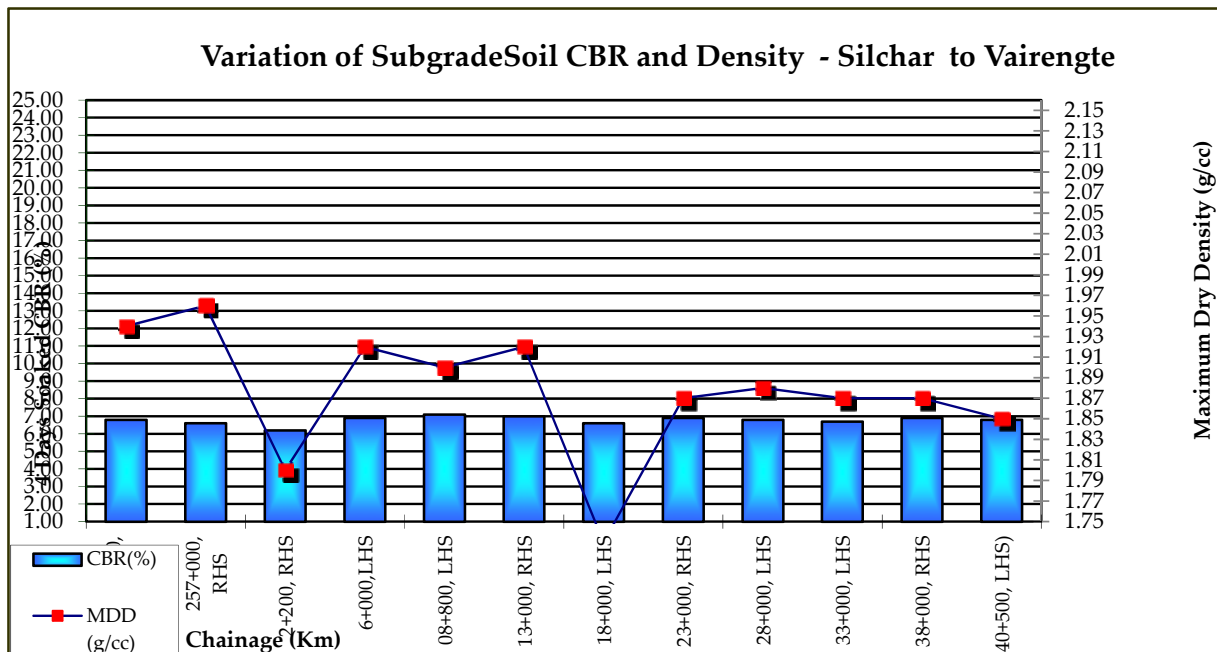


Fig 1.2 Soaked (4 Days) CBR vs MDD Graph of Subgrade Soil





Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



Pic 1.1 Photographs Showing Trial Pit

1.5.4 Green Field Soil Sample

A total of 5 soil samples were collected along the proposed green field alignment to understand the characteristic and strength of original ground soil. The details of green field alignment soil given in table below;

Table 1.5 Details of Chainage wise soil samples collected along Green Field



Sl No.	Design Chainage	Sample Type	Remarks
1	15+700	Bypass	Package-1 (0+000 to 20+000)
2	22+000	Bypass	Package:-2 (20+000 to 49+360)
3	23+500	Bypass	
4	31+200	Bypass	
5	36+900	Bypass	

The following Laboratory tests were conducted on collected bulk Toe/ OGL soil as per IS SP 36-Part-2 and CBR at 3 energy levels as per AASHTO T193-93.

- Grain size Analysis – by Wet sieving (24 hours soaked) as per IS 2720 Part 4
- Atterberg's limits (LL, PL & PI) as per IS 2720 Part 5
- Differential Free Swelling Index as per IS 2720 Part 40
- Compaction Tests (MDD & OMC) as per IS 2720 Part
- CBR @ 3 energy Levels as per AASHTO T 193 -93 in 4 days-soaked condition
- Soil classification as per IS, HRB & AASHTO

1.5.4.1 Analysis of Bypass Section Soil Sample

A total of 5 Soil samples were collected along green filed alignment. All the samples collected are belongs to belongs to Silty with low compressibility ML IS soil classification system. Liquid limit varies from 20% to 50.5%, plasticity Index ranging from 11.37 to 16.36 and free swelling index varies from 25% to 28%. One of the most important components influencing the structural strength requirements of a pavement is the subgrade strength, which in turn is influenced by the moisture content and degree of compaction of the subgrade soil. Laboratory Maximum Dry Density is in the range of 1.65gm/cc to 1.92gm/cc and optimum moisture content varies from 14.00%to 21.80%. The 4-days soaked CBR values have been determined at three energy levels i.e. at three different dry density. From this relationship of CBR and corresponding dry density, CBR at 97% MDD laboratory maximum dry density have been assessed and the same are furnished and Soaked CBR at 97% varies from 4.5% to 5.5%The 4-days soaked CBR values have been determined at three energy levels i.e. at three different dry density. From this relationship of CBR and corresponding dry density, CBR at 97% laboratory maximum dry density have been assessed and the

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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same are furnished in **Annexure 1**. Soaked CBR at 97% Laboratory Maximum Dry Density varies from 5.4% to 6.2%. Compaction and CBR graph is given in **Annexure 3**. The variation of laboratory MDD and 4 days Soaked CBR Graph of Toe/ realignment soil samples along the alignment are shown in figure below.



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360)



Volume III – Material Report

Table 1.6 Test results along bypass

Sl. No	Chainage/Location	Bypass	Particle Size Analysis					Atterberg Limits			FSI, %	Specific Gravity	Modified Compaction Test Results		Soaked CBR Value (3-Energy Level) at 97% MDD, %	Soil Description
			Boulders %	Cobbles %	Gravel %	Sand %	Silt & Clay, %	Liquid Limit %	Plastic Limit %	PI			MDD, g/cc	OMC, %		
1	15+700	Gree filed alignment	0	0	0	11	89.005	47.5	31.76	15.74	25	2.53	1.67	21.8	4.8	M L
2	22+000	Gree filed alignment	0	0	0	7.19	92.815	50.5	34.14	16.36	27	2.51	1.68	21.1	4.7	M L
3	23+500	Gree filed alignment	0	0	0	9.29	90.71	47	31.64	15.36	26	2.58	1.67	21	4.9	M L
4	31+200	Gree filed alignment	0	0	0	3	97	49	35.46	13.54	28	2.56	1.65	21.3	4.5	M L
5	36+900	Bypass	0	0	2.34	402	57	20	8.63	11.37	26	2.62	1.92	14	5.5	M L

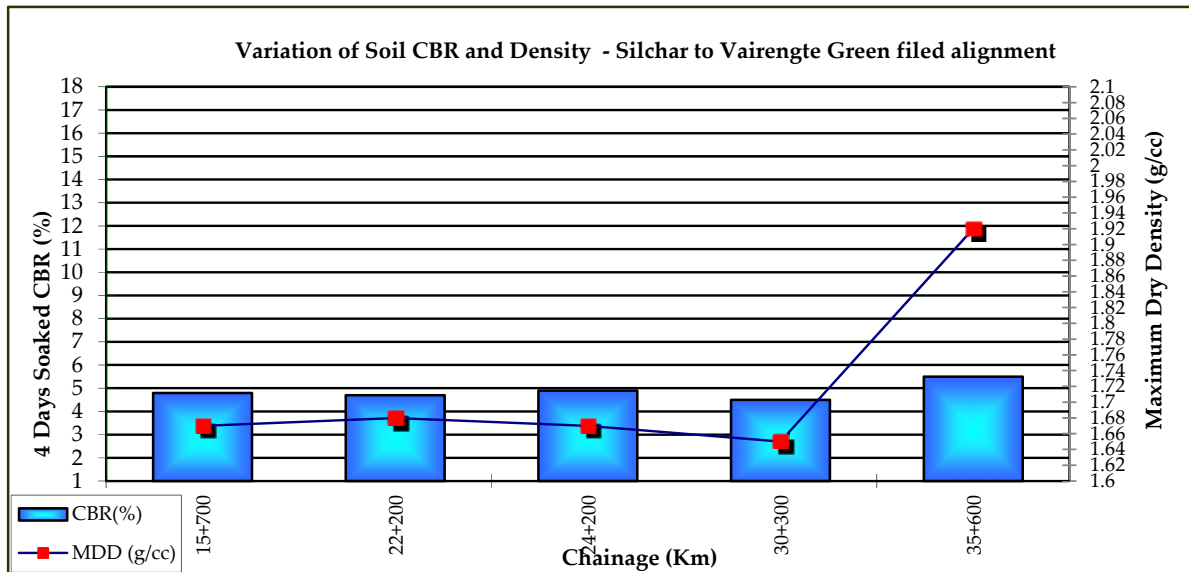




Fig 1.3 Soaked (4 Days) CBR vs MDD Graph of Green Field Soil sample



	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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Pic 1.2 Photographs Showing Soil samples



1.6 Quarry and Materials Investigations

The information about existing stone Quarries, Murrum Quarries/ Borrow pits, Sand Quarries, Water Sources, Bitumen Manufacturing refineries, Solid Blocks / RCC Hume pipe Manufacturing Industries, cement manufacturing industries and other construction material sources was collected from local PWD Divisional Offices and Sub divisional Offices, local Construction Contractors and local material suppliers throughout the project area, from other sources and also from direct observation through site Visits. The location details of the approved stone and sand quarry was collected officially from the respective forest department and the same was considered. Location Maps and type of material available in each project road were also collected and produced. The original available test results of the Materials from these identified sources were also collected. The suitability of the materials sources is evaluated based on laboratory test results and detailed analysis. After analysing the suitability of those material sources quantitatively and qualitatively, the lead chart is prepared.

1.7 Identification of Material Sources

Field Visits were made to NH-PWD Divisional Offices, Forest departments, PWD Sub-Divisional Offices, Mines and Geology approved Stone Metal Quarries, Private Stone Metal Quarries, River Sand Quarries, Locally available Murrum Borrow pits, and RCC Hume pipe manufacturing Industries, Solid Block making Units, Cement Manufacturing Industries if located along the project road / nearby project road. The available details including available test results were collected from respective the above.

The details of existing approved stone quarries, Mines and Geology approved Stone Metal Quarries, Sand Quarries, Murrum Borrow pit details were also collected from the forest department and local construction materials suppliers.

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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1.8 Field Visits to Quarry and Materials Sources

Field visits were made to the following Quarry and Materials Sources located along the project road and nearby sources. The approximate area, quantity availability was assessed, recorded and the samplings were made, packed, labelled and transported to Materials Testing laboratory.

- Stone Metal Quarries
- Murrum Borrow pits
- Sand Quarries
- Cement Manufacturing Industries
- RCC Hume Pipe Manufacturing Industries
- Solid Block, Paving Block, Brick Manufacturing Industries
- Bitumen Refineries and Petrochemicals
- Fly Ash / Pond Ash Producing Power Plants / Steel Industries
- Steel Manufacturing Industries
- Water Sources

1.8.1 Sampling of Materials from Sources



The Stone Aggregates, borrow pit Murrum, Sand, Solid Block, Bricks, Laterite Blocks and Water Samples were collected, packed, labelled and transported to Materials Testing laboratory for carrying out relevant tests.

- Stone Aggregates
- Borrow pit Murrum
- Sand
- Cement
- Solid Block, Paving Block and Bricks
- Water

1.9 Murrum Borrow Soil

The investigation is aimed at locating the potential borrow areas for sub-grade/embankment fill and granular sub-base along the project road within economic haulage. To obtain this information regarding probable borrow pits along the corridor and to obtain this objective, the offices of public works department and local people have been contacted.

There were no borrow area observed along the project road from Silchar to Vairengte, since the project road is passing on the hill. Hence the 2nos of borrow areas which are located along Silchar to Jiribam is considered for Silchar to Vairengte section. The locations, lead, and owner of borrow soil are given in table below. The distance of these borrow areas from the project road location varies from 0.1 km as shown in the

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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lead chart in below paragraph. Borrowing soil from these areas would require prior approval of the local authorities' negotiations with private people.

Table 1.7 Details of Barrow Area

SL No.	Sample No.	Existing Chainage (km)	Left/ Right	Location/ Name of Village	Lead (Km)	Remarks
1	BA 01	214+000 (NH-37)	Right	Tatbung Village (Manipur)	0.1	Private Land
2	BA 02	225+000 (NH-37)	Left	Uttar Lalpani (Assam)	0.1	Private Land

1.10 Laboratory Tests on Borrow pit Murrum

The following Laboratory tests were conducted on soil samples as per IS SP 36-Part-2 and CBR at 3 energy levels as per AASHTO T193-93 and the details of the result is given in **Appendix 1**.



- Grain size Analysis – by Wet sieving (24 hours soaked) as per IS 2720 Part 4
- Atterberg's limits (LL, PL & PI) as per IS 2720 Part 5
- Differential Free Swelling Index as per IS 2720 Part 40
- Compaction Tests (MDD & OMC) as per IS 2720 Part
- CBR @ 3 energy Levels as per AASHTO T 193 -93 in 4 days soaked condition
- Soil classification as per IS, HRB & AASHTO



Pic 1.3 Photographs of Borrow Area

1.11 Laboratory Tests on Borrow pit Murrum

The following Laboratory tests are in progress on collected bulk soil sub grade as per IS SP 36-Part-2 and CBR at 3 energy levels as per AASHTO T193-93.

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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- Grain size Analysis – by Wet sieving (24 hours soaked) as per IS 2720 Part 4
- Atterberg's limits (LL, PL & PI) as per IS 2720 Part 5
- Differential Free Swelling Index as per IS 2720 Part 40
- Compaction Tests (MDD & OMC) as per IS 2720 Part
- CBR @ 3 energy Levels as per AASHTO T 193 -93 in 4 days soaked condition
- Soil classification as per IS, HRB & AASHTO

1.12 Quarries for Aggregates

As per the information collected locally, there is no major quarry situated along the project road from Vairengte to Sairang, so the approved Stone and sand quarries near Silchar which were collected from respective forest department is considered for Vairengte to Sairang section and the details of the quarries are listed in below table.

The following aspects are considered while selecting the quarry for obtaining road metal:

- It should have sufficient crushing strength to with stand stresses due to high volume of traffic.
- It should be sufficiently hard and offer maximum possible resistance to abrasion.
- It should be tough and with stand breaking under hammer.
- Rock structure should be crystalline in nature.
- Texture of rock should be equiangular and interlocking.
- Specific gravity of rock should be moderately high.
- Rock should not be porous.

Identified stone aggregate quarries along project road near Silchar are given in below table.

Table 1.8 Details of Stone Quarries

Quarry No.	Name of the Quarry / Address / Location	Material Supplying	Existing Chainage	LHS/ RHS	Lead (Km)
Q1	Stone Quarry Madhura River Miner Mineral (Unit-1)	Metal sizes available are 40mm, 20mm, 12mm, 6mm and stone dust	262+500 (NH-37)	LHS	22.00
Q2	Stone Quarry Madhura River Miner Mineral (Unit-2)	Metal sizes available are 40mm, 20mm, 10mm, 6mm and stone dust	262+500 (NH-37)	LHS	22.00
Q3	Stone Quarry Dora Nala Minor Mineral unit	Metal sizes available are 40mm, 20mm, 10mm, 6mm and stone dust	262+500 (NH-37)	LHS	25.00

1.13 Natural Sand

The natural sand is collected from the approved Madhura River and Nakti nala sand quarry, which is at a distance of 22km and 18km from NH-37 along NH-27 (Guwhathi Rd). The permission has been given at following locations for sand mining from the government. All the sources have both coarse and fine sand deposits. These are very useful for bituminous and concrete work. Sand-samples were collected from sources for testing purposes.

Location of sand source and the details locations, lead, and river names are also tabulated below;

Table 1.9 Details of Sand Sources

Sl. No	Chainage	Left/ Right	Name of Village/River	Lead (Km)
P 1	262+500 (NH-37)	Left	Madhura River at Udharbond Range	22.00
P 2	262+500 (NH-37)	Left	Nakti nala at Udharbond Range	18.00

1.14 Water Sources for Construction Works

There are mainly two Water Sources identified along the project road, they are Barak River Water and Madhura River Water.

1.15 Recommendation of Materials Sources



Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



After analysing all the above field investigations and Laboratory Testing data, the suitability of Material Sources along with the lead Map and Lead Chart was prepared and recommended. Map showing locations of the various sources of material is given below

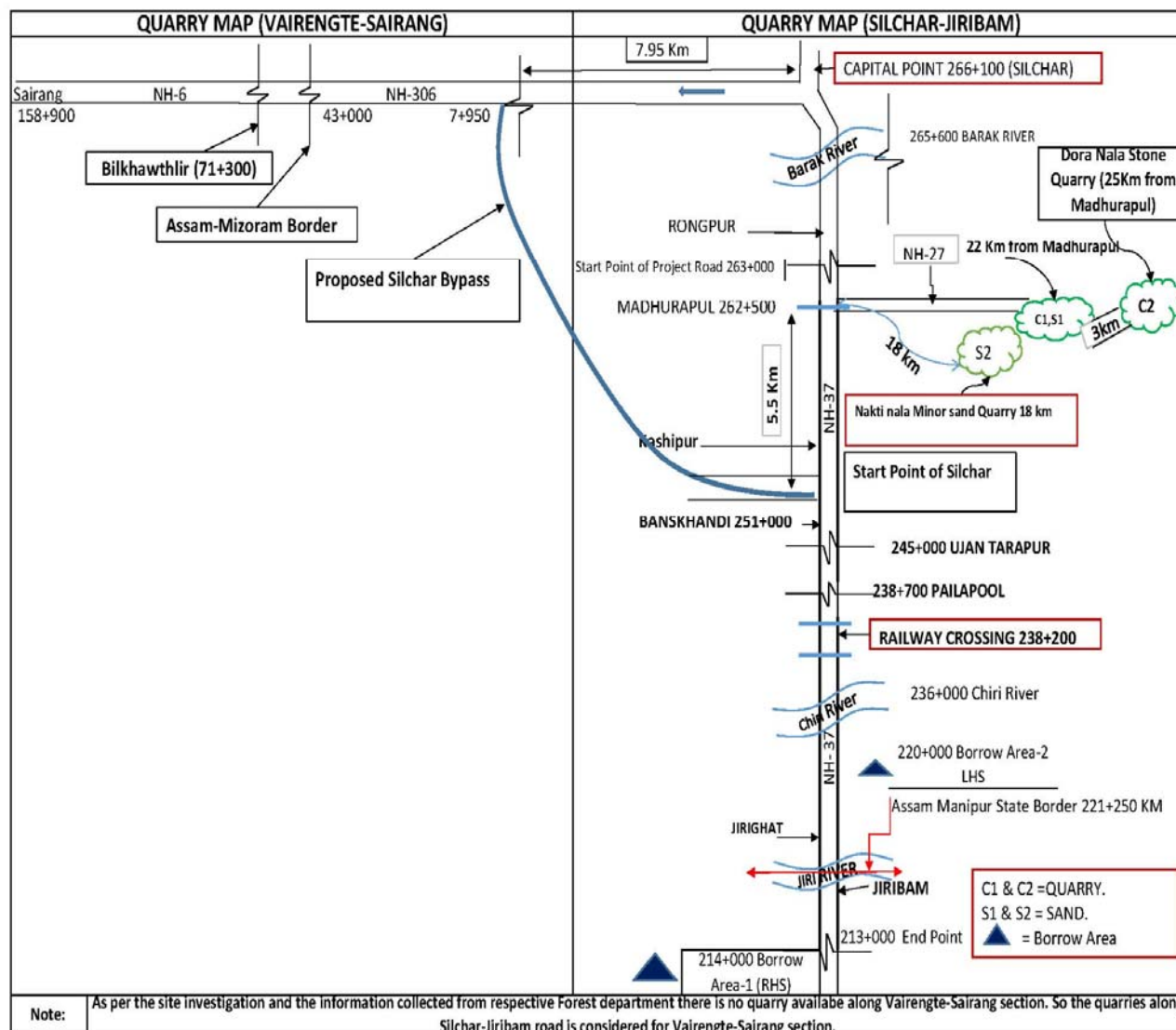




Fig 1.4 Lead Map

	<p>Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).</p> <p>Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)</p> <p>Volume III – Material Report</p>	
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1.16 Other Construction Materials

Bitumen

Bitumen in grade of VG-30, VG-40, CRMB-55, CRMB-60, and PMB-40 & Bitumen emulsion will be obtained from IOCL refinery at Haldia, West Bengal. Selection of refinery shall be as per the availability of material and lead.

Cement

Cement of all varieties/types i.e. Ordinary Portland, Portland Slag, and Portland Pozzolona confirming to relevant IS standards are readily available in the market in sufficient quantity, and also, would be directly supplied by the manufacturer to the project site for such a huge quantum of work and may be at rebated price.

Reinforcement Steel

Reinforcement steel confirming to relevant IS standard is readily available in market.

NP-4 Pipes

Numbers of pipe manufacturers are available at Silchar and Guwahathi. Good quality pipes of all sizes are being manufactured to the IS specifications.

Other materials

Retro reflective signage's, galvanized W-beam steel crash barrier, thermoplastic pavement marking paint, Bearings for structures, special admixtures for concrete, pre-stressed steel strands have to be obtained from Silchar and Guwahathi.

1.17 Geotechnical Investigations

1.17.1 Purpose of Investigation

The purpose of investigation was to explore subsurface conditions at specified locations by drilling boreholes to different depths in order to identify the thickness and sequences of various strata and to ascertain the sub surface profile of soils and bed rock to determine the most suitable foundation levels of structures.

The disturbed and undisturbed samples of soil, rock and ground water obtained from the boreholes were tested in the laboratory to assess engineering properties of the soil and rock and to generate necessary data required for deciding the suitability and type of foundation to be adopted.





Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

Section : Silchar to Vairengte (Package-2, mod. From Km 20+000 to Km 49+360360)

Volume III – Material Report



Pic 1.4 Photographs of Sub-Soil Investigation

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The data generated thus are required mainly to provide information needed for a realistic judgment on the foundation designs of piers/abutments. Similarly, in case of new road embankments running over soft deposits of clay will need special embankment design and ground improvement treatment as necessary.

1.17.2 Scope of work



- Drilling bore holes upto the maximum depth of 20.0 m by Shell and auger method or up to refusal depth as per IS code of practice and as per the direction of the Engineer-in-Charge.
- Collecting undisturbed soil samples / core samples from the bore holes at regular intervals or change of strata or wherever possible as per IS Code of Practice.
- Recording of water table level in the bore holes after completion of borehole.
- Preparation of report summarizing the details of soil classification, analysis of test data, type of foundation etc.
- Preparation of report summarizing the details of soil classification, analysis of test data, type of foundation etc.

1.17.3 Geotechnical Investigation at Structure Locations

Boreholes are located at abutment and pier locations of bridges which are required to be reconstructed and other new structures along the proposed alignment and test pits will be performed at minor box structures locations. The total number of structures proposed, their respective bore holes are presented in below table. The number of Bore holes and depth of borehole investigations are considered as per IRC 78.



Table 1.10 Bore log details

Section -1 (Silchar to Vairengte) (D. Ch 0+000 to D. Ch 49+360)										
Package-1 (from D. Ch 0+000 to D. Ch 20+000)										
Sl. No.	Design Chainage	Type of Structure	Proposed Span	No. of Bore Holes			Approx. Depth (m)	Bore Hole ID	Bore Hole Co-ordinates	
				At Abt.	At Pier/ Bed	Total			Easting	Northing
1	0+210	Minor Bridge	1x10	1	0	1	15	0+210 A1	482599.395	2746977.442
2	0+818	Flyover	1x30+ 1x40+ 1x30	1	1	2	20	0+818 A1	483139.742	2747148.991
							20	0+818 P1	483159.378	2747167.337
3	4+132	SVUP	1x7	1	0	1	15	5+055 A1	486367.347	2746146.452
4	4+833	LVUP	1x12	1	0	1	15	5+575 A1	486291.550	2745628.334
5	6+302	VUP	1x20	1	0	1	15	7+043 A1	486074.868	2744247.194
6	6+920	Major Bridge	2x40	1	1	2	20	7+660 A1	486138.659	2743670.248
7							20	7+660 P1	486121.621	2743642.343



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Section -1 (Silchar to Vairengte) (D. Ch 0+000 to D. Ch 49+360)										
Package-1 (from D. Ch 0+000 to D. Ch 20+000)										
Sl. No.	Design Chainage	Type of Structure	Proposed Span	No. of Bore Holes			Approx. Depth (m)	Bore Hole ID	Bore Hole Co-ordinates	
				At Abt.	At Pier/ Bed	Total			Easting	Northing
	9+098	Minor Bridge	1x10	1	0	1	15	9+839 A1	485607.990	2741551.208
8	9+585	Minor Bridge	1x10	1	0	1	15	10+325 A1	485496.917	2741076.844
9	10+389	Minor Bridge	1x10	1	0	1	15	11+130 A1	485261.901	2740295.777
10	10+859	Minor Bridge	1x10	1	0	1	15	11+600 A1	485072.511	2739875.950
11	12+119	LVUP	1x12	1	0	1	15	12+860 A1	484207.420	2739087.135
12	13+091.5	Major Bridge	14x30	2	13	5	25	13+830 A1	483470.981	2738963.881
							25	13+830 P1	483416.660	2738938.401
							25	13+830 P2	483308.018	2738887.442
							25	13+830 P3	483199.376	2738836.482
							25	13+830 A2	483090.734	2738785.522
13	13+667	VUP	1x20	1	0	1	15	14+405 A1	482777.249	2738619.225
14 15	13+891.5	Minor Bridge	2x25	1	1	2	20	14+630 A1	482604.919	2738491.267
							20	14+630 P1	482588.540	2738479.792
16	14+992	Flyover	1x30	1	0	1	20	15+730 A1	481531.058	2738280.358
16	15+538.5	Minor Bridge	3x10	1	1	2	15	16+277 A1	481203.611	2737872.593
17							15	16+277 P1	481200.073	2737850.695
	17+135	SVUP	1x7	1	0	1	15	17+874 A1	481372.784	2736293.639
18	18+662	Flyover	1x30	1	0	1	20	19+400 A1	482507.913	2735309.049
Subtotal				19	17	26	480			

Section -1 (Silchar to Vairengte) (D. Ch 0+000 to D. Ch 49+360)										
Package-2 (from D. Ch 20+000 to D. Ch 49+360)										
Sl. No.	Design Chainage	Type of Structure	Proposed Span	No. of Bore Holes			Approx. Depth (m)	Bore Hole ID	Bore Hole Co-ordinates	
				At Abt.	At Pier/ Bed	Total			Easting	Northing

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Section -1 (Silchar to Vairengte) (D. Ch 0+000 to D. Ch 49+360)										
Package-2 (from D. Ch 20+000 to D. Ch 49+360)										
Sl. No.	Design Chainage	Type of Structure	Proposed Span	No. of Bore Holes			Approx. Depth (m)	Bore Hole ID	Bore Hole Co-ordinates	
				At Abt.	At Pier/ Bed	Total			Easting	Northing
1	21+900	VUP	1 x 20	0	1	1	15	21+900 P1	483073.779	2732123.606
2	22+950	LVUP	1 x 12	0	1	1	15	22+950 P1	482757.505	2731127.207
3	24+325	LVUP	1 x 12	0	1	1	15	24+325 P1	483270.169	2729866.846
4	26+610	VUP	1 x 20	0	1	1	15	26610 P1	485244.315	2728884.643
5	29+938	Minor Bridge	1x10	0	1	1	15	29+937.5 P1	484592.665	2725762.819
6	31+610	VUP	1 x 20	0	1	1	15	31+610 P1	484229.692	2724155.114
7	33+860	VUP	1 x 20	0	1	1	15	33+860 P1	484453.718	2722054.470
8	35+810	VUP	1 x 20	0	1	1	15	35+810 P1	483813.172	2720216.367
9	36+513	LVUP	1 x 12	0	1	1	15	36+513 P1	483485.613	2719596.106
10	36+750	Minor Bridge	2x25	1	1	2	20	36+750 A1	483389.544	2719405.537
							20	36+750 P1	483380.992	2719382.038
11	37+169	Minor Bridge	1x15	0	1	1	15	37+169 P2	483388.307	2718971.191
12	37+700	Minor Bridge	1x40	1	1	2	20	37+700 A1	483545.866	2718484.957
							20	37+700 P1	483552.031	2718465.931
13	38+450	VUP	1 x 20	0	1	1	15	38+450 P1	483760.282	2717746.916
14	40+380	VUP	1 x 20	0	1	1	15	40+380 P1	483769.273	2715842.330
15	41+230	Minor Bridge	1x12	0	1	1	15	41+230 P1	483093.193	2715342.927
16	41+743	LVUP	1 x 12	0	1	1	15	41+43 P1	482841.260	482841.260

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Section -1 (Silchar to Vairengte) (D. Ch 0+000 to D. Ch 49+360)										
Package-2 (from D. Ch 20+000 to D. Ch 49+360)										
Sl. No.	Design Chainage	Type of Structure	Proposed Span	No. of Bore Holes			Approx. Depth (m)	Bore Hole ID	Bore Hole Co-ordinates	
				At Abt.	At Pier/ Bed	Total			Easting	Northing
17	43+375	LVUP	1 x 12	0	1	1	15	43+375 P1	482104.142	2713456.184
18	44+050	LVUP	1 x 12	0	1	1	15	44+050 P1	481626.862	2712981.106
19	44+960	VUP	1 x 20	0	1	1	15	44+960 P1	481191.831	2712190.551
20	45+533	Minor Bridge	1x10	0	1	1	15	45+533 P1	480670.243	2711967.443
21	46+257	Minor Bridge	1x20	1	1	2	15	46+257 A1	479982.209	2711777.885
							15	46+257 P1	479972.564	2711775.228
22	47+033	Minor Bridge	1x20	1	1	2	15	47+033 A1	479250.911	2711518.884
							15	47+033 P1	479241.515	2711515.454
23	47+355	LVUP	1 x 12	0	1	1	15	47+355 P1	478930.261	2711451.737
24	47+480	Minor Bridge	1x15	0	1	1	15	47+480 P1	478806.595	2711470.145
25	48+167	Minor Bridge	1x10	0	1	1	15	48+167 P1	478139.919	2711637.055
26	48+390	Minor Bridge	1x10	0	1	1	15	48+390 P1	477920.552	2711606.591
27	48+610	Minor Bridge	1x10	0	1	1	15	48+610 P1	477728.046	2711502.079
28	48+820	OP	2 x 12	0	1	1	15	48+820 P1	477556.570	2711380.852
29	48+500	Soil Stability Test		0	1	1	20	48+500 P1	477298.513	2711112.503

Note: The Geo-tech survey for Pkg-2 is completed and report preparation is in progress will be submitted separately shortly.

1.17.4 General geology of the Area

The state of Assam is located between lat 24° 7' N and 28° 0' N and Long 89° 45' E and 96° 00' E. The state is surrounded on the three sides of the North, the East and the South by hills and mountains. To the west it merges with the West Bengal and Bangladesh plains. The state has Brahmaputra valley in the northern part bordering Arunachal and the Barak valley in the southern part. In between two valley plains there is an area called the Karbi Anglong plateau succeeded to the south by the Dima Hasao Hills. The state is

encompassing an area of 78,438 Sq Km representation 2.39 % of the total area of the country and a population of about 3.12 crore.

Assam consists of three geological structure units. The structural core of the region is the Karbi-Anglong plateau which is the extension of Shillong Plateau. The second structural unit is the Tertiary depositional zone, which has given rise to the folded hills of the North Cachar Hills Districts including the state's highest Barail Range. The third structural unit comprises of the alluvium depositional plains of the Brahmaputra valley and the Barak Valley. The two plains came into existence in the quaternary period. From the geotechnical point of view, the state of Assam especially whole Northeast India falls in seismic zone-V. However, the state of Assam along with Northeast India lie in one of the world's wettest monsoon belts. The state falls within sub-tropical humid climatic zone. The state experiences mostly pleasant weather in all seasonal variations.

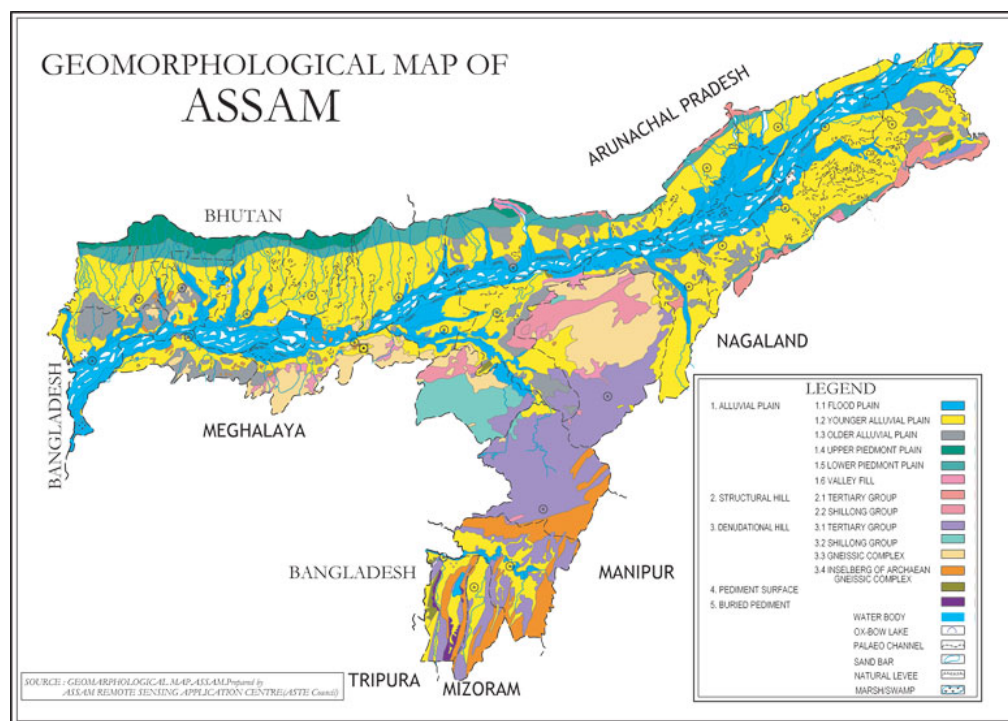




Fig 1.5 Geological and Mineral Map

The land of Assam is blessed with the immense mineral potential and other natural resources. The available major mineral resources found in the state are mainly of Petroleum & Natural Gas, Coal, Iron-Ore etc and the minor mineral are sand, China- clay, Silica, Granite , Limestone, Quartzite's, Fullers Earth etc. etc.

The main functions and activities of the Directorate are systematic geological investigation and its assessment and estimation of mineral deposits of the state. The Directorate also strives for ground water monitoring & its exploration for sustainable development of ground water resources. The Directorate is also engaged in the work of

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geological disaster management like earthquake, landslides and any incidents time to time to mitigate the geological disaster as well as for its better preparedness.

1.17.5 Seismicity

The study area falls in the seismic zone V as per IS: 1893 (Part I) -2016.

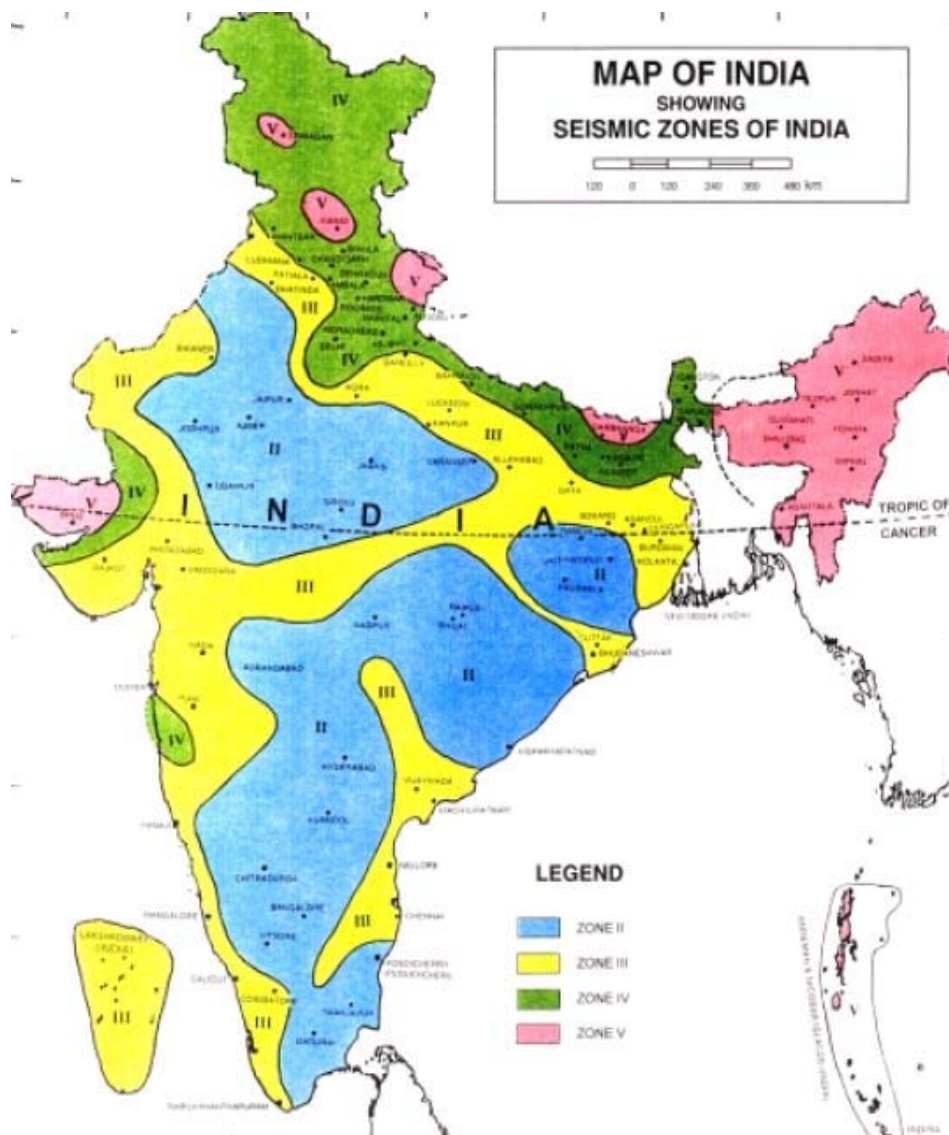




Fig 1.1 Seismic map of India

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1.17.6 Design Criteria



Foundation shall generally be open or raft type due to visibly rocky strata at shallower depth. However, pile foundations can also be envisaged for major structures. The type of foundations shall be decided based on the Geotechnical Investigation Reports for individual structure.

1.17.7 Design Methodology

1.17.7.1 Pile Foundation:

In general, the design of pile and pile cap will conform to provisions of IRC: 78-2014. The various assumptions made for the pile and pile cap designs are as follows:



- i) Bored cast-in-situ vertical piles have been proposed for the foundations. For pile foundations in soil the minimum spacing between the piles shall be 3D whereas for piles in rock the minimum spacing between the piles shall be 2D, where D is the diameter of pile.
- ii) The vertical capacity of piles shall be minimum of that recommended by Soil Consultants and Initial load test of pile.
- iii) Initial load test (not on working pile) shall be conducted as per contract specifications.
- iv) The vertical capacity of the pile shall be based on static formula given in IS: 2911 (Part-1/Section-2) and correlated with appendix-5 of IRC: 78. The permissible increase in pile capacity for wind and seismic load combinations [combination (ii) & (iii)] would be taken as 25% (as per cl 706.1.2 of IRC: 78). The following limiting values will be considered for computation of safe load:
 - Results of sub-soil investigation will be used for adopting the value of angle of internal friction " ϕ " and cohesion " C " of the soil.
 - Angle of wall friction ' α ' to be taken as equal to Angle of internal friction ϕ '.
 - The coefficient of earth pressure, ' K ' will be taken as 1.5 while calculating the safe load carrying capacity.
 - Maximum overburden pressure at the bottom of pile for the purpose of calculation of shaft friction and end bearing will be limited to 20 times the diameter of the pile.
 - Factor of safety will be taken as 2.5
- v) The lateral load capacity of pile shall be evaluated by using empirical formulae given in IS:2911 (Part-1/Section-3) by limiting the lateral deflection of 1% at its tip considering it as fixed headed pile under normal conditions (without scour) & at scour level under normal conditions (with scour). The capacity so evaluated will be used purely for the purpose of arriving at the upper bound of lateral load capacity. This deflection limitation will not be applicable in

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load combinations with seismic conditions for which the resulting stress and capacity of the section would be the governing criterion.

- vi) Soil stiffness for lateral loads shall be taken from IS: 2911. The vertical and lateral load capacity of the pile under fixed head condition shall be confirmed by Initial Pile Load Test. The length of (L1+Lf) under the free head condition will be obtained from lateral load test at site. The same length (L1+Lf) will then be correlated for Fixed Head condition after accounting for difference in length of fixity for Free Headed Condition and Fixed Head Condition.
- vii) The working load on pile for vertical and horizontal loads shall be checked by conducting routine tests during construction. For calculating pile loads, load obtained at pier base from STAAD analysis shall be applied on the pile cap.
- viii) Pile cap shall be designed based on bending theory using the forces derived in piles using rivet theory. No support from soil below pile cap shall be considered.
- ix) The top of pile cap will be kept about 500mm below the existing ground level and weight of the earth cover will be applied on top of pile cap when unfavourable. Indeed, the earth cover on pile cap for any favourable effect (stability, soil horizontal capacity, pile cap design) will be neglected.
- x) Top of the pile will project 50mm into the pile cap.
- xi) Pile foundations will be of M35 with minimum cement content of 400 kg/m³. The max water cement ratio shall be 0.4 with a minimum slump of 150- 200mm. Pile cap shall be of M35 grade of concrete. A clear cover of 75mm will be provided to any reinforcement closest to concrete surface of pile & pile cap.
- xii) The structural design of pile & pile cap will be checked for maximum/minimum axial load in pile with co-existent moment using IRC: 112.
- xiii) The minimum thickness of pile cap shall be 1.5 times the pile diameter.
- xiv) A minimum offset of 150mm will be adopted beyond the outer face of the outermost pile in the pile cap so as to bend the main flexural (bottom) reinforcement of pile cap for a defined minimum radius beyond the outer edge of pile.
- xv) Pile cap will be designed either by truss analogy or by bending theory, depending upon the spacing and number of piles in a pile group. Truss analogy may be used for pile caps with a maximum of 5 piles in a pile group. Beyond 5 piles, bending theory will be used.

Liquefaction potential of soil, if any, shall be considered as per soil investigation report. The length of liquefaction shall be ignored for vertical and lateral resistance under seismic condition. The seismic on structure within liquefaction shall be considered.

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1.17.7.2 Open Foundation:

General

In Soil: The foundation shall be decided based on the sub-soil investigation. The open foundation in soil shall be taken down to a comparatively shallow depth below the bed surface provided good bearing stratum is available and the foundation is protected against scour. The minimum depth of foundation shall be up to stratum having safe bearing capacity but not less than 2 m below the scour level or the protected bed level.

No tension is permissible in foundations resting on soil.



In Rock: The open foundation shall be anchored into the rock by 600 mm in hard rock and 1500 mm in weathered rock. Tension at bottom of footing is permissible as per clause 706.3.3.2 of IRC: 78.

Subgrade Modulus for Raft foundations: For calculation of subgrade modulus under the box structures, Bowles formula from chapter 10-5 shall be referred for which the settlement of 75 mm shall be considered.

Structural Analysis

The design of open foundation will confirm to provisions of IRC: 78-2014. The various specific assumptions to be made for the design of pile and pile cap will be as follows:

- i) Open foundations may be provided where the foundations can be laid in a stratum which is in-erodible or where the extent of scour of the bed is reliably known. The foundations are to be reliably protected by means of suitably designed aprons, cut-off walls or/and launching aprons as may be necessary.
- ii) The thickness of the footings shall not be less than 300 mm.
- iii) For solid wall type substructure with one-way reinforced footing, the bending moments can be determined as one-way slab for the unit width subjected to worst combination of loads and forces.
- iv) For two-way footing, bending moment at any section of the footing shall be determined by passing a vertical plane through the footing and computing the moment of the forces acting over the entire area of footings one side of the vertical plane.
- v) The shear strength of the footing may be checked at the critical section which is the vertical section at a distance 'd' from the face of the wall for one-way action where 'd' is the effective depth of the section at the face of the wall.
- vi) To ensure proper load transfer, a limiting value of ratio of depth to length/width of footing equal to 1:3 is specified. Based on this, for sloped footings the

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depth effective at the critical section shall be the minimum depth at the end plus 1/3rd of the distance between the extreme edges of the footing to the critical section for design of the footing for all purposes.

Shear Failure Criteria (Foundations resting on Non plastic soil)

The safe bearing pressure from Shear failure criteria can be obtained, using the Equation given below

$$Q_u = q (N_q - 1) S_q D_q I_q + 0.5 B \gamma N_\gamma S_\gamma D_\gamma I_\gamma W'$$

Where,

B = Width of the footing in m

D_q, D_γ = Depth factors S_q, S_γ = Shape factors

I_q, I_γ = Inclination factors

N_q, N_γ = Bearing capacity factor

q = Effective overburden pressure at foundation, in t/m²

W' = Water table correction factor

γ = Bulk unit wt. of foundation soil, in t/m³

1.17.8 Computation

The Geo-tech survey is in progress and the summary of field data and laboratory test results will be submitted during Final DPR submissions.

ANNEXURES

Annexure – 1 - Physical Characteristics of OGL Soil and existing subgrade soil Samples

Annexure – 2 – Compaction Test and Three Energy level along existing Subgrade

Annexure – 3 – Compaction Test and Three Energy level along existing Bypass

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Transys								Summary of Lab Test Results (Silchar to Sairang)								
Sl. No	Chainage/Location	Side	Particle Size Analysis					Atterberg Limits			FSI, %	Specific Gravity	Modified Compaction Test		Soaked CBR Value (3-Energy Level) at 97% MDD, %	Soil Description
			Boulders %	Cobbles %	Gravel %	Sand %	Silt & Clay, %	Liquid Limit %	Plastic Limit %	PI			MDD, g/cc	OMC, %		
1	262+000 (NH-37)	LHS	0.00	0.00	1.09	70.38	28.54	NP	NP	NP	32.00	2.66	1.94	13.76	6.80	Silty SAND with Gravel (SM)
2	257+000 (NH-37)	RHS	0.00	0.00	7.53	50.43	42.05	NP	NP	NP	31.00	2.68	1.96	13.36	6.60	Silty SAND with Gravel (SM)
3	2+200 (Silchar Bypass)	RHS	0.00	0.00	10.19	16.01	73.80	41.00	27.35	13.65	28.00	2.61	1.80	17.20	6.20	Silty SAND with Gravel (SM)
4	6+000 (Silchar Bypass)	LHS	0.00	0.00	11.23	56.94	31.84	NP	NP	NP	31.00	2.65	1.92	13.50	6.90	Silty SAND with Gravel (SM)
5	08+800 (NH306)	LHS	0.00	0.00	24.12	52.54	23.34	NP	NP	NP	32.00	2.72	1.90	14.20	7.10	Silty SAND with Gravel (SM)
6	13+000 (NH306)	RHS	0.00	0.00	23.56	50.44	26.01	NP	NP	NP	32.00	2.64	1.92	14.00	7.00	Silty SAND with Gravel (SM)
7	18+000 (NH306)	LHS	0.00	0.00	7.02	52.47	40.51	18.00	14.63	3.37	27.00	2.62	1.73	14.00	6.60	Silty SAND with Gravel (SM)
8	23+000 (NH306)	RHS	0.00	0.00	28.50	41.36	30.15	21.00	19.55	1.45	26.00	2.61	1.87	14.10	6.90	Silty SAND with Gravel (SM)
9	28+000 (NH306)	LHS	0.00	0.00	20.79	49.57	29.65	NP	NP	NP	33.00	2.70	1.88	14.40	6.80	Silty SAND with Gravel (SM)
10	33+000 (NH306)	LHS	0.00	0.00	3.40	49.38	47.22	NP	NP	NP	31.00	2.69	1.87	14.00	6.70	Silty SAND with Gravel (SM)
11	38+000 (NH306)	RHS	0.00	0.00	12.12	44.29	43.60	NP	NP	NP	32.00	2.66	1.87	13.90	6.90	Silty SAND with Gravel (SM)
12	40+500 (NH306)	LHS	0.00	0.00	6.62	50.77	42.61	NP	NP	NP	31.00	2.65	1.85	14.10	6.80	Silty SAND with Gravel (SM)

Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km).

Transys								Summary of Lab Test Results on bypass (Silchar to Vairengte)								
Sl. No	Design Chainage	Location	Particle Size Analysis					Atterberg Limits			FSI, %	Specific Gravity	Modified Compaction Test		Soaked CBR Value (3-Energy Level) at 97% MDD, %	Soil Description
			Boulders %	Cobbles %	Gravel %	Sand %	Silt & Clay,	Liquid Limit %	Plastic Limit %	PI			MDD, g/cc	OMC, %		
1	15+700	Gree filed alignment	0	0	0	11	89.005	47.5	31.76	15.74	25	2.53	1.67	21.8	4.8	ML (Silt with low compressibility)
2	22+200	Gree filed alignment	0	0	0	7.19	92.815	50.5	34.14	16.36	27	2.51	1.68	21.1	4.7	ML (Silt with low compressibility)
3	24+200	Gree filed alignment	0	0	0	9.29	90.71	47	31.64	15.36	26	2.58	1.67	21	4.9	ML (Silt with low compressibility)
4	30+300	Gree filed alignment	0	0	0	3	97	49	35.46	13.54	28	2.56	1.65	21.3	4.5	ML (Silt with low compressibility)
5	35+600	Gree filed alignment	0	0	2.34	40.14	57.525	20	8.63	11.37	26	2.62	1.92	14	5.5	ML (Silt with low compressibility)

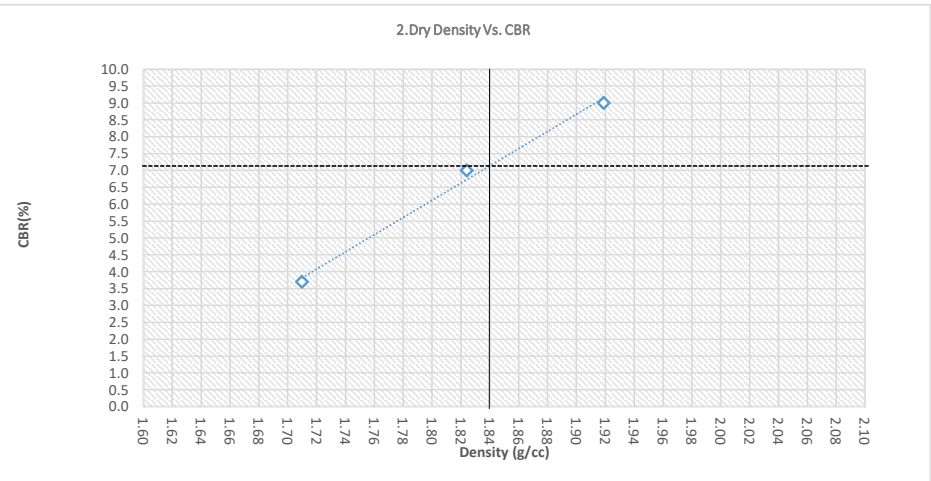
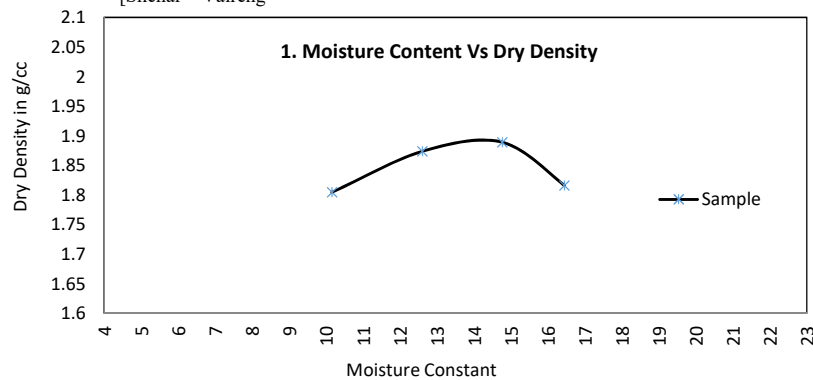
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-1
Chainage 08+000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.90
O.M.C (%)	14.20

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.7	1.71
II - energy level	7.0	1.82
III - energy level	9.0	1.92

CBR Value at 97% of MDD: 7.1 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

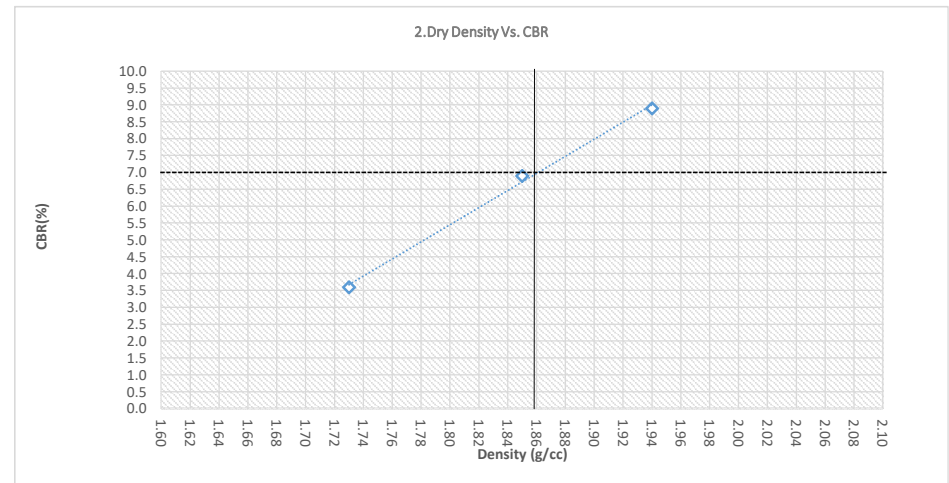
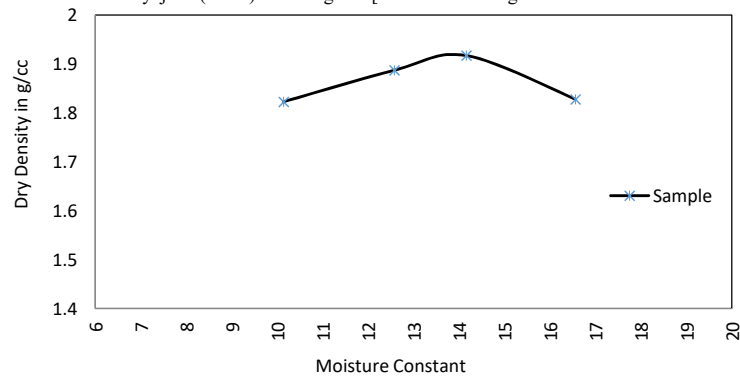
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-2
Chainage 13+000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) 1.920
O.M.C (%) 14.00

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.6	1.73
II - energy level	6.9	1.85
III - energy level	8.9	1.94

CBR Value at 97% of MDD: 7 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

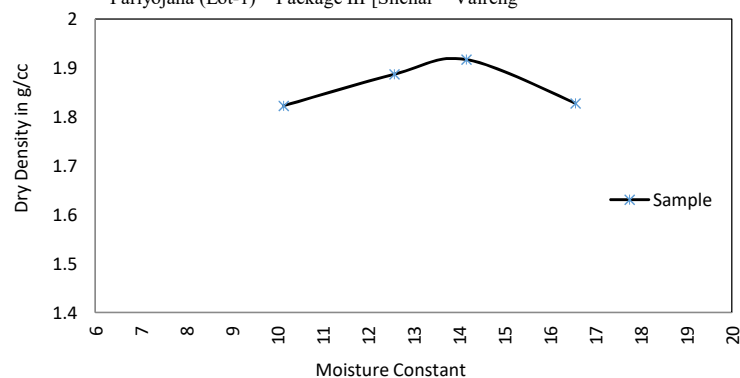
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-3
Chainage 18-000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) **1.73**
O.M.C (%) **14.00**

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.1	1.51
II - energy level	5.7	1.64
III - energy level	8.0	1.74

CBR Value at 97% of MDD: **6.6 %**

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

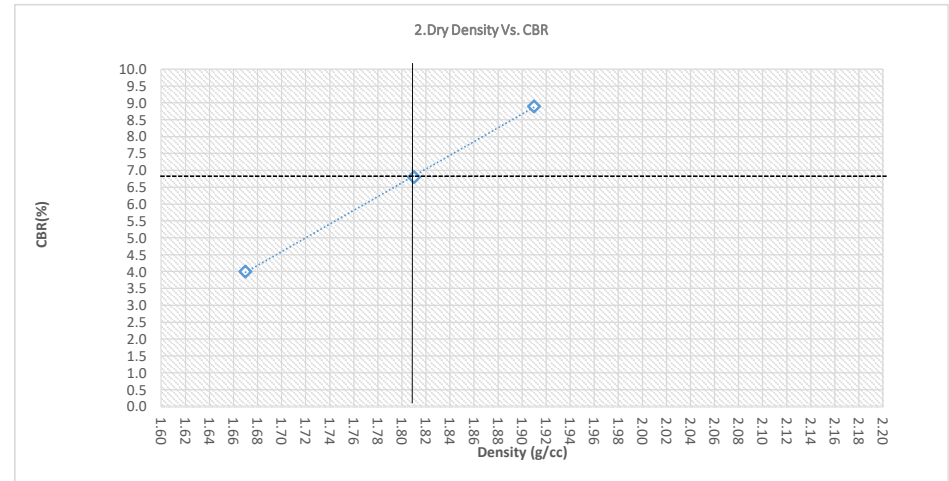
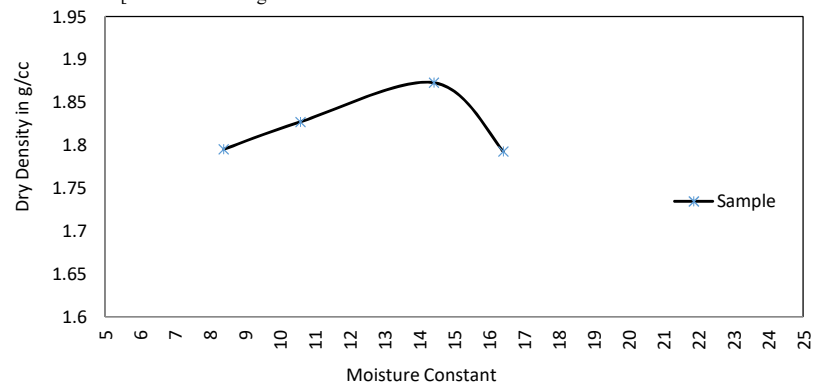
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-4
Chainage 23+000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.870
O.M.C (%)	14.10

CBR	CBR (%)	Density (gm/cc)
I -energy level	4.0	1.67
II - energy level	6.8	1.81
III - energy level	8.9	1.91

CBR Value at 97% of MDD: 6.9 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

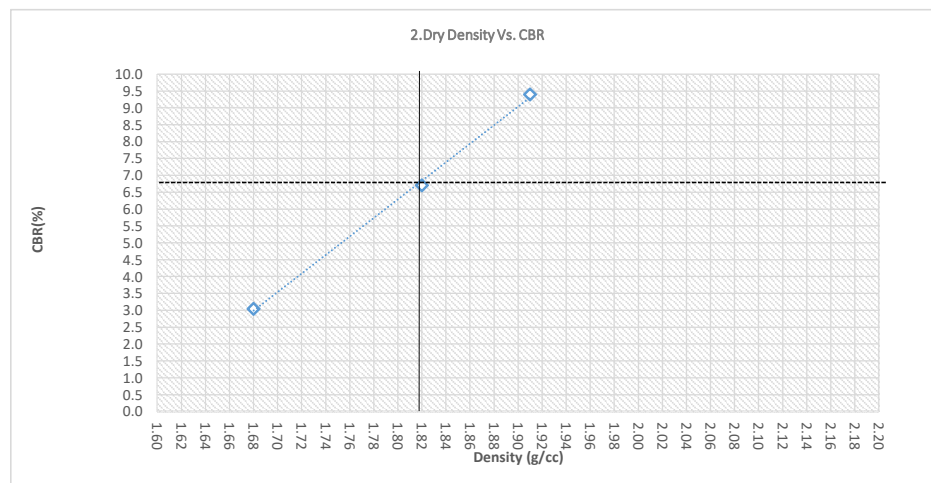
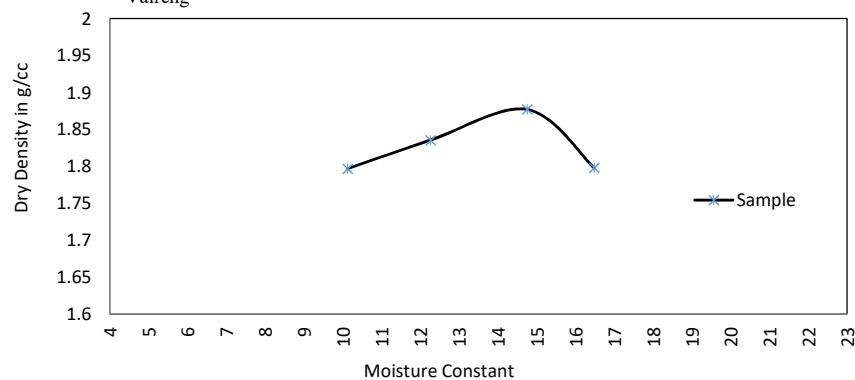
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-5
Chainage 28+000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.880
O.M.C (%)	14.40

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.1	1.68
II - energy level	6.7	1.82
III - energy level	9.4	1.91

CBR Value at 97% of MDD: 6.8 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

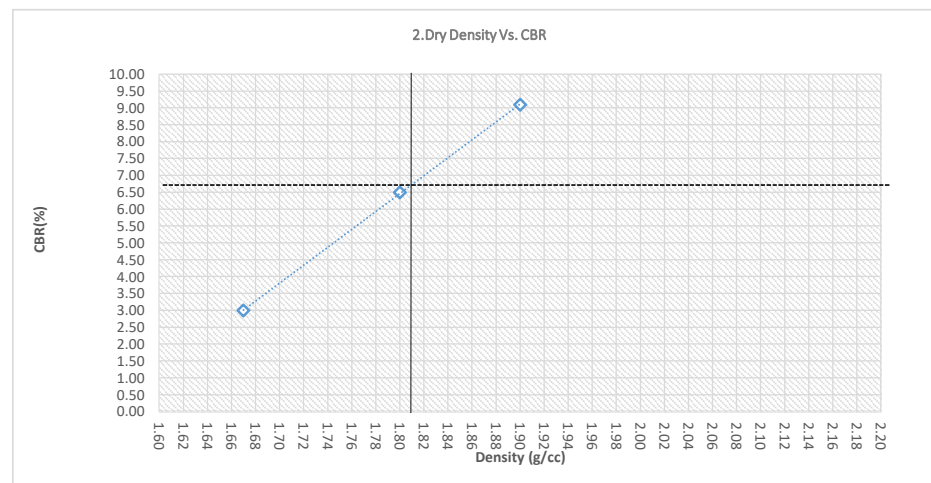
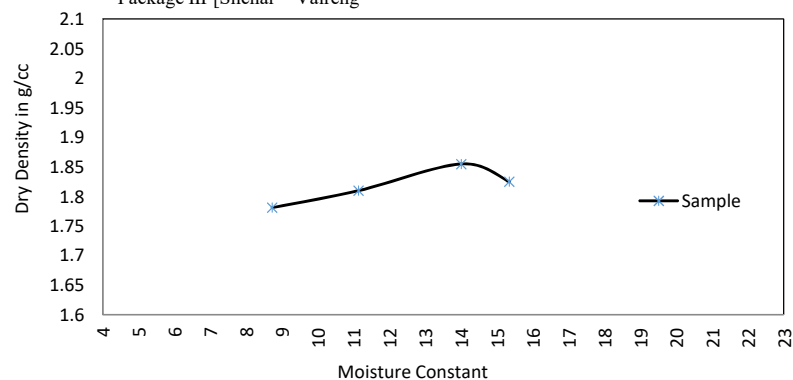
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-6
Chainage 33+000
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.870
O.M.C (%)	14.00

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.00	1.67
II - energy level	6.50	1.80
III - energy level	9.10	1.90

CBR Value at 97% of MDD: 6.7 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

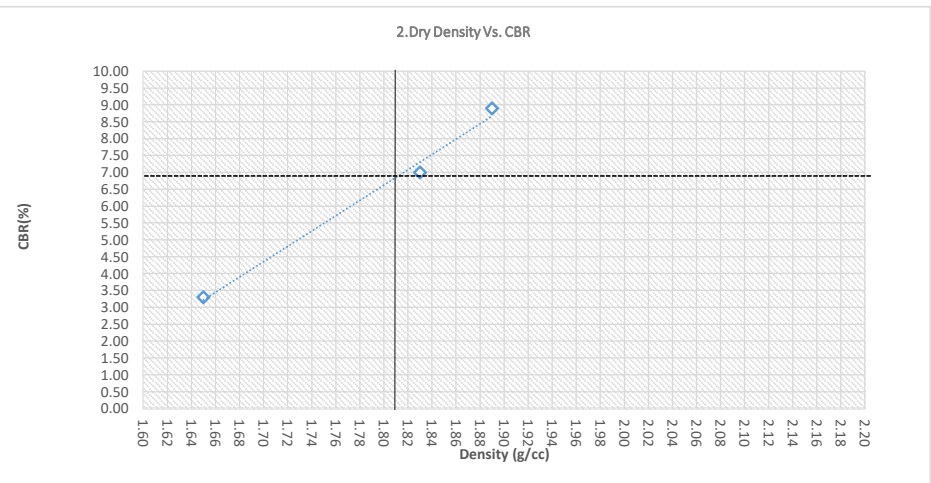
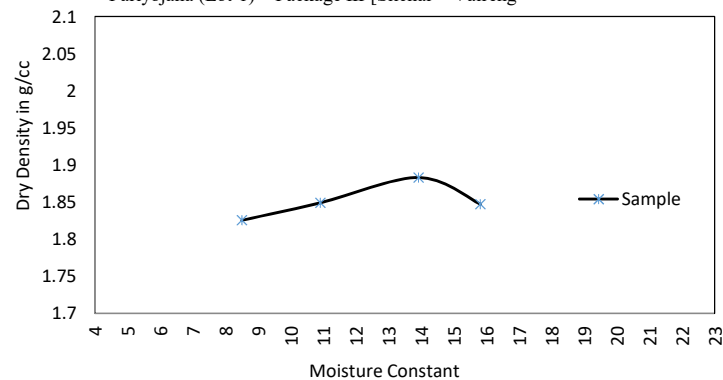
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-7
Chainage 38+000
Type of Sample RHS

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) 1.870
O.M.C (%) 13.90

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.30	1.65
II - energy level	7.00	1.83
III - energy level	8.90	1.89

CBR Value at 97% of MDD: 6.9 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

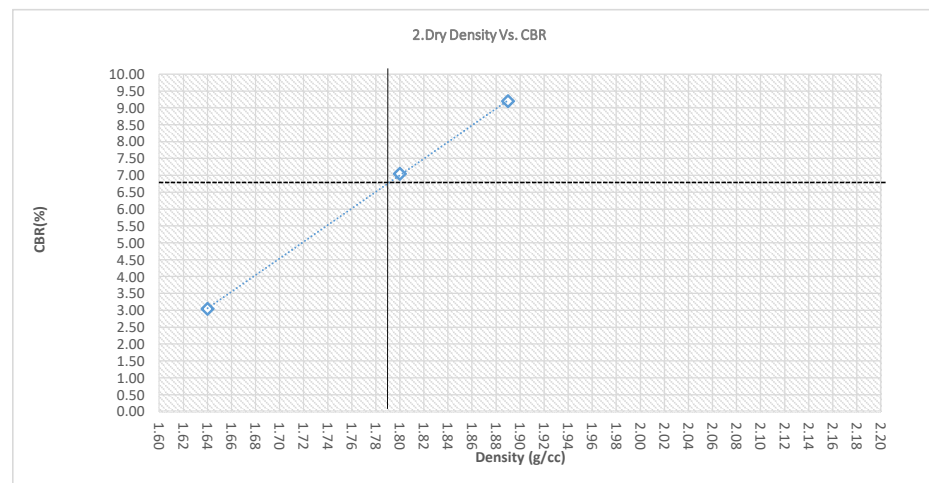
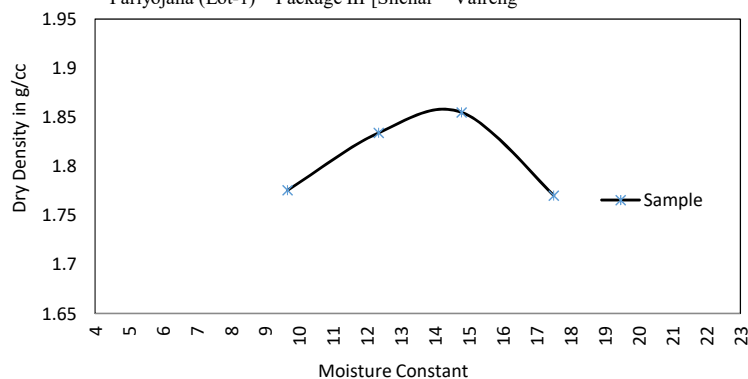
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No TP-8
Chainage 40+500
Type of Sample Subgrade

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.850
O.M.C (%)	14.00

CBR	CBR (%)	Density (gm/cc)
I -energy level	3.05	1.64
II - energy level	7.05	1.80
III - energy level	9.20	1.89

CBR Value at 97% of MDD: 6.8 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

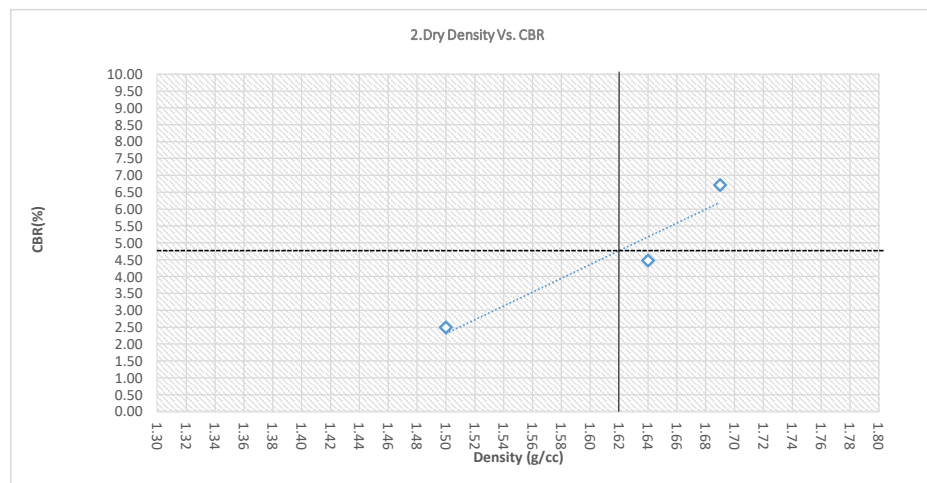
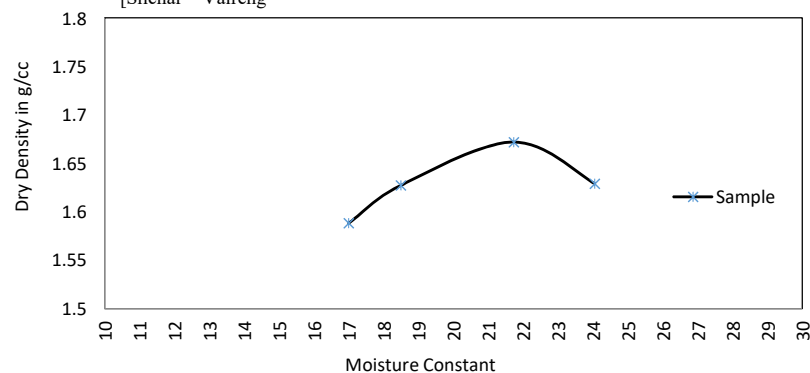
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No GF -1
Chainage 11+700
Type of Sample _____

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.670
O.M.C (%)	21.80

CBR	CBR (%)	Density (gm/cc)
I -energy level	2.50	1.50
II - energy level	4.48	1.64
III - energy level	6.72	1.69

CBR Value at 97% of MDD: 4.8 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

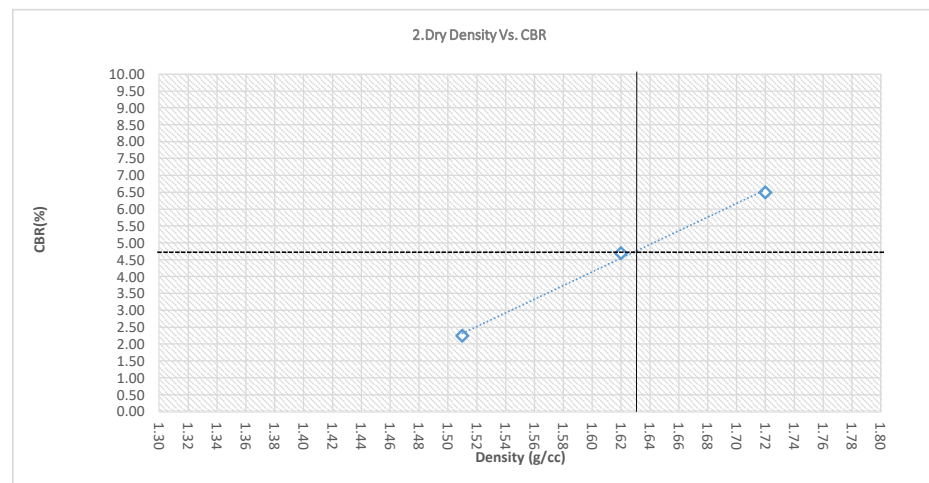
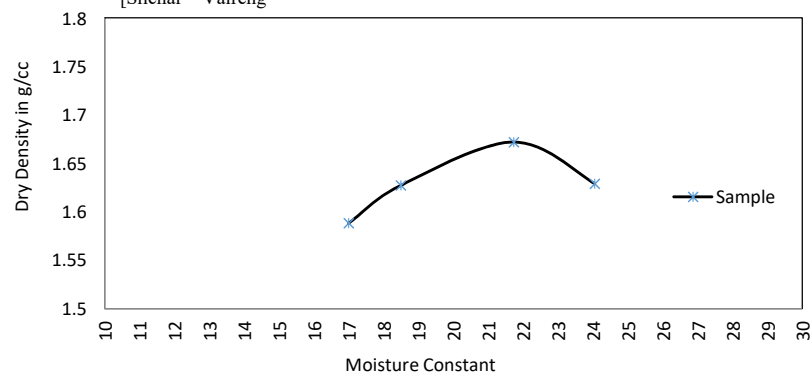
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No **GF-2**
Chainage **17+550**
Type of Sample _____

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) **1.680**
O.M.C (%) **21.10**

CBR	CBR (%)	Density (gm/cc)
I -energy level	2.25	1.51
II - energy level	4.70	1.62
III - energy level	6.50	1.72

CBR Value at 97% of MDD: **4.7** %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

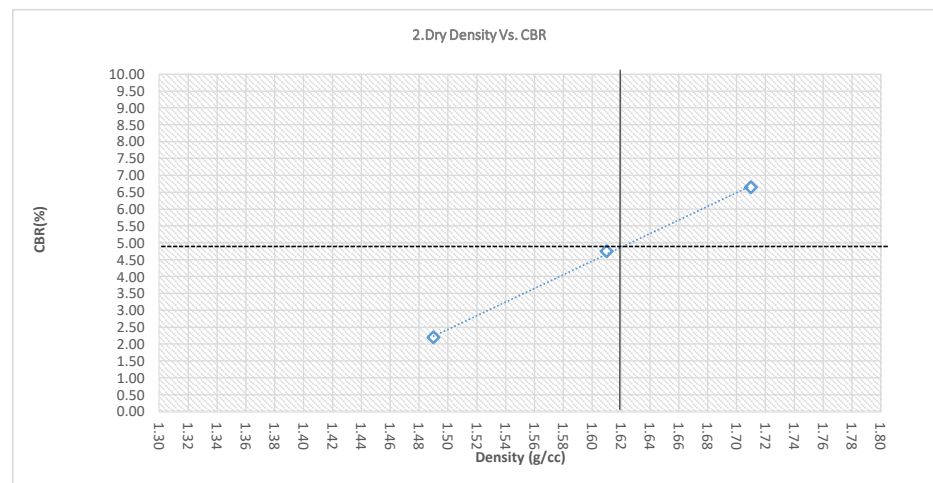
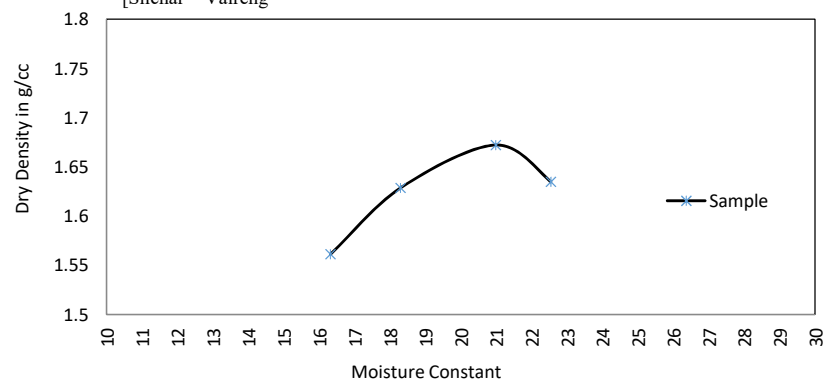
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No GF - 3
Chainage 20+200
Type of Sample

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) 1.670
O.M.C (%) 21.00

CBR	CBR (%)	Density (gm/cc)
I -energy level	2.20	1.49
II - energy level	4.75	1.61
III - energy level	6.65	1.71

CBR Value at 97% of MDD: 4.9 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

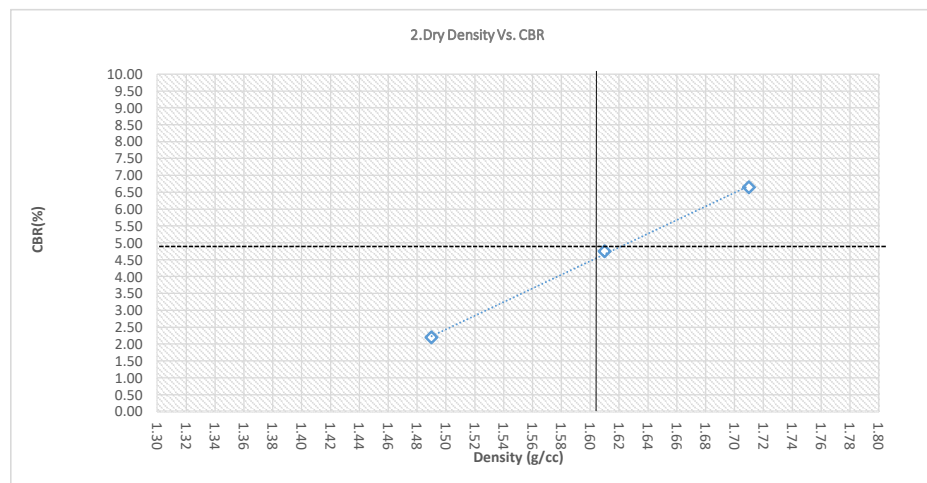
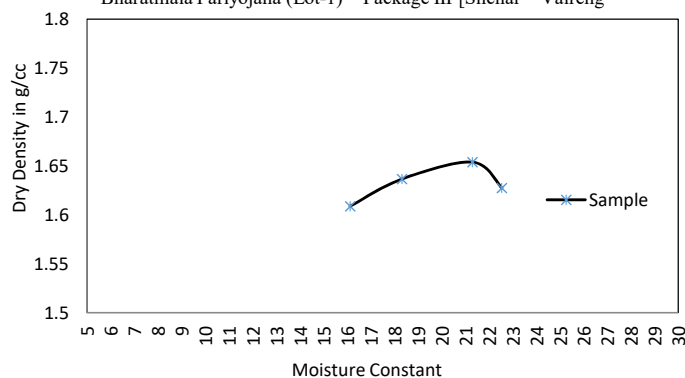
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No GF - 4
Chainage 26+200
Type of Sample

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc) 1.650
O.M.C (%) 21.30

CBR	CBR (%)	Density (gm/cc)
I -energy level	2.20	1.49
II - energy level	4.75	1.61
III - energy level	6.65	1.71

CBR Value at 97% of MDD: 4.5 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07

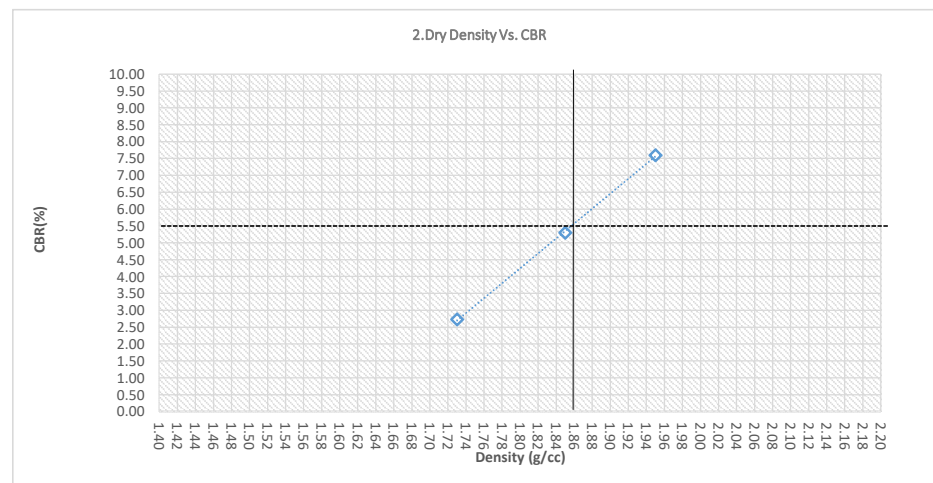
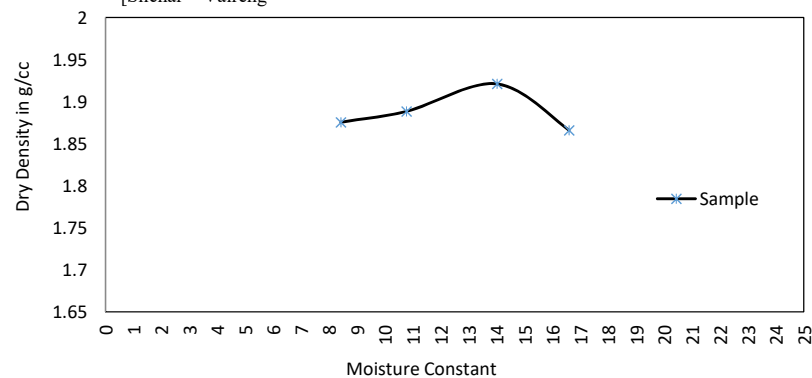
Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors, and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) (Package-III) (Silchar-Vairengte (49.9 km), Vairengte-Sairang (111 km), Silchar-Jiribam (55 km)).

LABORATORY COMPACTION AND CBR TEST RESULTS

Soil Sample Details:

Pit No GF-5
Chainage 31+500
Type of Sample

Name of work: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojna (Lot-1) – Package III [Silchar – Vaireng



Results:

M.D.D (gm/cc)	1.920
O.M.C (%)	14.00

CBR	CBR (%)	Density (gm/cc)
I - energy level	2.73	1.73
II - energy level	5.30	1.85
III - energy level	7.60	1.95

CBR Value at 97% of MDD: 5.5 %

References:

Proctor Compaction test (Heavy) : IS 2720, Part 8
CBR - 3 Energy Level : ASTM D 1887 -07