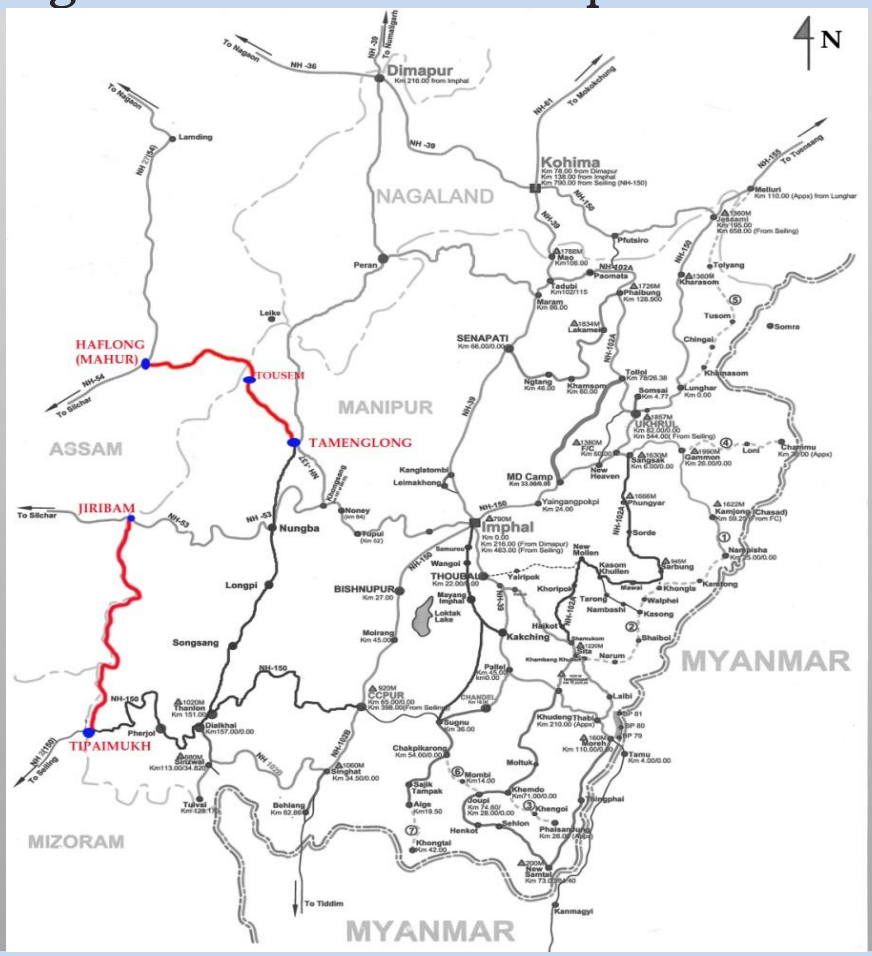
NATIONAL HIGHWAY INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED

Consultancy Services for preparation of Feasibility Study and Detailed Project Report for Two Lane with Paved Shoulders of Tamenglong-Tousem-Haflong Road in the State of Manipur and Assam.



DRAFT DETAILED PROJECT REPORT
VOL-III MATERIAL REPORT
PKG-5
AZURAM- MAKRU RIVER SECTION
(FROM KM 54+180 TO KM 69+500) LENGTH-15.32 KM

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CHAPTER 1
INTRODUCTION

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1.1 INTRODUCTION

- GENERAL

The selected National Highway serve as lifeline for population living in rural areas scattered in vast geographical span of districts. In Manipur the geographical rough & Hilly terrain demands for an effective road network in order to provide population proper connectivity. The condition of highways has quite improved in past years, however still lot of scope still remains for improvement in road infrastructure network across Manipur.

- PROJECT BACKGROUND

National Highways and Infrastructure Development Corporation Limited.,(NHIDCL) have been constituted by the Government of India in the year 2014 with the purpose of up-gradation and development of National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. Private consultants will provide consultancy service to establish the technical, economical and financial viability of the projects with due consideration to environmental and social safeguards and to prepare Detailed Project Reports for widening, relaying and / or reconstruction of roads. LN Malviya Infra Projects Pvt. Ltd., BHOPAL as consultants to provide the Consultancy Services for Preparation of Detailed Project Report for Tamenglong-Tousem-Haflong Road in the State of Manipur.

1.2 PURPOSE OF MATERIAL INVESTIGATION

The investigation for the soil and other construction material has been carried out to :-

- Determine the natural and physical characteristics of soil and soil profile for design of

embankment and pavement.

- Identify and locate borrow areas for their availability and suitability for use.
- Locate sources for aggregate require for pavement and structures and to ascertain their vitality and suitability for use.
- Locate sources of water suitable for construction.
- Gather general information regarding sub -soil, water level and flooding.
- Identify sources for other construction material such as cement, Sand, Aggregate, bitumen and steel.

1.3 DETAIL OF INVESTIGATION

The detailed investigation included both field and laboratory work. Samples of borrow soils, sand and crushed rock for use in embankment, pavement and in other structure were collected from the existing as well as proposed borrow sources / quarries within reasonable short haulage distance from the project corridor. Auger holes and test pits were excavated where necessary to obtain samples for testing.

The following **Table 1.1** Summarizes the investigation and testing accomplished by the consultant to archive the objective

Table 1.1 Quantum of investigation and Testing

S. No.	Description	Interval	Number
1.	Test pit excavation penetrating pavement structure down to sub-grade to record (a) pavement (b) field density and compaction and (c) collection of sub-grade sample	Min 1 per 1 kms. (Both Sides)	30
2.	Investigation of (I) Quarry sources (ii) Sand sources	 ------- -------	 1 1

1.4 TEST PROCEDURE

The standard test procedure followed for soil sampling and laboratory testing is given in Table 1.2. All laboratory tests have been performed at NEST Lab, AGARTALA and the results are compiled in Annexure.

Table 1.2 Standard Test Procedures

S. No.	Type of Test	Method
1.	Sieve analysis - Natural Soils - Selected Soil	IS: 2720 Part 4 IS: 2386 Part 1
2.	Field Density Test	
3.	Modified Proctor Compaction Tests - OMC - MDD	 IS :2720 Part 2 (Section l) IS :2720
4.	Atterberg Limits	IS :2720 Part 5
5.	CBR Soaked & Unsoaked & Swell Test	IS :2720 Part 16

CHAPTER 2
SOIL PROFILE ALONG THE PROJECT ROAD

CHAPTER 2
SOIL PROFILE ALONG THE PROJECT ROAD

2.1 FIELD AND LABORATORY TESTING

Test pits were excavated on an average at an interval of about 1 kms and at the location where the soil strata changes to perform field density and to collect samples for laboratory tests. They were carefully dug from the pavement surface up to sub grade level, after this they were manually leveled and prepared for field density tests. Field density tests on the sub-grade soil were conducted using the sand replenishment method at each test location and small quantity was collected in airtight containers for deterring the field moisture from each test pit.

Upon completion of field density test, respective sample of sub – grade soil was collected in bulk in gunny bag from each test pit for laboratory tasting. Finally holes were drilled using hand auger from the bottom of the test pit to collect soil samples for identification and laboratory classification test. Respective samples of soil and materials collected from the test pit and auger holes were subjected to various laboratory and field tests as listed below.

The tests performed were

- Grain size distribution
- Atterberg limit
- OMC & Maximum Dry Density for modified proctor Compaction
- CBR tests Soaked and Unsoaked

2.2 TEST RESULTS

The tests results of soil and soil field density are exhibited in Appendix 1 Summary of laboratory soil test result and field test result are given in Tables 2.1 and 2.2 respectively.

Table 2.1 Laboratory Soil test Results

S. No.	Chainage Km	Modified Proctor Compaction Test		Grain Size Analysis				Atterberg Limit			CBR
		OMC %	MDD gm/cc	Gravel %	Sand %	Silt %	Clay %	L.L. %	P.L. %	P.I. %	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	54.000(L)	12.6	1.899	0	52.64	28.13	19.23	35.65	27.56	8.09	10.8
2	58.000(L)	13.7	1.869	1.29	52.63	28.77	18.6	35.96	25.61	10.35	12.4
3	63.000(L)	12.3	1.919	0	53.27	28.96	17.77	35.65	23.96	11.69	12.7
4	68.000(L)	14.9	1.829	0	34.69	22.63	42.68	42.68	18	24.68	7.8

2.3 CONCLUSIONS

Along the entire corridor Four type of soil were encountered, Dark Grey Clayey Silty Sand, Light Yellow Clayey Silty Sand, Brownish Clayey Silty Sand & Greyish Silty Sandy Clay with high compressibility (CH) and granular properly and well graded soil. Field density measurements on the existing sub – grade reveals that they are within the acceptable range.

To evaluate the sub-grade strength in it existing condition, the CBR strength of the sub - grade were determine by compacting the samples in soaked (for four days) and unsoaked condition.

The soaked CBR of soil varies from 8.3% to 13.9% out of which 100 % of the results are above 8% CBR. Therefore CBR strength is quite good reflection of their potential strength.

CHAPTER 3
CONSTRUCTION MATERIALS

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CONSTRUCTION MATERIALS

3.1 OBJECTIVE

The objective of the construction material survey was to :

(I) Locate potential sources of soil borrow areas, gravel, rock quarries, water sources and other construction materials with in the project vicinity.

(II) Examine the engineering properties of materials relevant to the project as per MOSRTH specifications.

As a first step, material surveys were identified with the help of existing data, local enquiry and field assessment. Thereafter soil and aggregate samples were collected from the identified sources for testing.

3.2 BORROW AREAS

3.2.1 Identification

Investigation has been done to locate the potential borrow areas for sub – grade / embankment fill and granular sub- base along the project corridor with economic hauling distance. To achieve the objective the offices of NHIDCL and local people were connected. Based on the information collected, field surveys carried out and personal experience, potential burrow areas have been identified which either existing old borrow areas or new ones are lying in the Existing Road land belonging to government or people.

borrow areas have been identified in existing road side hill portion. These are spread between overall length of the project corridor. The soil from these borrow areas (or existing) is generally of hard moorum type with high CBR Value. The details of these areas i.e. , location, distance from the project road, is given Table 3.1 below.

Table 3.1: Borrow Areas Location

Sr. No.	Location	Villages	Distance from project corridor
1.	From Km 54 To Km 67	-	On Corridor Both Side

All the borrow areas have sufficient quantity of material and can be used in the road. Some of borrow areas are pre-approved by the NHIDCL. Burrowing soil from these areas would require prior notice to the local authorities' private people and permission obtained from them with or without royalties.

Soil samples from these borrow areas were collected by excavating pits down to 1.0 m. depth from the existing surface The top organic layer of 100 mm was removed before sampling.

3.2.2 Sampling and Laboratory Testing

3 borrow areas identified. The following tests were carried out on borrow soil samples

- Grain Size Analysis
- Atterberg Limits
- Proctor Compaction Test
- CBR Test

3.3 AGGREGATES

3.3.1 Quarries for Aggregates

Aggregates for sub- base, base and surface courses are proposed to be utilized from the crusher or quarries under operation within economical haulage distance of the project corridor. Some of these quarries have been leased by Manipur Government and the lessees have installed crusher and sell aggregates. The allotted area is a small fraction of the total area of each quarry. It is learnt that further area can be leased out by the Manipur Government for this purpose.

Table 3.2 : Location of Aggregate Quarries

Sr. No.	Location	Chainage (km.)
1.	At Barak River	At 25km Lead
2.	At Km 28.00 on Project Road	At 20km Lead

Table 3.3: Location of Sand Quarries

Sr. No.	Location	Chainage (km.)
1.	Barak River	At 25km Lead

3.3.2 Sampling and Testing

The following tests were conducted

3.3.2.1 For Aggregate

- Impact Value
- Specific Gravity
- Water Absorption

3.3.2.2 For Sand

- Grading
- Fineness Modules

Four samples each of aggregates and sand collected from the identified quarries have been tested. The test report is exhibited in Appendix -1. Summary of test results of Aggregates and sand is given in Table 3.4.

Table 3.4 Test Result of Aggregates at Location-1

S. No.	Name of Test	Sample Details / Result
1.	% Impact Value	25.89%
2.	% Specific Gravity	2.58
3.	% Water Absorption	1.40%
4.	CBR	31.46%

Table 3.5 Test Result of Aggregates at Location-2

S. No.	Name of Test	Sample Details / Result
1.	% Impact Value	34.95%
2.	% Specific Gravity	2.47
3.	% Water Absorption	1.83%
4.	CBR	26.16%

3.3.2.3 Aggregates

For the Aggregates tested, the impact value is 25.89 % which is within the permissible limit. The specific gravity varies from 2.58% to which is acceptable. The water absorption varies from 1.4% and less then the permissible limit of 2%. On the basis of this property; all the samples are suitable as aggregate for any of the pavement layers. However it may be pointed out that a change in type of crusher can result in lower flakiness and elongation index. It is therefore expected that with the use of integrated crushing plants (cone crusher as secondary unit), this property will get satisfied.

It therefore reveals that aggregate from the tested quarries, which are with reasonable reach of the projected corridor, after meeting all the engineering requirement and specifications can be used for construction.

3.3.2.4 SAND

The grading and fineness modules of sand samples tested are generally within the permissible limits and as such material from such quarries is fit for use.

3.4 WATER

The potable water from tube well, opens wells, water supply schemes is considered suitable for construction and available in plenty.

3.5 OTHER CONSTRUCTION MATERIALS

Bitumen is to be brought reputed oil refinery or from Distributor of Imphal, Guwahati or near by places . Manufacturer's test / quality certificate is required for each consignment received. Steel of various grade including HYSD steel as per IS specification is available in Imphal, Guwahati & other cities of Assam and can be bought from there or can be arranged from the Manufacturers. Manufacturer's test / quality certificate is needed for each consignment received.

CHAPTER 4
PROCUREMENT OF CONSTRUCTION MATERIALS

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4.1 BORROW AREA SOILS

To get the soil, the contractor

- Shall have to meet the owner (Private Person or Government Department) of the borrow area.
- Negotiate the price of the land (for Government area as per notified rules).
- Specifically mentioning the area required, depth of cut, exact time and duration of operation.
- Should make a proper agreement on the stamp paper with all terms and condition mentioned in it.
- Replace the top soil of the borrow area at the time of handing over the borrow pit to the owner, which was removed in the beginning of the operation, of excavation.

4.2 AGGREGATES

To get aggregates, the contractor

- Can purchase the aggregates. from the market as long as the aggregate meet the specification requirements.
- Can set up his own crusher in the quarry area, after taking the quarry area on lease from the revenue / mining department of the state.
- Take NOC from various Government Departments such as Police, Mining, Revenue etc. for new quarries.

4.3 SAND

Sand can be obtained from the natural stream or quarries by paying royalty to the Government.

4.4 WATER

To get Water, the contractor

- Can have it by installing pumps on the existing open well / bore holes along the road and payments may be paid to the owner of the wells / bore holes or
- Can dig his own tube well after taking approval from the state Ground Water Board.

4.5 GRANULAR SUB-BASE

To obtain GSB, the contractor

- Can have it from his own crusher as 'Direct Crusher Run'

4.6 OTHER CONSTRUCTION MATERIALS

To arrange other construction materials like cement, steel etc., the Contractor

- Can buy it directly from the sources / manufacturing unit or
- Can purchase from the local suppliers of nearby cities.

APPENDICES TO CHAPTER 1

Analysis Report

I. SAND

a.Source: Barak River

S. No.	Tests	Test Values
1.	**Sieve Analysis**	
2.	**Sieve size mm**	**% Passing**
3.	10	97.86
4.	4.75	95.58
5.	2.36	95.42
6.	1.18	94.51
7.	600	92.88
8.	300	35.00
9.	150	7.59
10.	75	0.00
11.	Deleterious Material	-
12.	Deleterious Material-Coal & Lignite	-
13.	Deleterious Material-Clay & Lumps	-
14.	Silt & Clay	0.48%
15.	Fineness Modulus	0.55%

IS Codes Followed: 2720(Various parts),2386(Various parts),383

II. Sub Soil Investigation Detail(LHS)

Chainage	Side	Type of Soil	CBR	OMC	MDD	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %	IS Classification
54+000	**LHS**	Dark Grey Clayey Silty Sand	10.8	12.6	1.899	35.65	27.56	8.09	0	52.64	28.13	19.23	SM-SC
55+000	**LHS**	Dark Grey Clayey Silty Sand	10	13.4	1.886	34.8	26.64	8.16	0	53.61	27.45	18.94	SM-SC
56+000	**LHS**	Dark Grey Clayey Silty Sand	10.6	13.2	1.889	35.68	24.86	10.82	0	46.79	29.79	23.42	SM-SC
57+000	**LHS**	Dark Grey Clayey Silty Sand	10	13.4	1.886	34.8	26.64	8.16	0	53.61	27.45	18.94	SM-SC

58+000	**LHS**	Light Yellow Clayey Silty Sand	12.4	13.7	1.869	35.96	25.61	10.35	1.29	52.63	28.77	18.6	SM-SC
59+000	**LHS**	Light Yellow Clayey Silty Sand	12.7	12.8	1.872	36.29	24.77	11.52	0	53.91	25.06	21.03	SM-SC
60+000	**LHS**	Light Yellow Clayey Silty Sand	12.2	12.7	1.883	34.89	26.22	8.67	4.96	47.55	28.64	23.81	SM-SC
61+000	**LHS**	Light Yellow Clayey Silty Sand	12.5	12.8	1.896	35.96	25.76	10.2	6.33	49.87	32.44	17.69	SM-SC
62+000	**LHS**	Light Yellow Clayey Silty Sand	13.9	12.6	1.899	34.69	21.34	13.35	1.07	52.67	26.79	20.54	SM-SC

63+000	**LHS**	Brownish Clayey Silty Sand	12.7	12.3	1.919	35.65	23.96	11.69	0	53.27	28.96	17.77	SM-SC
64+000	**LHS**	Greyish Silty Sandy Clay	7.9	14.5	1.799	44.93	18.18	26.75	0	32.79	25.32	41.89	SM-CI
65+000	**LHS**	Dark Grey Clayey Silty Sand	7.2	14.25	1.783	36.65	26.12	10.53	0	50.92	28.56	20.52	SM-SC
66+000	**LHS**	Dark Grey Clayey Silty Sand	10.1	12.1	1.899	35.85	26.74	9.11	0	51.64	28.94	19.42	SM-SC
67+000	LHS	Dark Grey Clayey Silty Sand	10.8	12.6	1.899	35.65	27.56	8.09	0	52.64	28.13	19.23	SM-SC

68+000	LHS	Greyish Silty Sandy Clay	7.8	14.9	1.829	42.68	18	24.68	0	34.69	22.63	42.68	SM-CI
69+000	LHS	Light Yellow Clayey Silty Sand	13.8	12.2	1.927	33.56	23.79	9.77	1.31	52.79	23.68	22.22	SM-SC

III. Sub Soil Investigation Detail(RHS)

Chainage	Side	Type of Soil	CBR	OMC	MDD	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %	IS Classification
54+000	**RHS**	Dark Grey Clayey Silty Sand	12.9	12.5	1.901	35.6	27.12	8.48	0	51.99	28.81	19.2	SM-SC
55+000	**RHS**	Dark Grey Clayey Silty Sand	10.6	13.1	1.887	34.25	26.91	7.34	0	53.1	28.16	18.74	SM-SC
56+000	**RHS**	Dark Grey Clayey Silty Sand	10.5	13.6	1.887	34.69	24.87	9.82	0	45.96	27.99	26.05	SM-SC
57+000	**RHS**	Dark Grey Clayey Silty Sand	10.2	13.5	1.882	35.89	24.67	11.22	0	54.27	27.29	18.44	SM-SC

58+000	**RHS**	Light Yellow Clayey Silty Sand	12.6	13.4	1.859	36.85	24.89	11.96	0	53.69	28.95	17.36	SM-SC
59+000	**RHS**	Light Yellow Clayey Silty Sand	12.6	12.5	1.885	35.69	25.93	9.76	0	52.76	26.89	20.35	SM-SC
60+000	**RHS**	Light Yellow Clayey Silty Sand	12.6	12.5	1.89	35.22	24.86	10.36	3.99	48.03	27.86	24.11	SM-SC
61+000	**RHS**	Light Yellow Clayey Silty Sand	12.7	12.7	1.895	35.62	26.03	9.59	5.77	50.12	31.63	18.25	SM-SC
62+000	**RHS**	Light Yellow Clayey Silty Sand	13.8	12.5	1.902	35.68	23.69	11.99	0	53.96	27.56	18.48	SM-SC

63+000	**RHS**	Brownish Clayey Silty Sand	12.5	12.4	1.923	35.67	24.52	11.15	0	52.11	27.96	19.93	SM-SC
64+000	**RHS**	Greyish Silty Sandy Clay	8.4	14.5	1.806	45.27	18.43	26.84	0	32.76	26.97	40.27	SM-CI
65+000	**RHS**	Dark Grey Clayey Silty Sand	7.05	15.2	1.776	35.15	26.55	8.6	0	51.67	29.12	19.21	SM-SC
66+000	**RHS**	Dark Grey Clayey Silty Sand	12.8	12.4	1.903	35.45	26.78	8.67	0	52.6	28.45	18.95	SM-SC
67+000	**RHS**	Dark Grey Clayey Silty Sand	12.9	12.5	1.901	35.6	27.12	8.48	0	51.99	28.81	19.2	SM-SC

68+000	**RHS**	Greyish Silty Sandy Clay	7.9	14.6	1.825	43.62	18.39	25.23	0	32.61	24.2	43.19	SM-CI
69+000	**RHS**	Light Yellow Clayey Silty Sand	13.5	12.4	1.932	34.17	24.52	9.65	2.38	54.21	24.82	18.59	SM-SC