Republic of the Union of Myanmar
Ministry of Construction, PW

The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Soil Investigation Report

(PP-I)

December 2013

Japan International Cooperation Agency
（JICA）

Pegasus Engineering Corporation
Oriental Consultants Global Co., Ltd.

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PUBLIC WORKS

MINISRTRY OF CONSTRUCTION

REPORT
ON
SOIL INVESTIGATION
FOR
ROAD IMPROVEMENT ALONG
PYAPON – KYONKADUN – DAWNYEIN – AMAR,
PYAPON TOWNSHIP, AYEYARWADDY REGION
UNION OF MYANMAR

DECEMBER, 2013

Submitted by-

SARAMAYRI – FUJI CO., LTD

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1.0 INTRODUCTION

Geotechnical investigation is essential to determine substratum of ground where to do proper design required structure of building. The soil investigation is essential for construction of infrastructures because the stability of those structures mainly depends on foundation sub soil stability. The Public Work is trying to improve the road along Pyapone to Amar. Saramari - Fuji Co., Ltd. is assigned to conduct soil investigation works near Dawnyein Village.

1.1 Objective of Project

The soil investigation conducted during this project phase intends to –

- To evaluate the long term stability of existing road condition
- To identify the thickness and extension of sub stratum around proposed structures
- To evaluate the physical and mechanical properties of soil strata lying proposed area
- To recognized the soil design parameter for foundation work and soil improvement work.

1.2 Scope of Work

The scope of investigation works includes three portion; field investigation work, laboratory testing and report preparation. The field investigation work includes soil boring, Standard Penetration Test (SPT) and field density test. There are two boring points and the depth of borehole is 30m. Standard penetration tests were performed in all the boreholes of designated locations in comply with ASTM Standard. Two soil field density tests are carried out along the road. The collected disturbed and undisturbed soil samples from the boreholes were tested at Saramayri – Fuji Co., Ltd. Laboratory.

(1) Field Works

Boring is carried out by TOHO-D1 drilling machines.

- Boring in soil
- Standard Penetration Test
- Soil sampling
- Water level measuring
- Field density testing

(2) Laboratory Test

- Physical and mechanical property test of soil

(3) Reports

1. Geotechnical Assessment Report

All the field investigation works were carried out in accordance with ASTM Code of Standard and the units are applied Metric System.

1.3 Project Location

The project area is located along Pyapon – Amar Road, near Dawneyin Village, Pyapon Township, Ayeyarwaddy Region. The location of project area is indicated as figure (1-1) and detail location of project site.

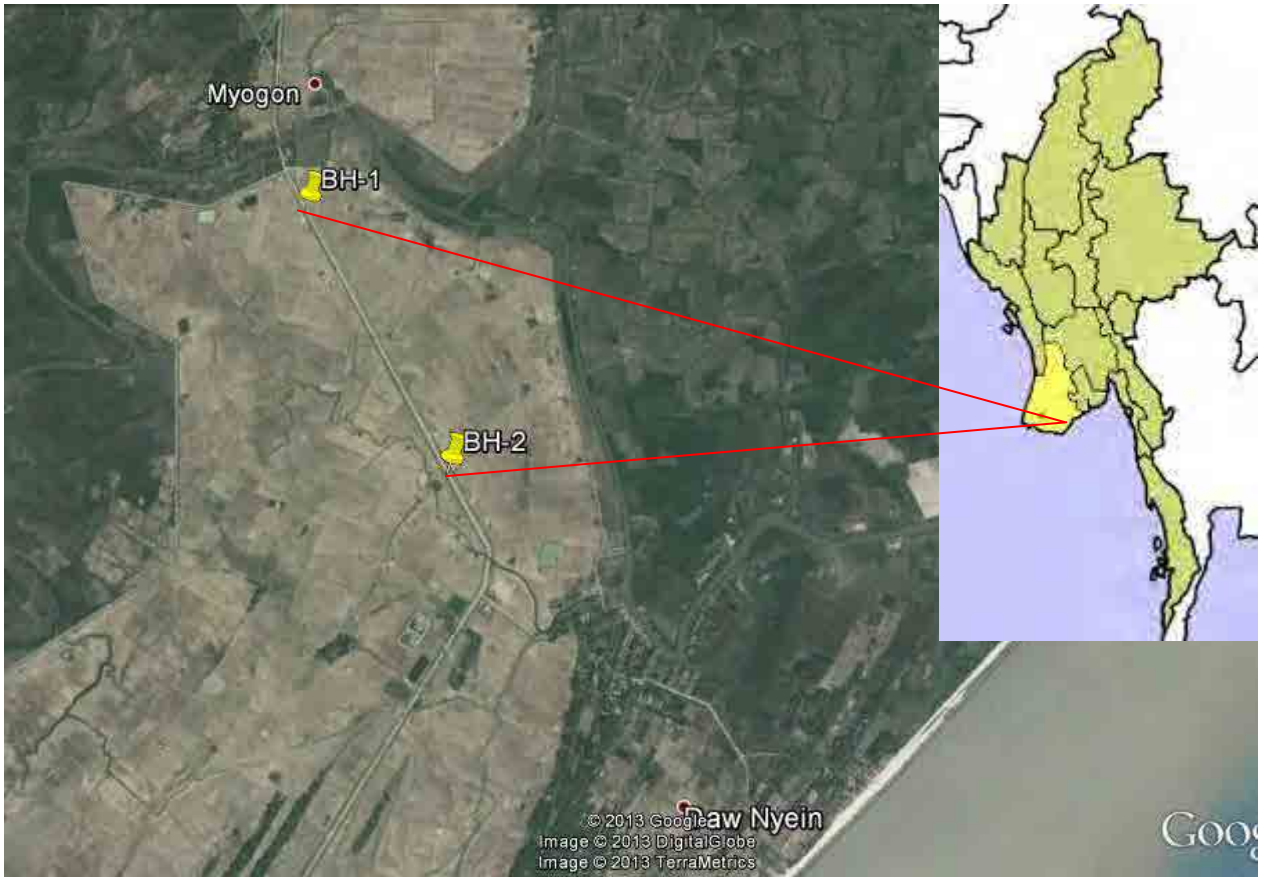


Figure - 1.1 Location Map of Project Area

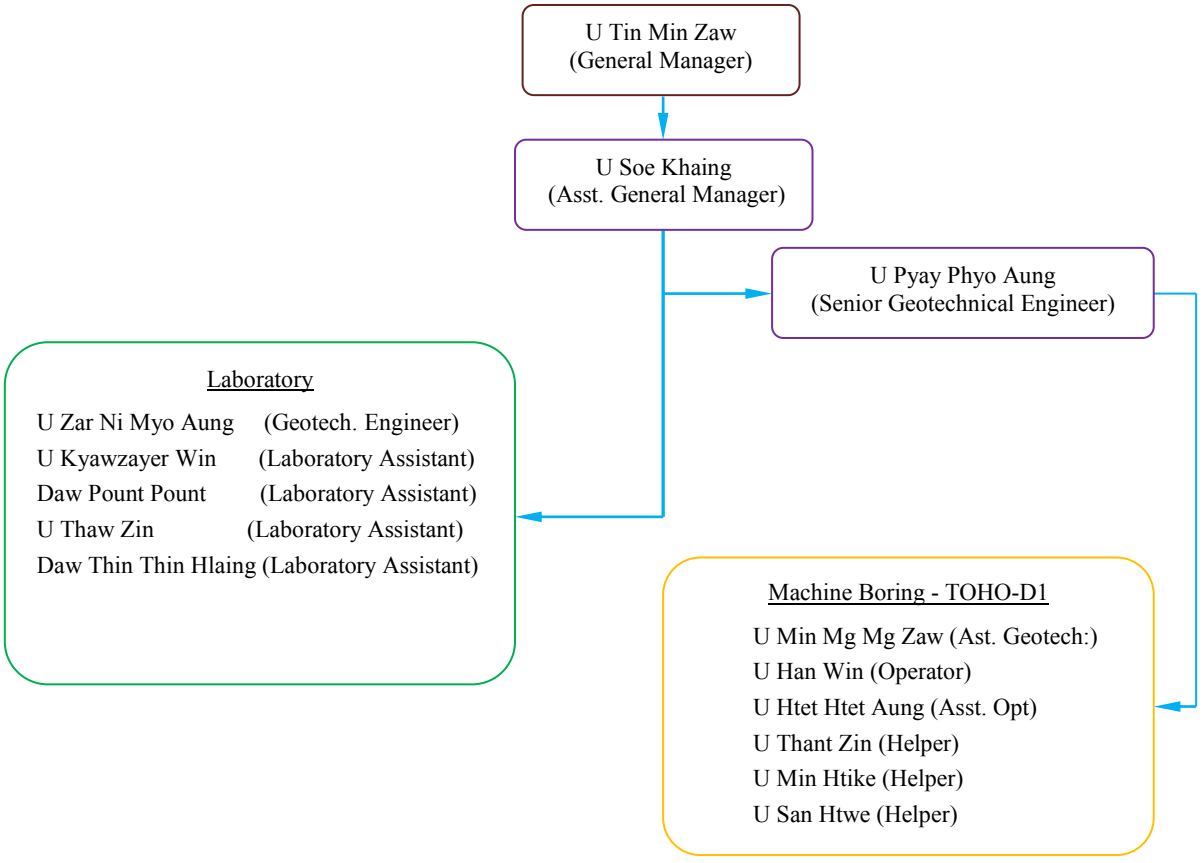
1.4 Project Duration and Personnel

The investigation works was started from 23rd October, 2013 and completed two Boreholes on 27th October, 2013.

The executed detailed actual working schedule is illustrated in table (1-1) respectively, indicating the organization chart of personnel of the operation and their responsibilities, including list of geotechnical engineers, drilling crews for one boring machine, technicians and the entire person involved in this operation.

Table - 1.1 Actual Working Schedule of Geotechnical Investigation Work

No.	Description	October-2013											November-2013								December-2013							
		21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	~	28	29	30	1	2	3	4	~	25	26	27
1	Preparation																											
2	Mobilization																											
3	Field Investigation				BH-02																							
							BH-01																					
4	Field Density Test																											
5	De-mobilization																											
6	Laboratory Testing																~											
7	Report Preparation																											
8	Final Report Submission																											



Flow Chart - 1.1 Organization Chart of Responsible Person

1.5 Equipment Applied in the Project

1.5.1 Boring Equipments

The boring equipment, TOHO-D-1 was applied in the soil investigation work of project area, to study general condition of soil layers under planned area for future construction. The specification and the type of boring equipment were presented in following table.

Table - 1.2 Specification of Boring Equipment

Parts of Equipment	*Particulars*
Brand of Boring machine	TOHO- "D-1"
Boring Type	Rotary
Feeding Type	Hydraulic Feed Type
Drilling Capacity	150m
Spindle Stroke	400mm
Spindle Inner Dia.	43mm
Hoisting Speed	10~59m/min
Weight	476kgf
Oil Pump Delivery Capacity	19 l/min
Oil Pump Working Pressure	45~70kgf/cm^2
Attached Water Pump Type	Toho "BG-3B"
Discharge Capacity	54 l/min
Working Pressure	15 kgf/cm^2
Engine	Yamar Engine 110
Power	11.0 HP

Photo - 1-7 TOHO D-1 Drilling Machine

1.5.2 Laboratory Instruments

The principal instrument applied for soil laboratory tests are as shown in the following table.

Table - 1.3 Applied Laboratory Instruments

Instrument Name	Manufacturer and Type
1. Electric Balance	SARTORIUS 1404B (MP8-1)
2. Atterberg's Limit Test Apparatus	MARUI 1115013
3. Test Sieve	TOKYO SAITAMA (JIS Z 8801)
4. Unconfined Compressive test Apparatus	MARYI 19047 (Automatic recording type)
5. Direct Shear Test (CU or UU)	YF – STZ JY – 6
6. Consolidation Test	YF – WG – 1B

Photo - 1.1 Laboratory Instruments for Physical Properties Tests

2.0 SITE CHARACTERIZATION

2.1 Topography

As the project area located at the delta region of Ayeyarwaddy Region, flat lying flood plain feature is dominated. Very low relief levee are observed near river or creek. In general the topography of the project area is flat with very thick soil deposit.

The typical drainage pattern is braded channel. The channels are meandering and it show old age state of river.

Photo - 2.1 Topographic feature of the project area

2.2 Regional Geologic Setting

The Ayeyarwaddy Delta is mainly composed of interfacies of flood plain deposit and marine deposit. Silt and clay is flood plain deposit and sand is marine deposit. In project area, the flood plain deposit covers the whole area and thicker than 30 m. The ayeyarwaddy delta is located between Western fold belt and Central Burma Basin. The bed rock is difficult to estimate, because the deposits are very thick in this region. There are two active fault which run more than 100 km away from project area; the Sagaing Fault and the Andaman Trust.

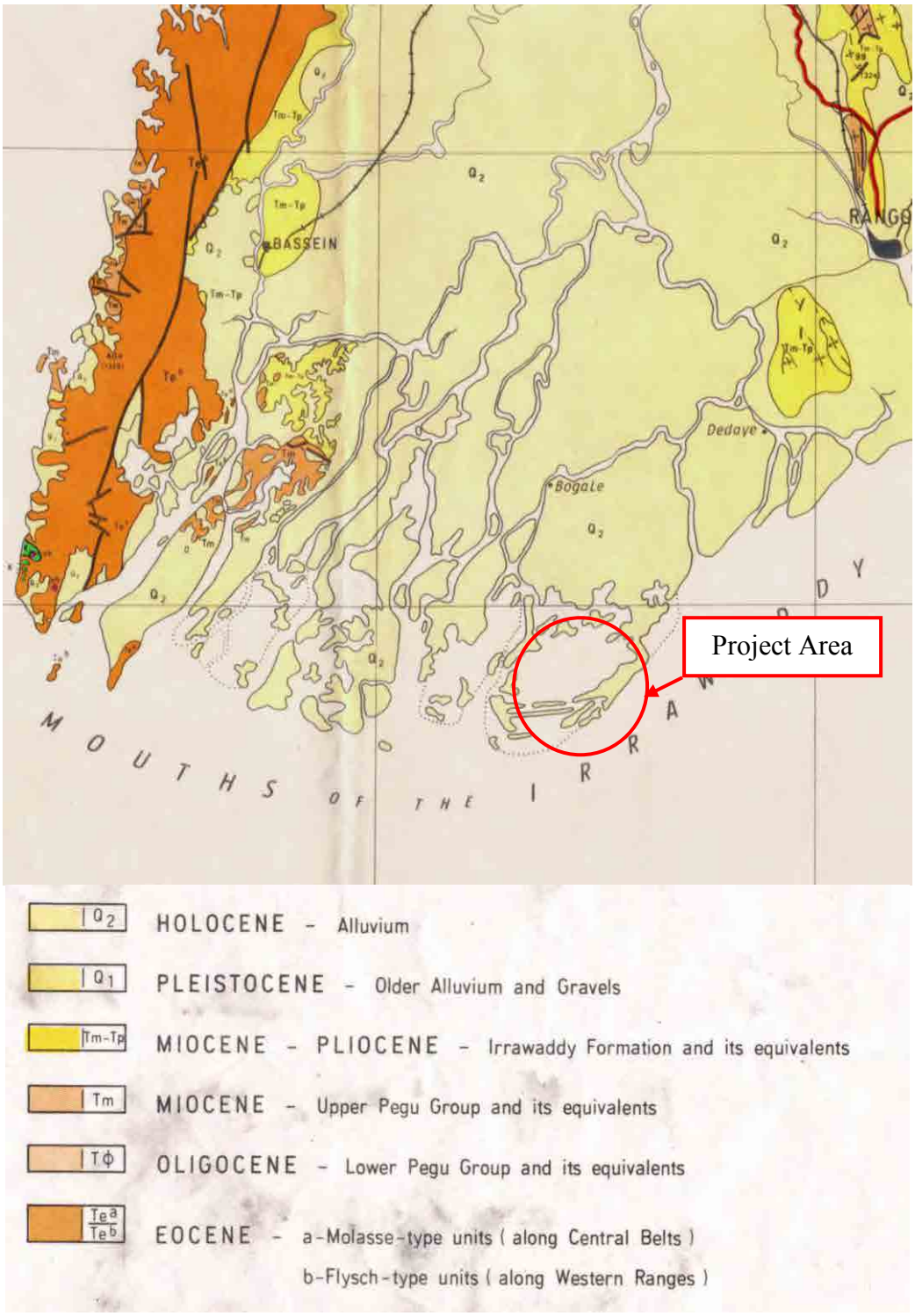


Figure - 2.1 Regional Geological Map of Project Area

2.3 Natural Vegetation and Landuse

The natural vegetation grows along the channels. The natural vegetation is tidal plants, mostly are bushes and small trees. The land almost covers with paddy fields, and residential area is sparsely located where the good accessible area.

3.0 FIELD INVESTIGATION

3.1 Investigation Works

The objective of the present investigation is to identify the general stratification of the ground and the nature of the soil. Two boring points were planned to investigate by the client's requirement. The field investigation included soil boring with the performing of the test associated with Standard Penetration Test (SPT), disturbed soil sampling, Undisturbed soil sampling and water level measuring. In addition field density test is carried out in test pit of 0.5m depth at selected area. Total boring length is 60 m and the total quantity of investigation work is listed in Table – 3.1.

Table - 3.1 : Total Quantity of Boring Work

No.	BH. No.	Soil drilling (m)			Standard penetration test (No.s)	Undisturbed sampling (No.s)	Water level measure	Water sample (No.s)
		Diameter (ø)		Sub- total				
		115 mm	64 mm					
1	BH-1	3	27	30	27	**3**	1	-
2	BH-2	3	27	30	27	**3**	1	
Total		**6**	**54**	**60**	**54**	**6**	**2**	-

3.2 Location of Boring Points

The locations of investigation points of boring points were designated by Client. The first point is located near Myogone Village and another one is located north of Dawnyein Village. The boring point is shown in Table-3.2.

Table - 3.2 : The Location of Boring Points

Borehole	Easting (m)	Northing (m)	Zone	Elevation (m)
BH-01	777313	1763141	46P	99.917
BH-02	778178	1761613	46P	99.772
SF	777312	1763142	46P	100.000

Photo - 3.1 Temporary Bench Mark (SF) near BH-01

3.3 Boring Works

In boring, rotary direct circulation method is appropriately applied using metal crown bits attached to casings of 115mm and metal crown bits of Ø 64 mm in diameter setting with single core tube are properly applied depending on soil condition to drilling process. The drilling machines are operated by setting on the stage with maintaining horizontal level of drilling machine and vertical position of drilling direction while drilling on field investigation works. Boring and SPT testing in all the points are operated from drilling stage maintaining the stability of boring machine. In the way of direct circulation of drilling fluid, water and betonies slurry was inevitably utilized to control the circulation of the sludge. The schematic diagram of boring equipment is shown in following Figure – 3.1.

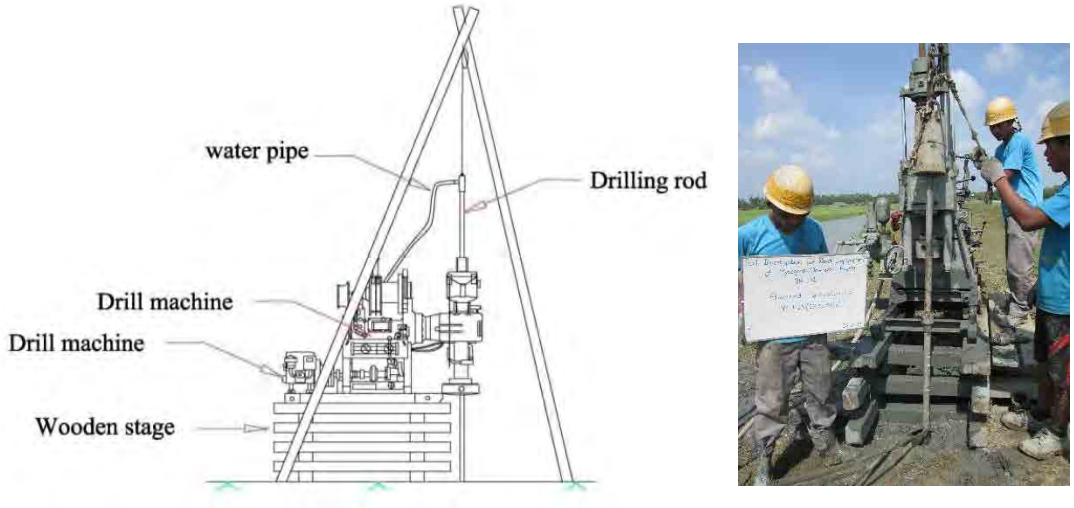


Figure - 3.1 : Schematic View of Drilling Machine setting

3.4 Standard Penetration Test (SPT)

The standard penetration test was done in accordance with *(American Society of Testing and Material; ASTM) Standard D1586.* The test was performed using a spilt barrel sampler (50mm diameter) connected to the end of boring rods. The sampler was driven into the soil by means of a 63.4 kg (140 lbs) hammer falling freely through the height of 76 cm on to the anvil attached to the rod. The sampler is driven 450 mm into the soil. SPT N value is recorded for each 150 mm penetration of the sampling tube. In this case, seating drive of 150mm is first reached and the blow count for the seating drive is not applied because the bottom of the hole may be apart from natural condition at a certain extent. The resistance, N-value, is taken as number of blow for the penetration of test drive of next 300 mm. When 50 blows are reached before the full penetration 300 mm, no other blows are applied but final penetration is recorded. At the conclusion of the test, the retained soil sample is extracted and stored in plastic bag for further analysis. In which, Figure – 3.2 indicates the procedure and apparatus of standard penetration test. The distribution of N-value for each stratum is summarized in Graph - 3.1.

Photo - 3.2 : View of Standard Penetration Test and SPT Sample

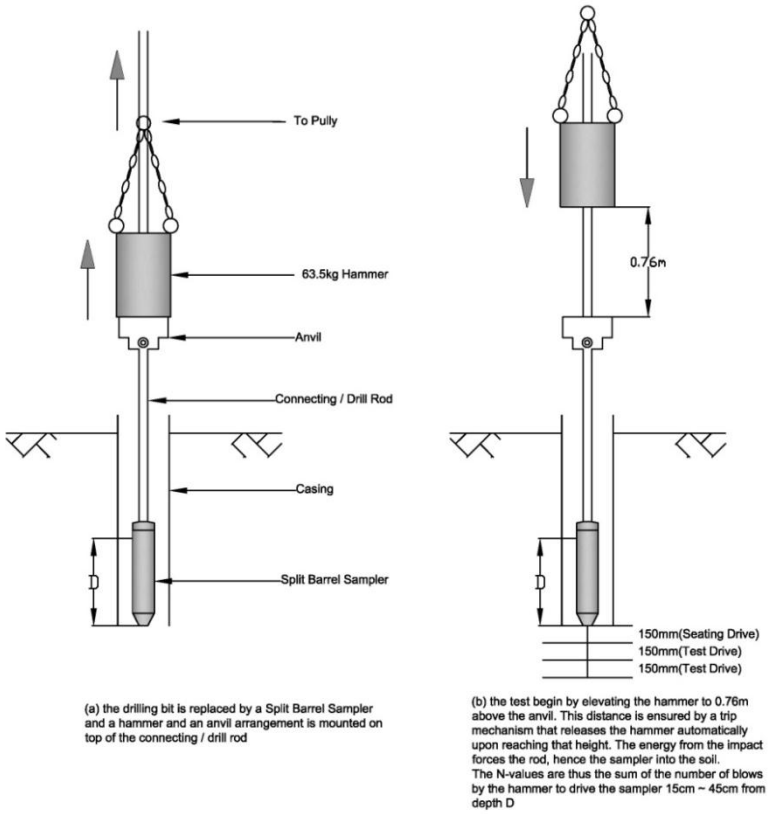
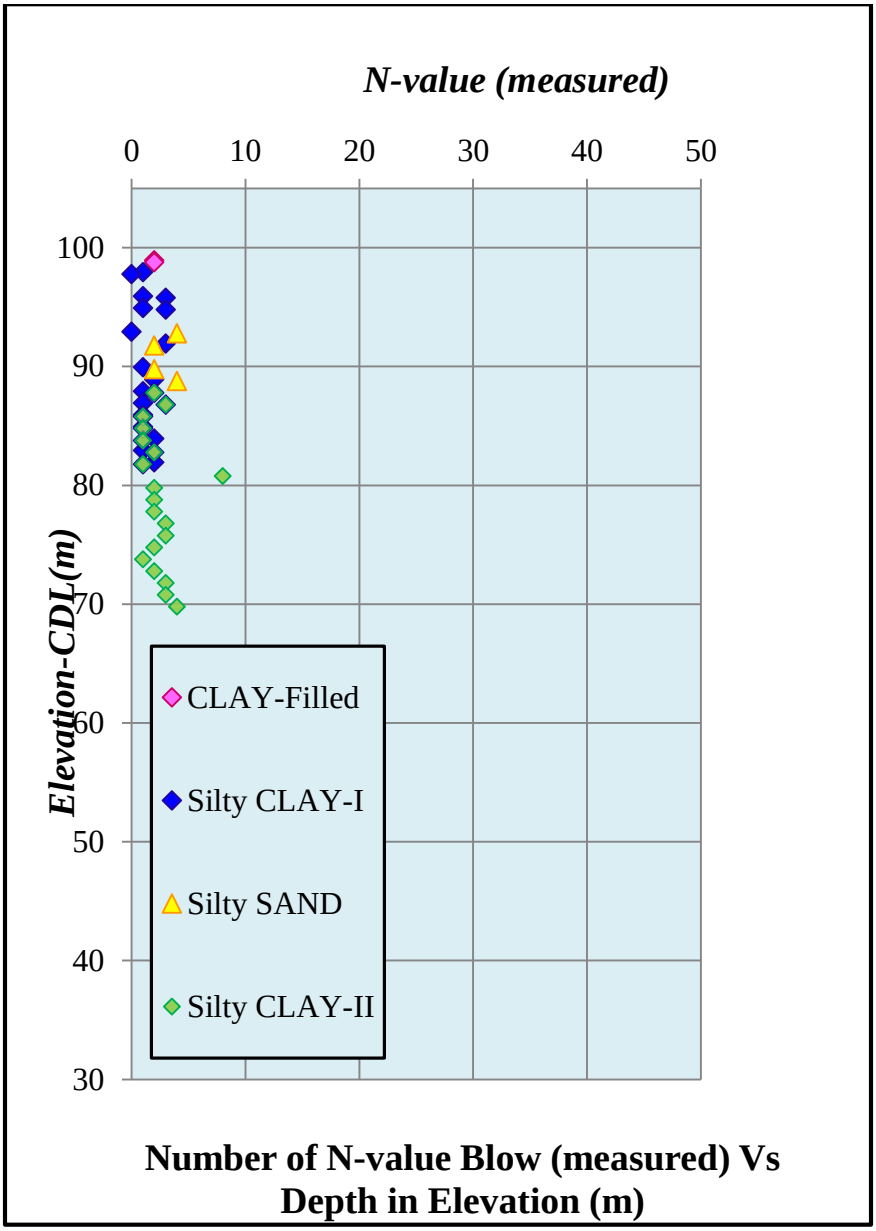


Figure - 3.2 : Procedure and Apparatus of Standard Penetration Test



Graph - 3.1 : Number of N-Value (measured) vs Depth in elevation level relationship

Table - 3.3 : The List of SPT N value in Specific Soil Layer

Soil Name	SPT – N			
	Minimum	Maximum	Average	Represented N
Clay (Filled)	2	2	2	2
Silty Clay 1	0	3	1	1
Silty Sand	2	4	3	3
Silty Clay 2	1	8	2	2

Table - 3.4 : Comparison for SPT in different standards

Items to be Compared			JIS A 1219 (1995)	ASTM D 1586-84 (1992)	BS 1377 Test 19 (1990)
Testing Equipment	Rod	Length Less than 15m	JIS Rod (Outer diameter 40.5/42mm)	A Rod (Outer Diameter 41.2mm,Inner Diameter 28.5mm)	AW Rod (Outer Diameter 41.3mm, Mass 5.7kg/m)
		Length More than 15m		Recommend to use more rigid rod.	BW Rod or centerizer in every 3 m shall be installed with of AW Rod.
		Bend	-	-	-
	Sampler	Outer Diameter	51mm	50.8±1.3mm	50±0.15mm
		Inner Diameter	35mm	35.0mm	35±0.15mm
		Total Length	810mm	482~812mm (Sampler head is not included)	685mm
		Angle of Shoe edge	19°47′	16~23°	17°15′
		Thickness of Shoe edge	1.15mm	2.54mm	1.6mm
		Drain Hole	4 Hole	Ø9.2mm×2 holes	Ø13.0mm x 4 holes
		Ball Value	-	Hole Ø22.2mm, Ball : Ø25mm	Hole: Ø22.3mm, Ball: Ø25mm
	Hammer	Mass	63.5 kg	63.5±1.0kg	65kg
		Drop	75 cm	76±2.5cm	76cm
	Anvil		h:60mm D:75mm	-	-
Remarks on Testing Borehole	Applicable Diameter of Borehole		65~150mm	56~162mm	-
	Water Level in Borehole		Pay attention not to disturb the soil below the bottom of the hole	Ground water level shall be kept above the water table when the SPT is carried out under water table.	Ground water level shall be kept above the water table when the SPT is carried out under water table.
	Drilling Bit Type			Water jet type bit shall not be used.	Water jet type bit shall not be used.
	Appropriateness for Drilling by Sampler			Sampler with water jet shall not be used for drilling.	-
	Points to note when casing pipes are used			Casing Pipe shall not be below than bottom of hole.	Casing Pipe shall not be below than bottom of hole. Clearance between casing pipe and core tube shall be more than 10% of inner area of casing pipe section.
	Gushed water and water loss			Pump pressure during drilling shall be recorded if water loss is found.	Pay attention on gushing and water loss.
Penetration Test	Penetration	Seating Drive	15cm	15cm	15cm
		Test Drive	30cm	30cm	30cm
		Finishing Drive	0~5cm	-	-
	Maximum blow Counts		50 blows for Test Drive	100 times including seating drive	50 times excluding seating drive.
	Record of blow counts	Blow Counts during test Drive	Total penetration for Test Drive. However, in case penetration per blow is less than 2 cm, blow counts every 10 cm. Shall be recorded.	Blow counts in every 15cm penetration including seating drive.	Blows counts in every 7.5cm penetration for test drive.
		In Case 30cm penetration cannot be achieved.	penetration for 50 blow counts	Blow counts equivalent blow counts for last 30cm penetration including seating drive.	Penetration for 50 blow counts in Test blow.
	Way to drop the hammer		Free drop	Full Automatic or semi automatic drop system or Cone pulley (Pulley Diameter : 150~200mm, number of wind of rope : Less than 2-1/4)	Recommend the free drop. Pay attention on friction between winch and rope.
Applicable	Soil Types for the Test		All kinds of soils	All kinds of Soils	Mainly for Sandy Soil.
	Application for gravel and sandy gravel layer		-	-	Test shall be done by replacing the shoe to cone with 60° of edge angle.
	Testing Interval in deep		Generally 1.0m interval is adapted but not prescribed in the standard.	-	-

3.5 Filed Density Test

The sand cone method is applied for filed density test for existing embankment. The pit was excavated up to 0.5 m depth for conducting field density test. Two points near boreholes are carried out for field density test. The test was conducted according to *ASTM D 1556 – 00; Standard test method for density and unit weight of soil in place by the sand-cone method*.

The test is carried out as following method. Firstly, a test hole is hand excavated in soil to be tested and all the material from the hole is saved in a container. The hole is filled with free flowing sand of known density, and the volume is determined. The in-place wet density of the soil is determined by dividing the wet mass of removed material by the volume of the hole. The water content of the material from the hole is determined and the dry mass of material and the in-place dry density are calculated using the wet mass of the soil, the water content and the volume of the hole. The detail test result is indicated in Appendix-B. The table 3.5 indicates the summary of field density test result.

Table - 3.5 : Summary of Field Density Test Result

Location	Moisture Content (%)	Bulk Density kN/m³	Dry Density kN/m³
Start Point (near BH-01)	30.40	17.06	13.04
End Point (near BH-02)	31.50	18.24	11.18

Photo - 3.3 : View of Carrying out Filed Density Test

3.6 Characteristics of Soil Strata Relying on Field Test

There has been carried out two boreholes which is maximum depth of 60 m with the performance of Standard Penetration Tests. In this operation, total four numbers of different layers have been recognized. The soil layers are classified in accordance with their physical properties and/or their relative density. The boring logs are attached at Appendix-A. The four different layers observed in project area are described from top to bottom as follows.

1. Clay (Filled Material)
2. Silty Clay 1
3. Silty Sand

4. Silty Clay 2

Clay (Filled Material)

As the soil investigation is carried out on the unpaved road, the filled layer is firstly observed. The filling material is almost composed of clay. It is soft, mottled brown and gray, wet to moist, low to medium plastic clay with traced of wood fragments. The thickness is 2m.

Silty Clay 1

Silty Clay 1 layer is observed in both BH-01 and BH-02. The thickeness of silty clay in BH-01 is about 17 m. In BH-02, two layers of silty clay 1 is observed. The silty sand layer is interbedded between upper and lower layer. The upper layer is 5m thick whereas the lower layer is about 7m thick. It is very soft to soft, gray, wet to moist, low to medium plastic silty clay with organic matter. It is flood plain deposit and some lamination of sand layers are observed among the silty clay layer.

Silty Sand

This layer is found only in borehole BH-02. It is interbedded within Silty Clay 1 layer. The thickness about 5 meter. It is very loose, gray, moist, fine grained silty sand with clay patches.

Silty Clay 2

The silty clay 2 layer is observed in both BH-01 and BH-02. The thickness is difficult to estimate, because the borehole is terminated at that layer. It is very soft to firm, gray, moist, low to medium plastic silty clay with traced of fine sand and mica mineral. It is differ from Clay 1 is its consistency.

4.0 LABORATORY TEST

There has two number of investigations boring points, total 54 numbers of standard penetration tests (disturbed samples) and 6 numbers of undisturbed sample (thin wall piston sample) were collected in this field investigation at project site. The undisturbed samples and some selected numbers of disturbed samples were sent to office laboratory to test for physical property tests, as well as mechanical property tests. The total quantities and results of laboratory tests carried out are listed in the table, below and detail laboratory results are expressed in Appendix - C. The entire tests were carried out in accordance with *(American Society of Testing and Material; ASTM)*.

The physical properties tests include the following items.

- Natural Moisture Content Test
- Specific Gravity Test
- Particle Size Analysis Test
  - Grain Size Distribution Test
  - Hydrometer Test
- Atterberg's Limits Test
  - Liquid Limit Test
  - Plastic Limit Test

The mechanical properties tests consist of –

- Unconfined Compression Test
- Direct Shear Test
- One Dimensional Consolidation Test

Total quantity of laboratory tests are described in Table – 4.1 and summary of laboratory test results for each borehole are illustrated in Table – 4.2.

Table - 4.1 : Total Quantity of Laboratory Tests

Bore Hole	Physical Properties Test						Engineering Properties Test			Chemical Test
	Natural Moisture Content Test	Specific Gravity Test	Particle Size Analysis Test		Atterberg's Limit Test		Unconfined Compression Test	Consolidation Test	Direct Shear Test (UU)	Water Quality Test
			Sieve Analysis Test	Hydrometer Analysis Test	Liquid Limit Test	Plastic Limit Test				
BH-01	9	9	9	9	9	9	3	3	2	1
BH-02	9	9	9	9	9	9	3	3	2	1
Total	**18**	**18**	**18**	**18**	**18**	**18**	**6**	**6**	**4**	**2**

Table - 4.2 : Summary of Laboratory Test Result

BH No.	Sample No.	Depth		Soil Type	Water Content	Specific Gravity	Grain Size Distribution				Atterberg's Limit			Bulk Density	Direct Shear Test		One Dimensional Consolidation Test			Compression Test	
		GL - (m)	EL; (m)		W	Gs	Gravel	Sand	Silt	Clay	LL	PL	PI	ρt	Cuu	ϕuu	eo	Py	Cc	qu	εf
					(%)		(%)	(%)	(%)	(%)	(%)	(%)	(%)	g/m³	kN/m²	Degree		kN/m²		kN/m²	(%)
BH-01	P-1	1.00	98.92	CH	48.45	2.776	-	0.25	57.35	42.40	69.50	26.86	42.64	-	-	-	-	-	-	-	-
	T-1	3.00	96.92	ML	48.89	2.736	-	16.90	58.80	24.30	48.27	30.36	17.91	1.738	34.52	16.96	1.56	111.21	0.64	33.78	4.66
	T-2	6.00	93.917	CL/or)ML	44.40	2.741	-	2.04	76.26	21.70	36.10	23.52	12.58	1.758			1.34	97.76	0.31	37.27	6.94
	T-3	9.00	90.92	CH	55.45	2.748	-	1.05	48.95	50.00	59.80	23.98	35.82	1.703	6.28	35.75	1.32	254.58	0.35	48.15	4.86
	P-9	12.00	87.92	CH	48.23	2.742	-	1.85	58.45	39.70	50.07	22.23	27.84	-	-	-	-	-	-	-	-
	P-13	16.00	83.92	CL	37.52	2.742	-	18.88	52.13	29.00	43.30	19.53	23.77	-	-	-	-	-	-	-	-
	P-18	21.00	78.92	CH	49.99	2.759	-	1.98	48.73	49.30	62.44	23.68	38.76	-	-	-	-	-	-	-	-
	P-23	26.00	73.92	SC	30.79	2.745	-	51.32	30.58	18.10	35.72	18.04	16.78	-	-	-	-	-	-	-	-
	P-26	29.00	70.92	CL	41.01	2.755	-	13.38	52.63	34.00	49.07	21.00	28.07	-	-	-	-	-	-	-	-
BH-02	P-1	1.00	98.77	CH	48.07	2.806	-	0.72	60.58	38.70	68.28	25.65	42.63	-	-	-	-	-	-	-	-
	T-1	3.00	96.77	CH	54.59	2.747	-	1.53	54.68	43.80	65.70	27.53	38.17	1.677	11.67	12.24	1.81	58.84	0.75	32.31	7.90
	T-2	6.00	93.77	CH	54.39	2.756	-	0.92	53.08	46.00	68.20	26.90	41.30	1.708			1.51	223.49	0.46	48.64	3.70
	T-3	9.00	90.77	MH	60.57	2.639	-	1.95	58.45	39.60	75.34	39.11	36.23	1.587	19.81	8.53	1.52	102.97	0.57	63.55	7.19
	P-10	13.00	86.77	CL	41.47	2.748	-	6.85	62.05	31.1	45.3	22.35	22.95	-	-	-	-	-	-	-	-
	P-13	16.00	83.77	CH	43.40	2.760	-	10.75	57.45	31.80	50.78	22.53	28.25	-	-	-	-	-	-	-	-
	P-16	19.00	80.77	CL	34.13	2.726	-	35.54	52.06	12.4	32.18	22.28	9.9	-	-	-	-	-	-	-	-
	P-20	23.00	76.77	CL	36.60	2.747	-	19.48	48.43	32.10	48.20	21.33	26.87	-	-	-	-	-	-	-	-
	P-25	28.00	71.77	CH	40.98	2.763	-	10.18	58.73	31.10	57.92	24.28	33.64	-	-	-	-	-	-	-	-

4.1 Index Property of Soil

Physical property tests are done for investigation. The detail laboratory test results are illustrated in Appendix – C.

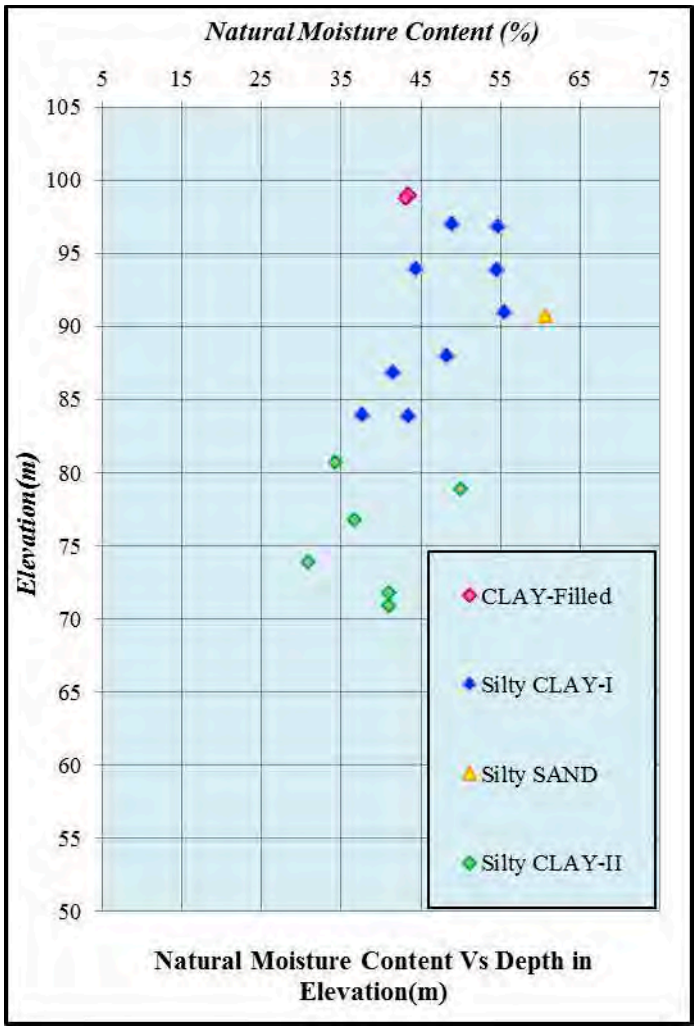
4.1.1 Natural Moisture Content Test

18 numbers of natural moisture content tests have been carried out on soil samples for required four different soil layers at our laboratory in accordance with ASTM Standard. The table-4.3 illustrates the summary of natural moisture content in each soil layers. The photograph of testing natural moisture content is shown in Photo-4.1 and the variation of water content with depth in elevation can be seen in Graph-4.1. The detail laboratory test results are illustrated in Appendix – C.

Photo - 4.1 Natural Moisture Content Test

Table - 4.3 Summary of Natural Moisture Content of Test Results

No.	Soil Type	Natural Water Content (%)	
		Range	Average
1	Clay (filled)	43.10 ~ 43.50	43.30
2	Silty Clay 1	37.50 ~ 55.50	47.60
3	Silty Sand	60.57	60.57
4	Silty Clay 2	30.80 ~ 50.00	38.90



Graph - 4.1 : Natural moisture content (%) vs Depth in elevation level relationship

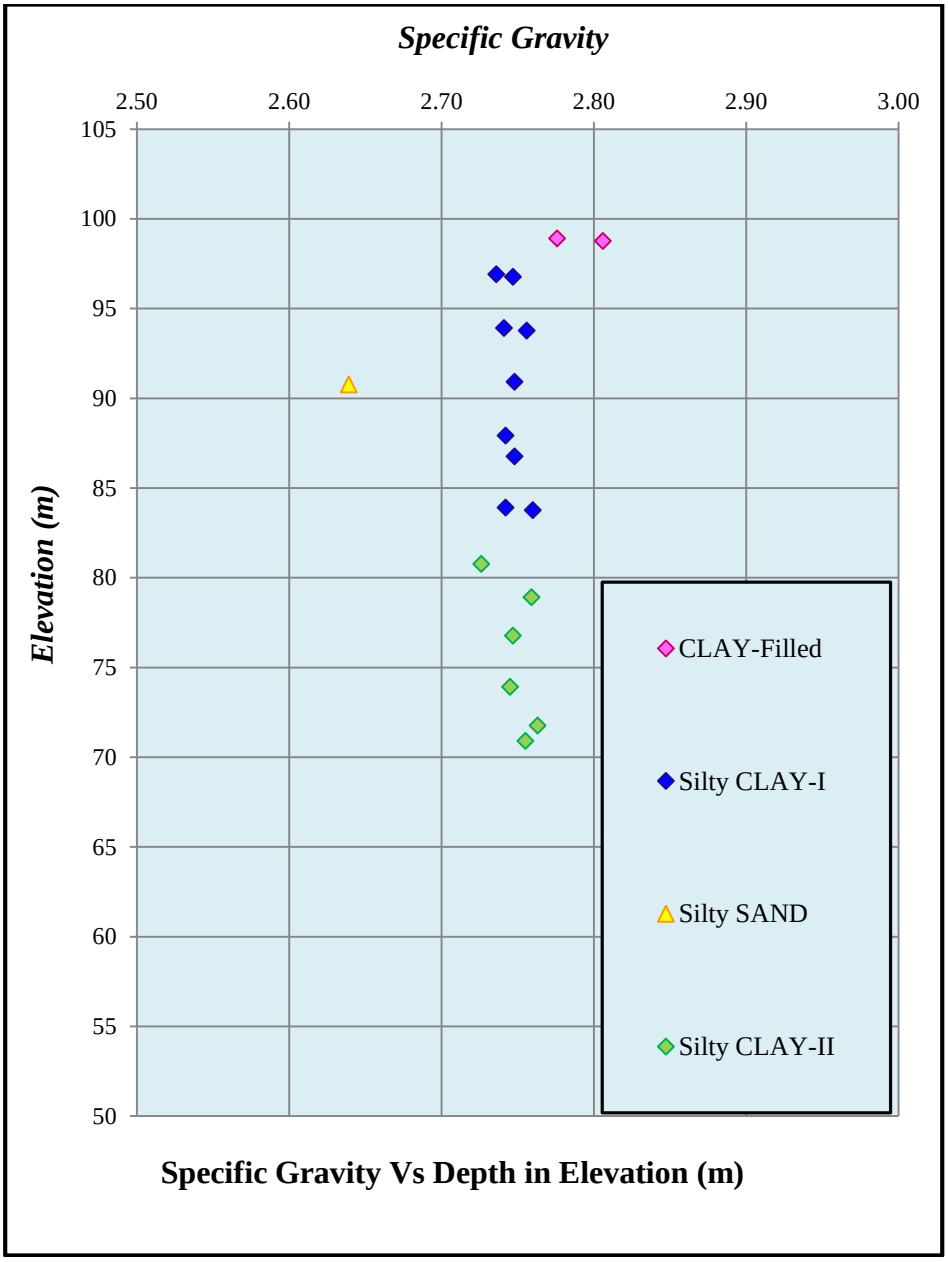
4.1.2 Specific Gravity Test

The specific gravity tests in this project were carried out in accordance with ASTM Standard at office laboratory. There have been (18) numbers of specific gravity tests. The table - 4.4 illustrates the summary of specific gravity for each soil layers. The photograph of testing specific gravity is shown in Photo-4.2, and the relationship between specific gravity and depth in elevation of each soil layer is shown in Graph-4.2. The detail test results were described in Appendix-C.

Photo - 4.2 Specific Gravity Test

Table - 4.4 Summary of Specific Gravity Test Results

No.	Soil Type	Specific Gravity	
		Range	Average
1	Clay (filled)	2.776 ~ 2.806	2.791
2	Silty Clay 1	2.736 ~ 2.760	2.747
3	Silty Sand	2.639	2.639
4	Silty Clay 2	2.726 ~ 2.763	2.749



Graph - 4.2 : Specific Gravity vs Depth in elevation level relationship

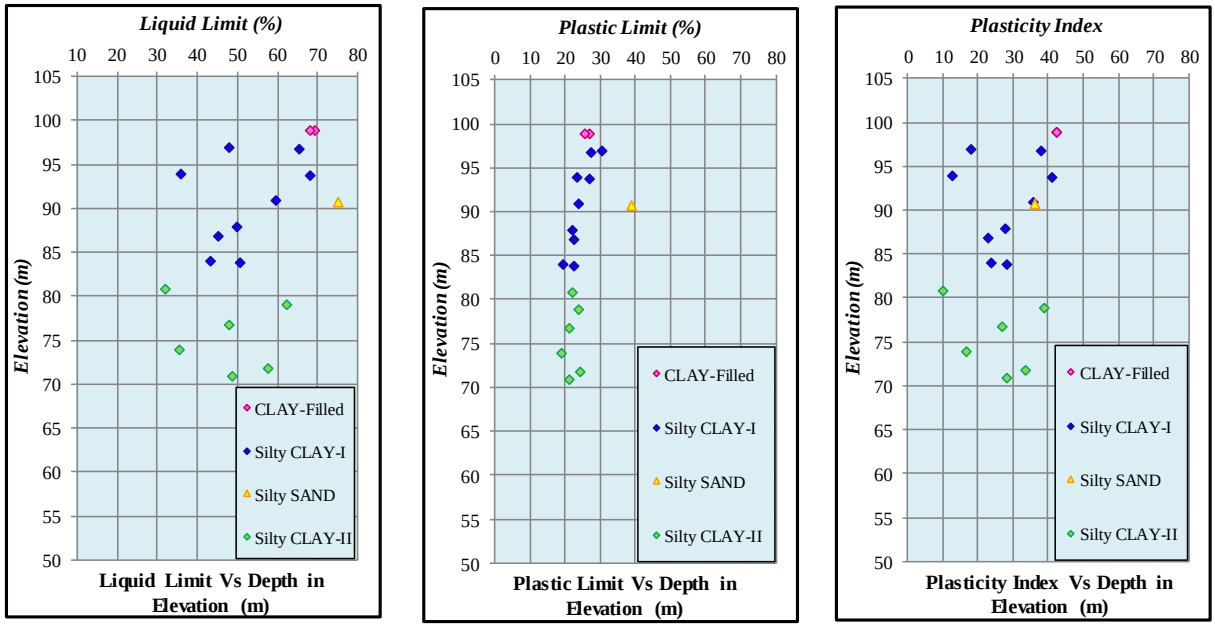
4.1.3 Atterberg's Limit Test

The Atterberg's Limit tests were made on (18) numbers for liquid limit tests and (18) numbers for plastic limit tests of specimens from disturb and undisturbed samples by ASTM Standard at office laboratory. The summary of Atterberg's Limit Test result is shown in Table - 4.5. Graph-4.3 illustrate the Plastic Limit, Liquid Limit and Plasticity Index of each soil layer versus depth in elevation and Graph-4.4 shows condition of soil in project area by ranges in plasticity chart. The photograph of testing is shown in Photo-4.3. The details of test results were shown in Appendix – D.

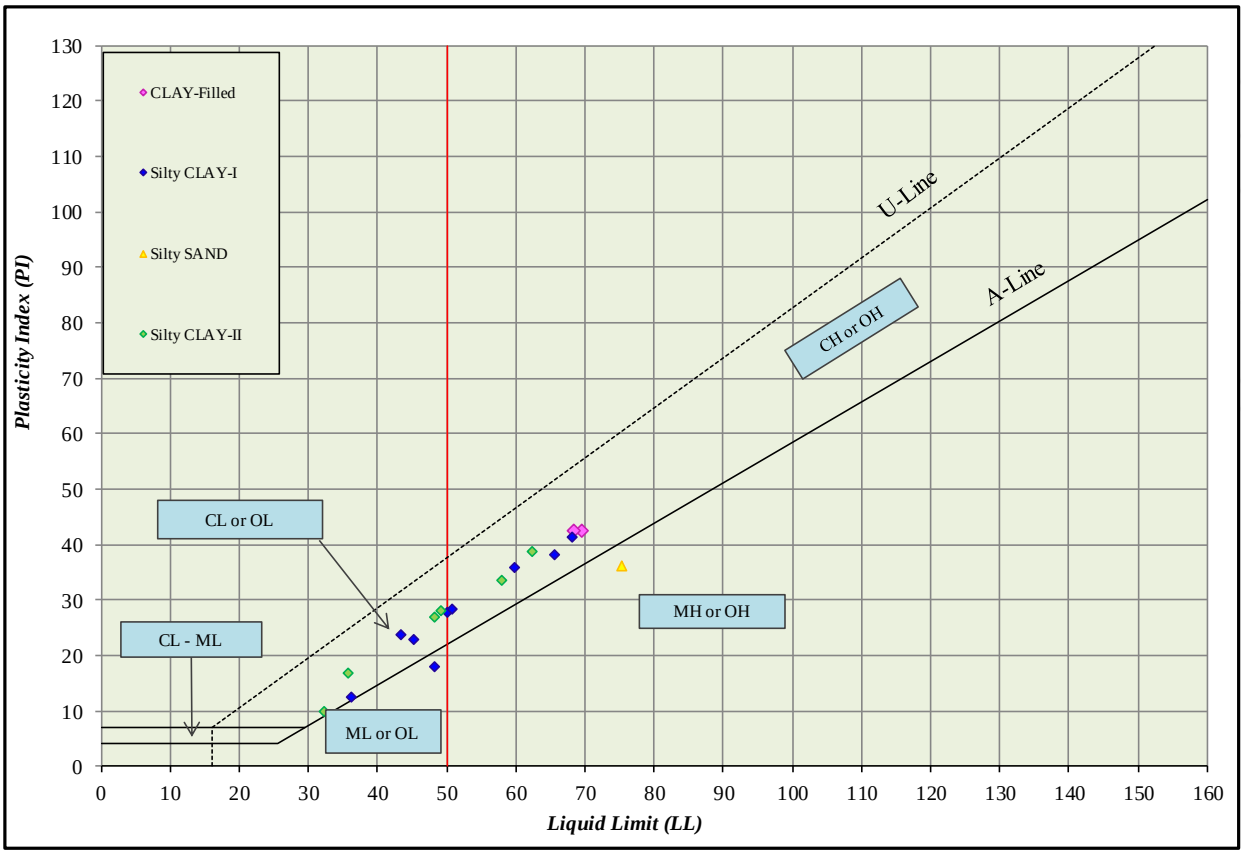
Photo - 4.3 Atterberg's Limit Test

Table - 4.5 Summary of Atterberg's Limit Test Result

	Soil Type		Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
Atterberg's Limit Test	Clay (filled)	Range	68.28 ~ 69.50	25.65 ~ 26.86	42.63 ~ 42.64
		Average	68.89	26.26	42.64
	Silty Clay 1	Range	36.10 ~ 68.20	19.53 ~ 30.36	12.58 ~ 41.30
		Average	51.90	24.33	27.62
	Silty Sand	Range	75.34	39.11	36.23
		Average	75.34	39.11	36.23
	Silty Clay 2	Range	32.20 ~ 64.40	18.94 ~ 24.28	9.90 ~ 38.76
		Average	47.60	21.92	25.67



Graph - 4.3 Plastic Limit, Liquid Limit and Plasticity Index vs Depth in Elevation (m)



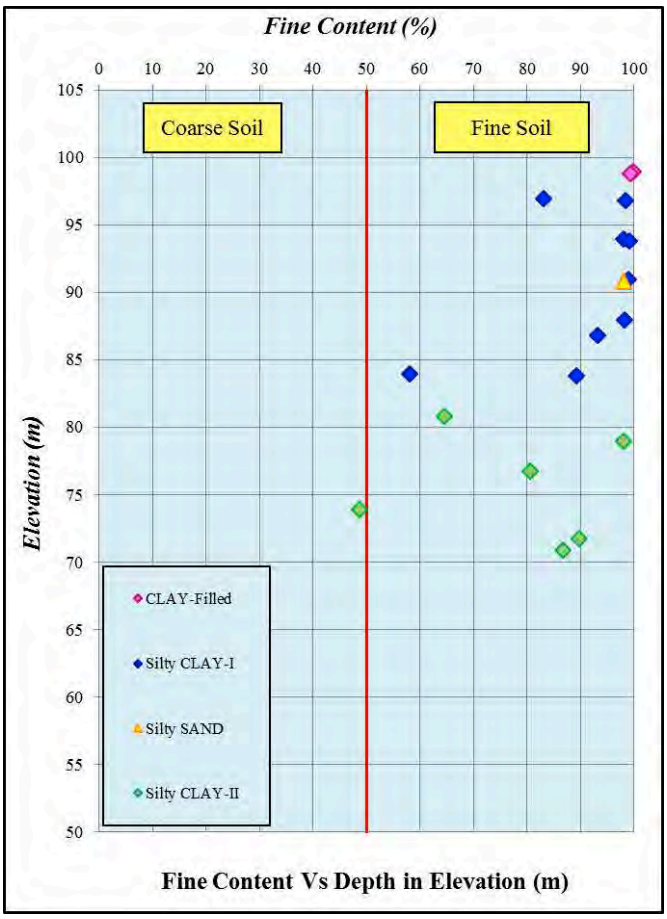
Graph - 4.4 Condition of Atterberg's Limit Test Results

4.1.4 Grain Size Analysis Test

Soil classifications or grain size distribution test were done by ASTM Standard. In this project, (18) numbers of sieve analysis tests including (18) numbers of hydrometer tests were carried out in laboratory of Saramayri-Fuji Co., Ltd. Grain size analysis testing and hydrometer testing are shown in Photo- 4.4 and 4.5. Graph-4.5 is illustrated the grain size distribution of each soil layer versus depth in elevation. The details of grain size analysis test results were shown in Appendix-C.

Photo - 4.4 Grain Size Distribution Test

Photo - 4.5 Hydrometer Test



Graph - 4.5 Fine Content vs Depth in Elevation (m)

4.2 Mechanical Properties of Soil

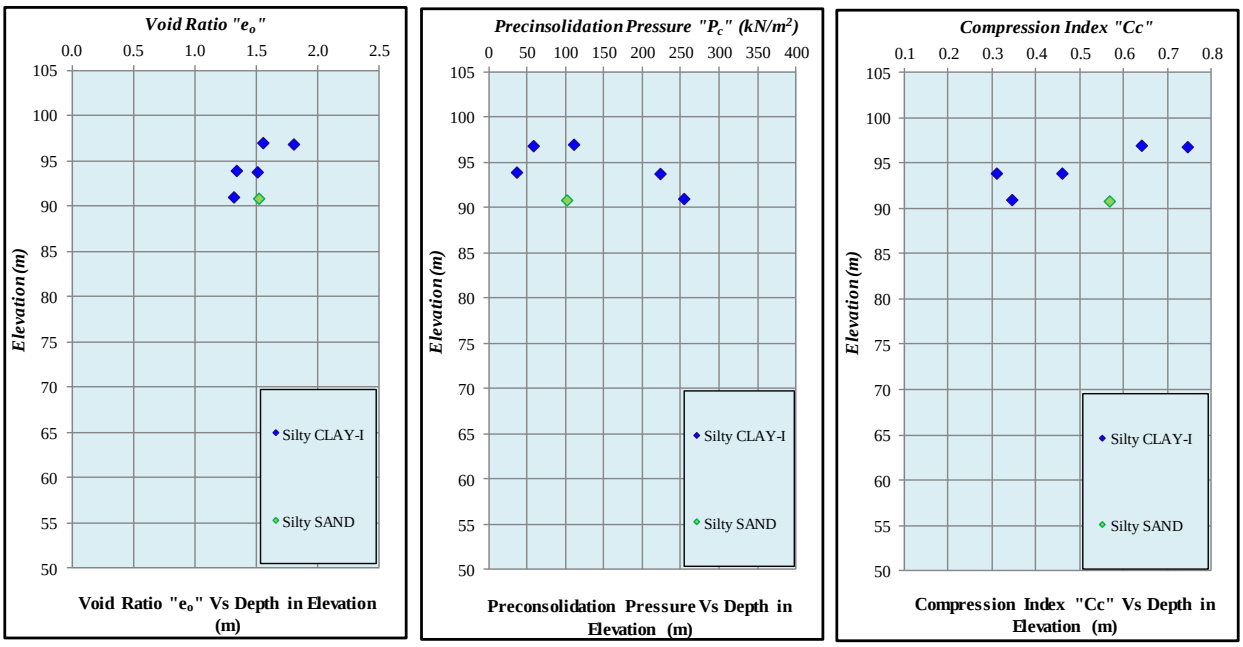
In order to get the mechanical or engineering properties of soils, three kinds of test were carried out; one dimensional consolidation test, unconfined compressive strength test and direct shear test. All mechanical tests were carried out in office laboratory.

4.2.1 One Dimensional Consolidation Test

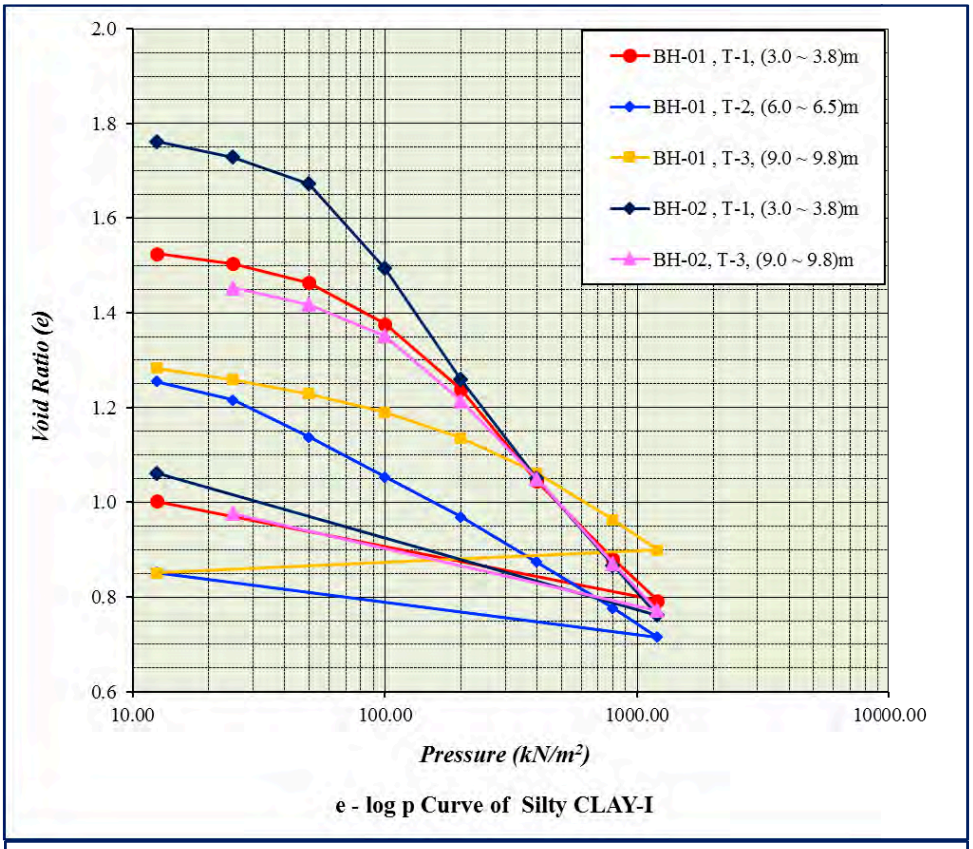
The one dimensional consolidation tests were carried out in undisturbed sampeles taken from Silty Clay 1 layer and Silty Sand layer. There are (4) numbers of tests were carried out in accordance with ASTM Standard. Table 4.6 summarized some results of one dimensional consolidation tests such as initial void ratio (e_0), Pre-consolidation Pressure (Pc) and compression index (Cc). Graph-4.6 indicate the relationship between (e_0), (Pc) and (Cc) versus their depth in elevation at investigation area. Moreover,Graph-4.7 show the e-log-P curve results from one dimensional consolidation tests of soil from the investigation area, and Graph-4.8 shows the relationship between coefficients of condsolidation (Cv) versus pressure of that soil.

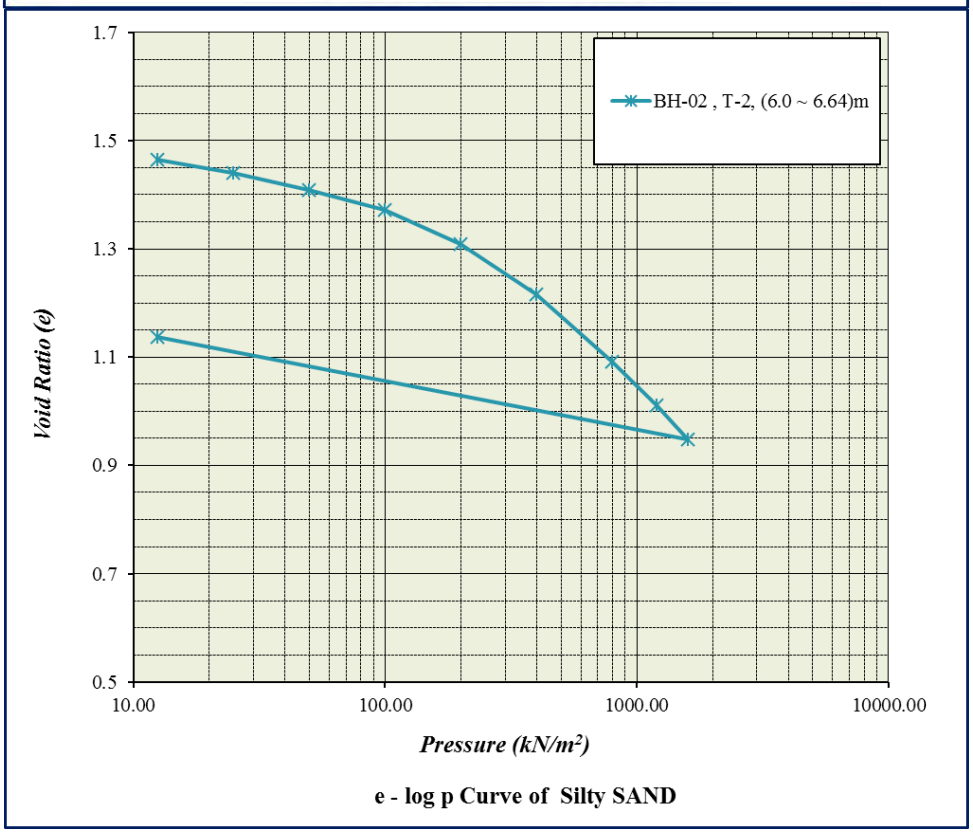
Table - 4.6 Summary of One Dimensional Consolidation Test Results.

No.	Soil Type	Initial Void Ratio (e_0)		Consolidation Yield Stress Pc (kN/m^2)		Compression Index (Cc)	
		Range	Average	Range	Average	Range	Average
1	Silty Clay 1	1.32 ~ 1.81	1.508	37.76 ~ 254.58	137.18	0.31 ~ 0.74	0.50
2	Silty Sand	1.520	1.520	102.97	102.97	0.57	0.57

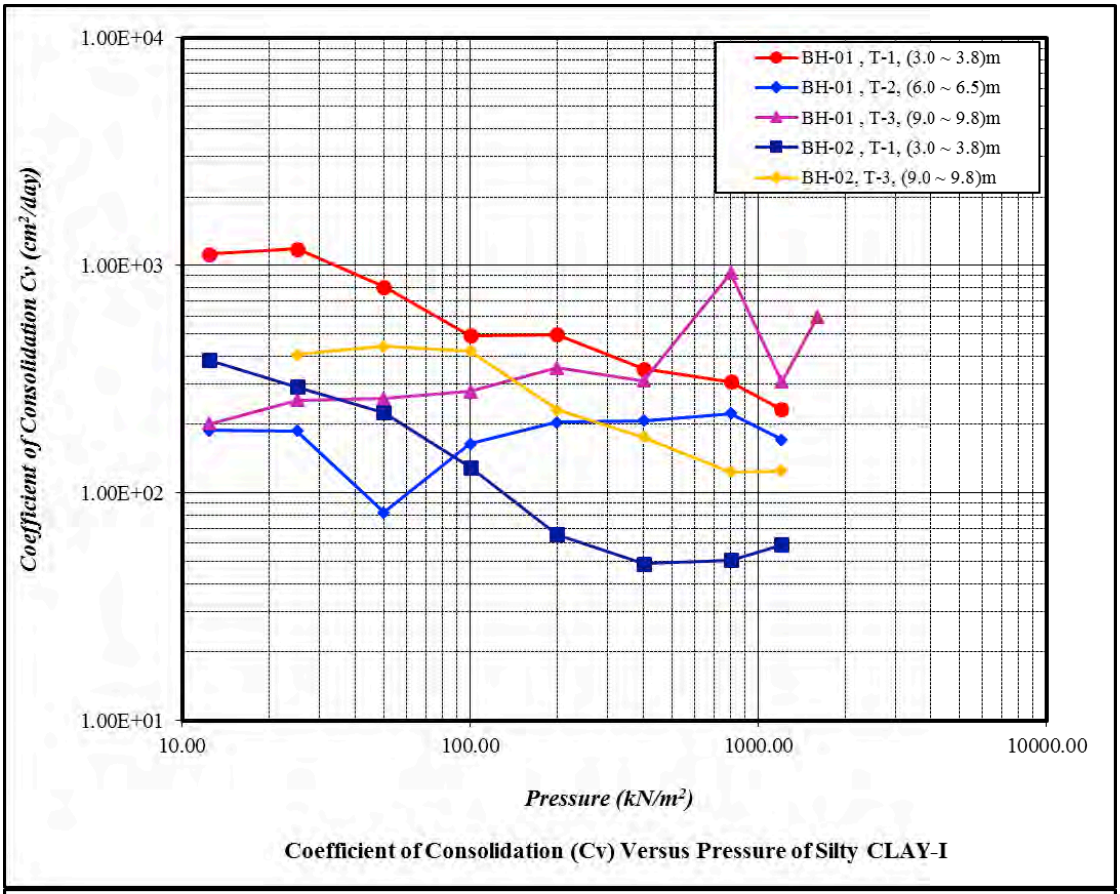


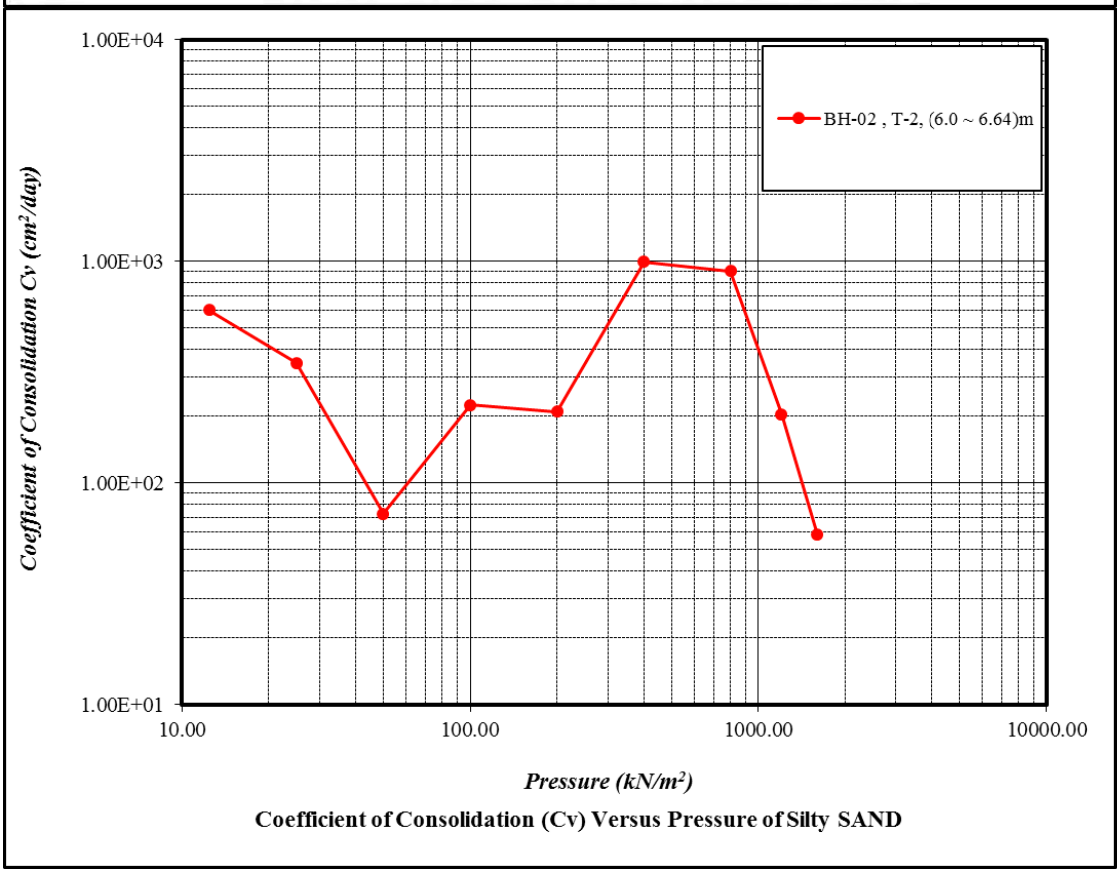
Graph - 4.6 Void Ratio, Pre-consolidation Pressure and Compression Index vs Depth in Elevation (m)





Graph - 4.7 e – log p Curve of Silty Clay 1 and Silty Sand





Graph - 4.8 Coefficient of Consolidation (Cv) versus Pressure of Silty Clay 1 and Silty Sand

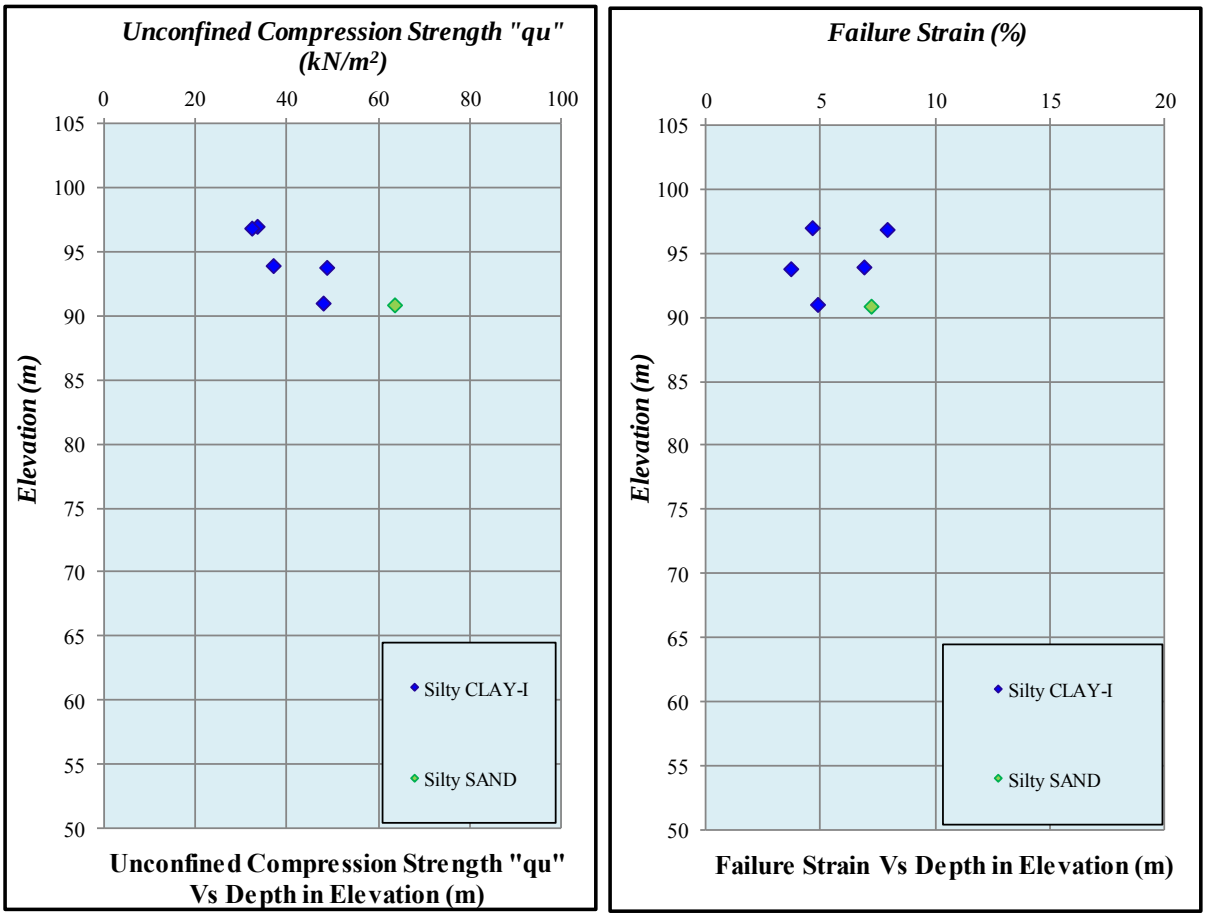
4.2.2 Unconfined Compressive Strength Test

The total (6) numbers of undisturbed sample from the project area were carried out for unconfined compression test at office laboratory in accordance with ASTM Standard. Summary of unconfined comperssion test results are described in Table – 4.7.

The relationship between the unconfined compressive strength and failure strain vs depth in elevation is presented in Graph-4.9.

Table - 4.7 Summary of Unconfined Compressive Strength Test Results

No.	Soil Type	Compression Strength (kN/m^2)		Failure Strain (%)	
		Range	Average	Range	Average
1	Silty Clay 1	32.31 ~ 48.64	40.03	3.70 ~ 7.90	5.61
2	Silty Sand	63.55	63.55	7.19	7.19



Graph - 4.9 Unconfined Compressive Strength and Failure Strain vs Depth in Elevation (m)

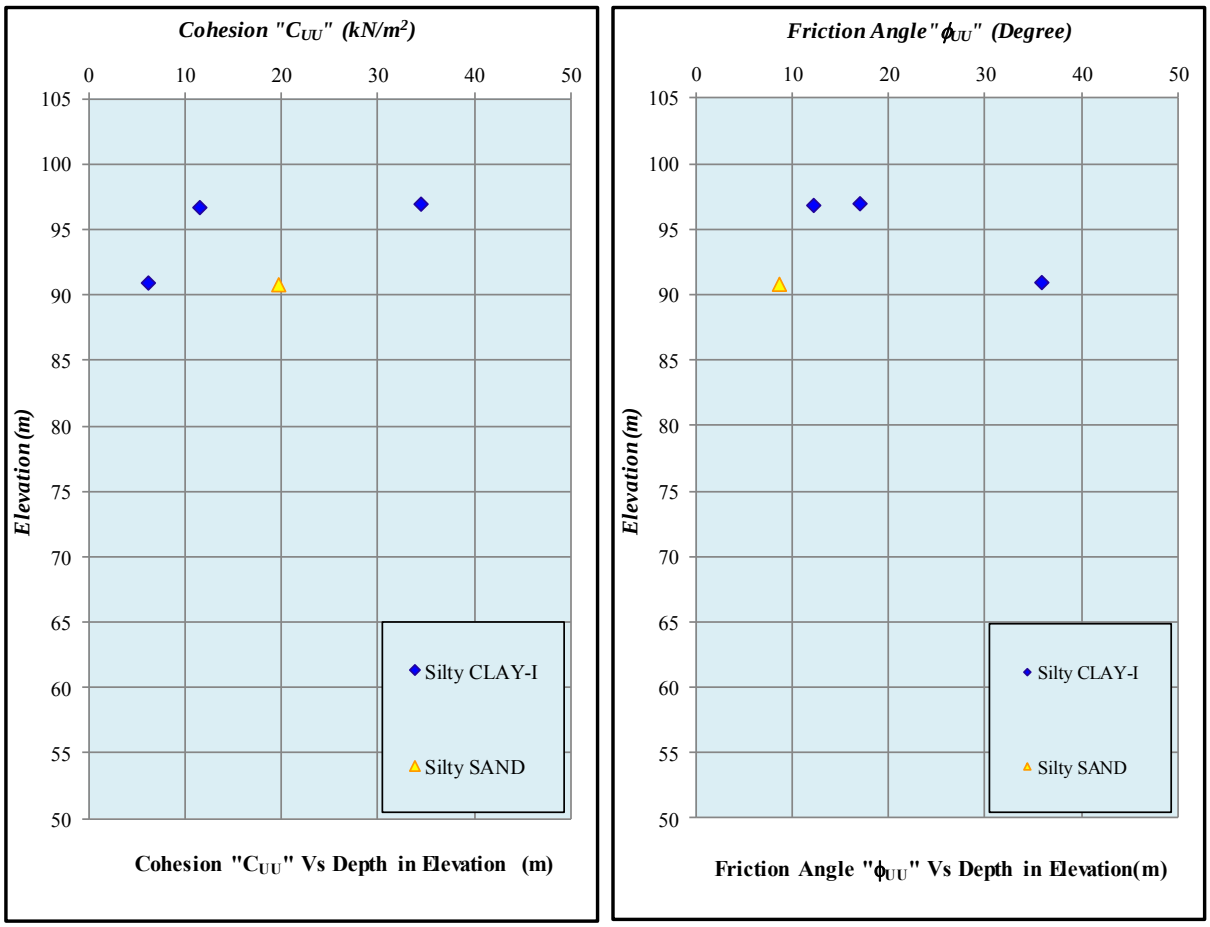
4.2.3 Direct Shear Test

The direct shear tests were carried out from (4) numbers of undisturbed samples by undisturbed piston sampler from Silty Clay 1 and Silty Sand layers of unequal consistency. There are total (4) numbers of direct shear (UU) tests from ten boreholes were carried out in accordance with ASTM Standard. Table 4.8 indicates the summary of direct shear test results.

Graph-4.10 indicate the relationship between cohesion (C) and phi angle (ϕ) versus their depth in elevation at investigation area.

Table - 4.8 Summary of Direct Shear Test Results

No.	Soil Type	Cohesion C_{UU} (kN/m^2)		Phi Angle ϕ_{UU} (degree)	
		Range	Average	Range	Average
1	Silty Clay 1	6.28 ~ 34.52	17.49	12.24 ~ 35.75	21.65
2	Silty Sand	19.81	19.81	8.51	8.53



Graph - 4.10 Cohesion "C_{uu}" and Friction Angle "ϕ_{uu}" vs Depth in Elevation (m)

4.3 Standard Proctor Compaction Test

The bulk sample from test pits are collected for standard proctor compaction test. The standard proctor compaction test is carried out according to ASTM standard. The soil sample is collected at filled material of existing embankment. The following table indicates the maximum dry density and optimum moisture content of embankment material.

Table - 4.9 Summary of Standard Proctor Test Results

Location	Maximum dry density (t/m^3)	Optimum moisture content (%)
Start Point (near BH-01)	1.586	22.00
End Point (near BH-02)	1,666	19.00

4.4 Water Quality Test

Water sampling is carried out by using water delivery sampler made of stainless steel with an outer diameter of 50 mm and length of 1 meter. On the day prior to sampling after completion of the drilling works, the borehole was flushed with water to be able to remove the remnants left at the bottom of the borehole, and left overnight. And then, in the morning of the next day water sample was taken before withdrawal casing pipes.

Water samples from all investigated holes of the project area have been sent to ISO Tech laboratory and then tested in order to inspect pH value, Sulphate and Chloride contents. All of the test items are listed below as-

1) pH value
2) Color (true)
3) Turbidity
4) Conductivity
5) Total hardness
6) Total alkalinity
7) Phenolphthalein alkalinity
8) Calcium hardness
9) Iron
10) Magnesium hardness
11) Carbonate ($NaCo_3$)
12) Chloride (as CL)
13) Sodium chloride (as NaCL)
14) Bicarbonate (HCO_3)
15) Sulphate (as SO_4)
16) Total solids
17) Suspended solids
18) Dissolved solids

The result of water quality test is attached in Appendix – D

5.0 GEOTECHNICAL ASSESSMENT

The geotechnical assessment report is prepared for choosing suitable foundation design for proposed building and infra structures, evaluating adverse effects of ground response to loading of structures during and after construction, and recognized the potential hazards to the proposed structures. In order to evaluate above mentioned factors, the relevant geotechnical design parameter such as cohesion (C), angle of internal friction (Ø), modulus of elasticity (E) and poison ratio (υ') have to be evaluated primarily. Moreover, the dry unit weight and saturated unit weight of soil and ground material should be evaluated.

5.1 Geotechnical Design Parameters

The geotechnical parameters can be directly evaluated from many ways such as field in situ testing, laboratory testing and so on. Some of the design parameters cannot be evaluated directly neither from field tests nor laboratory tests due to the unfavorable of nature of deposit or investigation methods. However, some parameters would be derived from the other instrumental testing of past events and some mechanical and physical properties obtained from field and laboratory tests. For evaluating the stability of ground, the shear strength parameters are significant. The geotechnical design parameters required for foundation design analysis are listed as below-

C_u Cohesion of soil (kN/m^2)
ϕ Friction angle of soil (angle of internal friction in degree)
γ_d Dry unit weight of soil (kN/m^3)
γ_w Saturated unit weight of soil (kN/m^3)
γ' Effective unit weight of soil below water table (kN/m^3)

a) Dry Unit Weight of Soil (γ_d)

The dry soil defines as the soil located above the water table. The dry unit weight of soil can be evaluated from the field density test. However, field density test cannot be carried out. Hence the unit weight of dry soil can be derived from the unit weight of saturated soil using the following equation-

$$\gamma_d = \gamma_{sat} / (1+w)$$

Where - γ_d = unit weight of dry soil (kN/m^3)
γ_{sat} = unit weigh of saturated soil (kN/m^3)
w = natural moisture content (%)

The natural moisture content (w) can be resulted from the laboratory tests (of collected Disturbed Samples).

b) Saturated Unit Weight of Soil (γ_{sat})

The saturated soil defines as the soil located below the water table. The saturated unit weight of soil can be evaluated directly from the field density test or equation.-

$$\gamma_{sat} = (G_s\gamma_w + e\gamma_w) / (1 + e)$$

Where- γ_{sat} = saturated unit weight of soil (kN/m^3)
γ_w = saturated unit weight of water (kN/m^3)
G_s = specific gravity of soil
e = void ratio of soil (e = wG_s for saturated soil)

The G_s and *w* can be resulted from laboratory tests of collected "Disturbed Samples".

The unit weight of soil can be also taken from the determination of bulk density of soil from undisturbed sample.

c) Effective Unit Weight of Soil (γ')

The effective unit weight of soil under water table can be evaluated from the equation-

$$\gamma' = \gamma_{sat} - \gamma_w$$

Where- γ' = effective unit weight of soil (kN/m^3)
γ_{sat} = saturated unit weight of soil (kN/m^3)
γ_w = unit weight of water (kN/m^3)

The unit weight of water in SI unit is 9.8 kN/m^3 (or) 10 kN/m^3.

In this report, the unit of soil can also be referred from the recommended design parameters by *Japan Highway Cooperation (J.H.C)*, see table 5.1.

d) Cohesion (Cu)

The cohesive strength also known as undrained shear strength of cohesive soil is normally evaluated from the unconfined compression test. The cohesive strength Cu can be derived from -

$$Cu = q_u / 2$$

Where- Cu = cohesive strength (kN/m^2)
q_u = unconfined compressive strength (kN/m^2)

However, the undrained cohesive strength can also be determined from direct shear test of undisturbed sample and remolded samples.

For granular soil, as the undisturbed sample cannot be easily collected, the cohesive strength can be reliably derived from SPT N-value, or referred from previous experiences; i.e. from Table 5.1. In case of cohesive strength derived from SPT N value the following equation is used-

$$Cu = 20N/3 \text{ (kN/m}^2\text{)}$$

e) Friction angle (∅)

The friction angle of the granular soil can be directly evaluated from the SPT N-value. The friction angle of such deposits can be also evaluated from equation and the recommended design parameters by *Japan Highway Cooperation (J.H.C)* (See Table 5.1). In case of granular soil, the friction angle of soil can be derived from following equation.

$$ø = \sqrt{20N} + 15$$

The friction angle for cohesive soil can be also determined from direct shear test.

f) Modulus of Elasticity (*E*)

The modulus of elasticity of soil can be derived from the SPT N-value. In general, the modulus of elasticity of soil can be evaluated by multiplying SPT N-value. The modulus of elasticity of soil for granular soil is evaluated from the equation -

$$E = 700N\ (KN/m^2)$$

However the modulus of elasticity of cohesive soil can be derived from undrained cohesive strength; in following eqution-

$$E = 100Cu\,,$$

g) Poisson's Ratio (υ')

The poisson's ratio is the ratio of axial strain versus lateral strain. In this report poisson's ratio of the soil can be estimated from experts' options described in following table.

Table - 5.1 Typical Values of Poisson's Ratio

No	Type of Soil	υ'
1	Saturated clay	0.4 ~ 0.5
2	Unsaturated or sandy clay	0.2 ~ 0.4
3	Sand: ø = 40°	0.2
4	Sand: ø = 20°	0.5

The table 5.3 indicates the geotechnical design parameters evaluated from various method for the road improvement project.

Table - 5.2 Recommended Soil Parameter by J.H.C

Soil Type		Condition of Soil		Bulk Density γt (tf/m^3)	Internal Friction Angle φ (°)	Cohesion Cu (tf/m^2)	Remarks (Soil Name)
Fill Material	Gravel Gravelly Sand	Compacted one.		2.0	40	0	(GW), (GP)
	Sand	Compacted one.	Well graded one.	2.0	35	0	(SW), (SP)
			Poor graded one.	1.9	30	0	
	Silty Sand Clayey Sand	Compacted one.		1.9	25	Less than 3	(SM), (SC)
	Silt, Clay	Compacted one.		1.8	15	Less than 5	(ML), (CL) (MH), (CH)
	Kanto Loam	Compacted one.		1.4	20	Less than 1	(VH)
Natural Ground	Gravel	Dense or Well graded one.		2.0	40	0	(GW), (GP)
		Not dense and Poorly graded one.		1.8	35	0	
	Gravelly Sand	Dense one.		2.1	40	0	(GW), (GP)
		Not dense one.		1.9	35	0	
	Sand	Dense or Well graded one.		2.0	35	0	(SW), (SP)
		Not dense and Poorly graded one.		1.8	30	0	
	Silty Sand Clayey Sand	Dense one.		1.9	30	Less than 3	(SM), (SC)
		Not dense one.		1.7	25	0	
	Sandy Silt Sandy Clay	Stiff one.		1.8	25	Less than 5	(ML), (CL)
		Firm one.		1.7	20	Less than 3	
		Soft one.		1.6	15	Less than 1.5	
	Silt Clay	Stiff one.		1.7	20	Less than 5	(CH), (MH), (ML)
		Firm one.		1.6	15	Less than 3	
		Soft one.		1.4	10	Less than 1.5	
	Kanto Loam	---		1.4	5	Less than 3	(VH)

Table - 5.3 Geotechnical design parameters from various derivation methods

No.	Soil Name	N-Value (Average)	Cohesion Cu kN/m^2			Friction angle (degree)			Bulk Density (kN/m^3) Lab Test		Bulk Density (kN/m^3) by JHC		Modulus of Elasticity (kN/m^2)
		N	SPT	Lab	by JHC	SPT	Lab	by JHC	γ_d	γ_{sat}	γ_d	γ_{sat}	
1	Clay (filled)	2	13	N/A	<50	0	N/A	15	12.1	17.7	N/A	18.0	1300
2	Silty Clay 1	1	6	20	<15	0	0	10	10.6	16.5	N/A	14.0	600
3	Silty Sand	3	0	32	0	22	9	15	9.7	15.6	N/A	17.0	2100
4	Silty Clay 2	3	20	N/A	<15	0	0	10	13.1	18.2	N/A	14.0	2000

Remark : The bulk density for Clay (filled) layer is estimated from field density test

Table - 5.4 Recommended geotechnical design parameters

No.	Soil Name	N-Value (Average)	Cohesion Cu	Friction angle ϕ	Bulk Density (kN/m^3)			Modulus of Elasticity (kN/m^2)	Poission's Ratio
		N	kN/m^2	(degree)	γ_d	γ_{sat}	γ'		υ
1	Clay (filled)	2	10	0	12	17	7	1300	0.4
2	Silty Clay 1	1	5	0	10	16	6	600	0.4
3	Silty Sand	3	0	20	9	15	5	2100	0.5
4	Silty Clay 2	3	20	0	13	18	8	2000	0.4

6.0 CONCLUSION

6.1 Ground Condition

As the project area is located on the deltaic region of Ayeyarwaddy River near off shore, the quaternary deposit is mainly dominated. In project area, the marine deposit is underlain by fluvial deposit. As the river and marine dynamism is still progress on the area, the erosion, sedimentation process is still progressed on.

According to investigation result, the clayey soil is dominated the whole area. Among them the sandy soil interbedded. The clayey soil are very soft to soft in consistency while the sandy soil is very loose in density. The drilling work is carried out up to 30 m from ground surface. It is observed that the soil in an area is soft for foundation works for road and other infrastructures construction. The succession of soil layer from top to bottom are –

1. Clay (filled material)
2. Silty Clay 1
3. Silty Sand
4. Silty Clay 2

The ground water table is detected very shallow about 1 m from embankment. It is regarded that the groundwater is fully saturated during rainy season. Moreover, the road will be fully inundated during rain storm and high tide.

6.2 Foundation Work

The foundation work for road, bridge and building construction should not be done without ground improvement work, because the ground is too soft to rest for heavy or light load structures. Moreover, the ground is mainly composed of saturated soft clay. Therefore, the consolidation settlement will occur when the load is applied to that soil layer. As the permeability of the soil is very low, the dewatering work is not difficult for excavation work.

6.3 Seismicity of the Area

According to Seismic Zone Map of Myanmar, the project area is belonged to Zone II, moderate zone, where the modified Mercalli scale classes is 7, and peak ground acceleration is 0.15g. Although the ground material is very soft in consistency and shallow groundwater table, the liquefaction potential is very low, because the whole area is made up of cohesive soil and low peak ground acceleration.

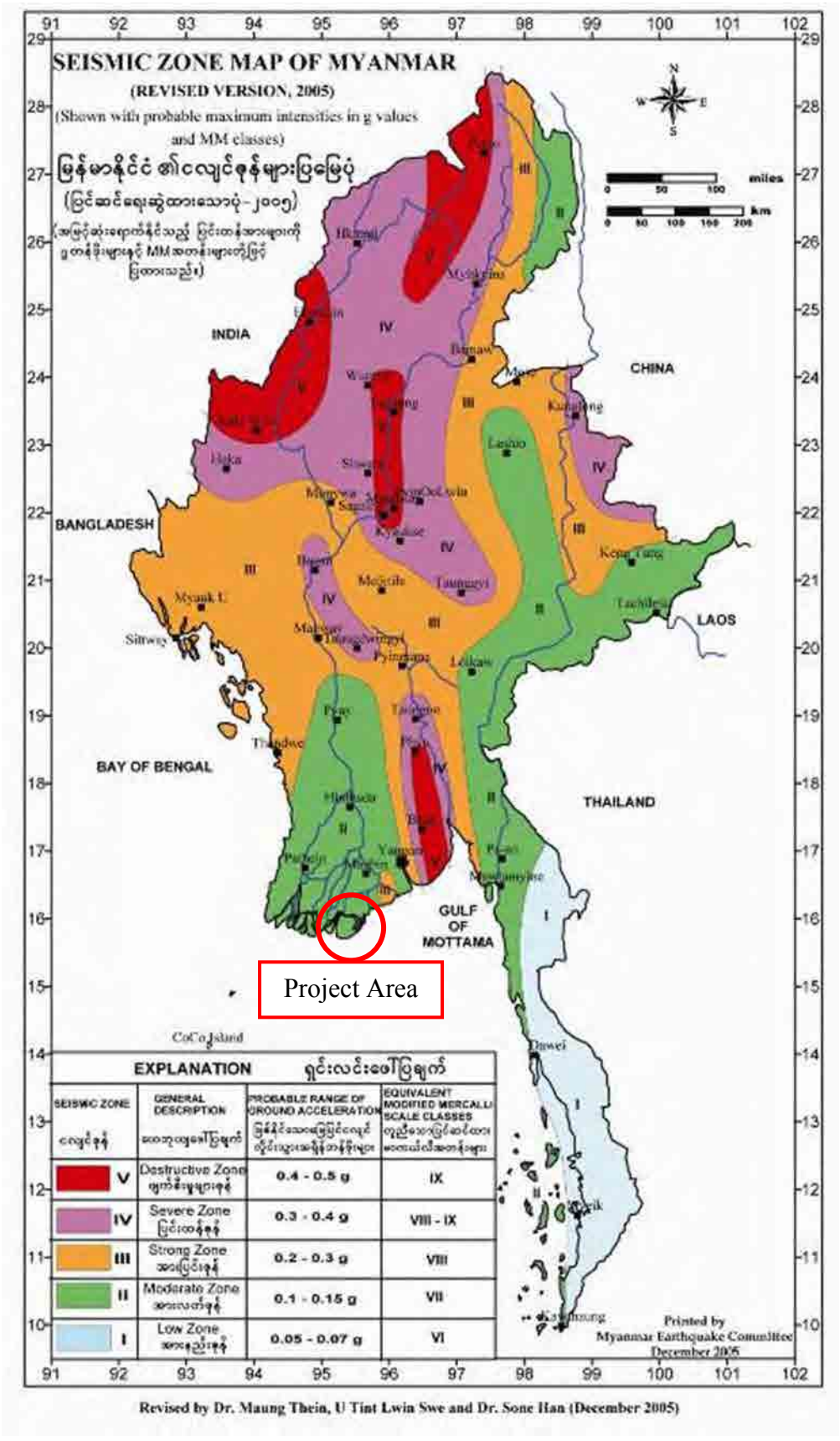


Figure - 6.1 Earthquake zoning map of Myanmar

Table - 6.1 The Level of Probable Damage and Destruction

Zone	MM Class	Probable Damage	Examples of Damage
V	IX	Major damage	Considerable damage in specially designed structures Major damage in good RC buildings
IV	VIII-IX	Considerable damage	Considerable damage in good RC buildings Major damage in ordinary brick buildings
III	VII	Moderate damage	Moderate damage in good RC buildings Considerable damage in ordinary brick buildings
II	VII	Minor damage	Minor damage in good RC buildings Moderate damage in ordinary brick buildings
I	VI	Slight damage	Minor damage in ordinary brick buildings

APPENDICES

APPENDIX "A"

BORING LOGS

BORE HOLE No. **BH-01**

BORING LOG

Job No. 2013-032 | Sheet No. 1 OF 1

PROJECT NAME : Soil Investigation for Road Improvement Project
LOCATION : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
GROUND LEVEL : 99.917m
COORDINATE : E 777313.000 ; N 1763141.000 DEPTH : 30.00m

BORING EQUIPMENT : TOHO " D1 "
BORING METHOD : Rotary Direct Circulation
ORIENTATION : Vertical
GROUND WATER LEVEL : 1.00m

DATE : 26.10.2013 To 27.10.2013

CLIENT
ORIENTAL CONSULTANT

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION
1					mottled brown and gray	Soft	CLAY Filled materials	Soft, mottled brown and gray, moist, medium plasticity, CLAY, with trace of decayed wood fragments Filled materials
2	97.917	2.00	2.00					
3					gray	Very soft to soft	Silty CLAY-I	Very soft to soft, gray, wet to moist, low to medium plasticity, Silty CLAY Fine sand and mica minerals are observed as trace in this layer GL-(8.00~8.50)m and (11.0~11.50)m; organic matter are observed as traces
19	80.917	19.00	17.00					
20					gray	Very soft to firm	Silty CLAY-II	Very soft to firm, gray, moist, low to medium plasticity, Silty CLAY Fine sand and mica minerals are observed as traces in each layer GL-(26.00~26.50)m and (27.00~27.50)m; Silty SAND layer are observed as intercalated layer
30	69.417	30.50	11.50					This borehole is terminated at 30.00m, after confirmation

DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)
	3.00 Ø115	▽
26.10.13 20.00		
27.10.13 30.00		

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

DEPTH GL - (m)	N-Value (Blows / 30cm)
1.00	2/30
2.00	1/30
3.00	
4.00	1/30
5.00	1/30
6.00	
7.00	0/30
8.00	3/30
9.00	
10.00	1/30
11.00	2/30
12.00	1/30
13.00	1/30
14.00	1/30
15.00	1/30
16.00	2/30
17.00	1/30
18.00	2/30
19.00	4/30
20.00	2/30
21.00	3/30
22.00	3/30
23.00	3/30
24.00	2/30
25.00	2/30
26.00	6/30
27.00	4/30
28.00	1/30
29.00	2/45
30.00	2/30
31.00	

CURVE OF BLOW ●
N-Value (Blows / 30cm)
0 10 20 30 40 50

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)
P-1	1.00			
	1.50			
P-2	2.00			
	2.50			
	3.00			
UD T-1	(80/80) cm			
	3.80			
P-3	4.00			
	4.50			
P-4	5.00			
	5.50			
UD T-2	6.00			
	(50/50) cm			
	6.50			
P-5	7.00			
	7.50			
W-1				
P-6	8.00			
	8.50			
UD T-3	9.00			
	(80/80) cm			
	9.80			
P-7	10.00			
	10.50			
P-8	11.00			
	11.50			
P-9	12.00			
	12.50			
P-10	13.00			
	13.50			
P-11	14.00			
	14.50			
P-12	15.00			
	15.50			
P-13	16.00			
	16.50			
P-14	17.00			
	17.50			
P-15	18.00			
	18.50			
P-16	19.00			
	19.50			
P-17	20.00			
	20.50			
P-18	21.00			
	21.50			
P-19	22.00			
	22.50			
P-20	23.00			
	23.50			
P-21	24.00			
	24.50			
P-22	25.00			
	25.50			
P-23	26.00			
	26.50			
P-24	27.00			
	27.50			
P-25	28.00			
	28.50			
P-26	29.00			
	29.50			
P-27	30.00			
	30.50			

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (mean)	Consistency	SPT N-Value (mean)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Ref : Terzaghi et al., 1996

Sample key
- P-1 Disturbed sample (SPT sample)
- UD T-1 Undisturbed Sample (Piston sampler)
- UD D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core lost)
- W-1 Water sample

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Revision No.	Rev: 00
Revision Date	06.11.2013

Remarks

App 3

BORE HOLE No. **BH-02**

BORING LOG

Job No. 2013-032 | Sheet No. 1 OF 1

PROJECT NAME : Soil Investigation for Road Improvement Project
LOCATION : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
GROUND LEVEL : 99.772m
COORDINATE : E 778178.000 ; N 1761613.000 DEPTH : 30.00m

BORING EQUIPMENT : TOHO " D1 "
BORING METHOD : Rotary Direct Circulation
ORIENTATION : Vertical
GROUND WATER LEVEL : 0.50m

DATE : 24.10.2013 To 25.10.2013

CLIENT
ORIENTAL CONSULTANT

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION
1					mottled brown and gray	Soft	CLAY Filled materials	Soft, mottled brown and gray, wet to moist, low to medium plasticity, CLAY, with trace of decayed wood fragments Filled materials
2	97.772	2.00	2.00					
3					gray	Soft	Silty CLAY-I	Soft, gray, wet to moist, low to medium plasticity, Silty CLAY, with trace of organic matter Fine sand and mica minerals are observed as trace in this layer
4								
5								
6								
7	92.772	7.00	5.00					
8					gray	Very loose	Silty SAND	Very loose, gray, moist, low plasticity, fine grained, Silty SAND, with clay patches
9								
10								
11								
12	87.772	12.00	5.00					
13					gray	Very soft to soft	Silty CLAY-I	Very soft to soft , gray, moist, low to medium plasticity, Silty CLAY, with trace of fine sand and mica minerals
14								
15								
16								
17								
18								
19	80.772	19.00	7.00					
20					gray	Very soft to firm	Silty CLAY-II	Very soft to firm, gray, moist, low to medium plasticity, Silty CLAY, with trace of fine sand and mica minerals
21								
22								
23								
24								
25								
26								
27								
28								
29								
30	69.272	30.50	11.50					This borehole is terminated at 30.00m, after confirmation
31								

DATE & DEPTH (m): 24.10.13 / 10.00; 25.10.13 / 30.00

CASING (DEPTH (m) & DIAMETER (mm)): 3.00 / Ø115

WATER DEPTH (m)

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

DEPTH GL - (m)	N-Value (Blows / 30cm)
1.00	2/30
2.00	0/30
3.00	
4.00	3/30
5.00	3/30
6.00	
7.00	4/30
8.00	2/30
9.00	
10.00	2/30
11.00	4/30
12.00	2/30
13.00	3/30
14.00	1/30
15.00	1/30
16.00	1/30
17.00	2/30
18.00	1/30
19.00	8/30
20.00	2/30
21.00	2/30
22.00	2/30
23.00	3/30
24.00	3/30
25.00	2/30
26.00	1/30
27.00	2/30
28.00	3/30
29.00	3/30
30.00	4/30
31.00	

CURVE OF BLOW ●
N-Value (Blows / 30cm)
0 10 20 30 40 50

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)
P-1	1.00			
	1.50			
P-2	2.00			
	2.50			
UD T-1	3.00 (30/30) cm			
	3.80			
P-3	4.00			
	4.50			
P-4	5.00			
	5.50			
UD T-2	6.00 (64/80) cm			
	6.64			
P-5	7.00			
W-1	7.50			
P-6	8.00			
	8.50			
UD T-3	9.00 (80/80) cm			
	9.80			
P-7	10.00			
	10.50			
P-8	11.00			
	11.50			
P-9	12.00			
	12.50			
P-10	13.00			
	13.50			
P-11	14.00			
	14.50			
P-12	15.00			
	15.50			
P-13	16.00			
	16.50			
P-14	17.00			
	17.50			
P-15	18.00			
	18.50			
P-16	19.00			
	19.50			
P-17	20.00			
	20.50			
P-18	21.00			
	21.50			
P-19	22.00			
	22.50			
P-20	23.00			
	23.50			
P-21	24.00			
	24.50			
P-22	25.00			
	25.50			
P-23	26.00			
	26.50			
P-24	27.00			
	27.50			
P-25	28.00			
	28.50			
P-26	29.00			
	29.50			
P-27	30.00			
	30.50			

SCALE (m)

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (mean)	Consistency	SPT N-Value (mean)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Ref : Terzaghi et al., 1996

Sample key
- P-1 Disturbed sample (SPT sample)
- UD T-1 Undisturbed Sample (Piston sampler)
- UD D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core lost)
- W-1 Water sample

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

Saramayri - Fuji Construction Co., Ltd

Revision No.	Rev: 00
Revision Date	06.11.2013

Remarks

App 4

APPENDIX “B”

FIELD DENSITY TEST RESULTS

DENSITY OF SOIL IN PLACE BY SAND - CONE METHOD (1)

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanma — Date: 31.10.13

Location: Near Myogone Village, Pyapon Township, Irrawaddy Region — Operator: T H & K H A

Point No. & Depth: Start Point (GL- 0.50 m) — Apparatus No.: 3

1.Determination of volume of apparatus

Test No.			1	2	3	4	5
Mass of apparatus with water	m_2	g	6856	6856	6856		
Mass of apparatus	m_1	g	2528	2528	2528		
Mass of water in apparatus	m_2-m_1	g	4328	4328	4328		
Water temperature	t	°C	29	29	29		
Volume of water of 1g at t °C	K	cm^3/g	1.00405	1.00405	1.00405		
Volume of apparatus (1)	V_1	cm^3	4346	4346	4346		
Mean value			V_1 =	4346	cm^3		

2.Determination of bulk density of sand for test

Test No.			1	2	3	4	5
Mass of apparatus with sand	m_3	g	8520	8522	8520		
Mass of apparatus	m_1	g	2528	2528	2528		
Mass of sand in apparatus	$m_4 = m_3 - m_1$	g	5992	5994	5992		
Bulk density of sand for testing (2)	ρ_s	g/cm^3	1.379	1.379	1.379		
Mean value			ρ_s =	1.379	g/cm^3		

3.Determination of mass of sand required to fill the funnel

Test No.			1	2	3	4	5
Mass of apparatus and sand	m_3	g	8508	8516	8508		
Mass of apparatus and remaining sand	m_5	g	7044	7050	7042		
Mass of sand required to fill funnel	$m_6 = m_3 - m_5$	g	1464	1466	1466		
Mean value			m_s =	1465	g		

Remarks:

Density Check by $2000cm^3$ Container

Mass of apparatus and sand	8504	g
Mass of apparatus and remaining sand	4280	g
Mass of sand required to fill funnel	1465	g
Volume of container	2000	cm^3
Bulk density of sand for testing	1.380	g/cm^3

(1) $V_1 = K\ (m_2 - m_1)\ cm^3$

(2) $\rho_s = m_4 / V_1\ \ g/cm^3$

DENSITY OF SOIL IN PLACED BY SAND - CONE METHOD (2)

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date: 31.10.13

Location: Near Myogone Village, Pyapon Township, Irrawaddy Region — Operator: T H & K H A

Point No. & Depth: Start Point (GL- 0.5 m)

Apparatus No. 3 — Soil name: Silty clay — Weather: cloudy

Bulk density of sand ρ_s = 1.379 g/cm^3 — Mass of sand required to fill the funnel m_6 = 1465 g

Test hole No.		No. T-1	No. T-2	No. T-3	No.
Container No.		-	-	-	
Mass (removed soil + container)	g	-	-	-	
Mass of container	g	-	-	-	
Mass of removed soil	m_r g	2710	2580	2464	
Dry mass of removed soil	$m_o = \frac{100\ m_r}{w+100}$ g	2074	1995	1877	
Max. grain size	mm	2	2	2	
Mass of apparatus with sand	m_3 g	7528	7528	7528	
Mass of apparatus with remaining sand	m_8 g	3998	4074	3954	
Mass of sand in hole & funnel	$m_9=m_3-m_8$ g	3530	3454	3574	
Mass of sand in test hole	$m_{10}=m_9-m_6$ g	2065	1989	2109	
Volume of test hole	$v_o = \frac{m_{10}}{\rho_s}$ cm^3	1497.2	1442.1	1529.1	
Bulk density	$\rho_t = \frac{m_r}{v_o}$ g /cm^3	1.81	1.79	1.61	
Dry density	$\rho_d = \frac{m_o}{v_o}$ g /cm^3	1.39	1.38	1.23	

Sketch of testing point

Moisture content

No.	BD-21	No.	M-1	No.	CB-37	No.	
m_a g	199.83	m_a g	181.09	m_a g	194.11	m_a g	
m_b g	159.11	m_b g	147.49	m_b g	155.73	m_b g	
m_c g	27.21	m_c g	32.64	m_c g	33.06	m_c g	
w %	30.87	w %	29.26	w %	31.29	w %	
No.	E-131	No.	C-5	No.	E-140	No.	
m_a g	198.54	m_a g	206.69	m_a g	202.33	m_a g	
m_b g	162.18	m_b g	165.42	m_b g	163.72	m_b g	
m_c g	42.83	m_c g	24.72	m_c g	40.19	m_c g	
w %	30.47	w %	29.33	w %	31.26	w %	
Mean w =	30.668 %	Mean w =	29.294 %	Mean w =	31.3 %	Mean w =	%

Sketch of test hole

No. No. No. No.

Mean value

Moisture content	w =	30.4 %
Bulk density	ρ_t =	1.74 g/cm^3
Dry density	ρ_d =	1.33 g/cm^3
Max. Grain size		2 mm
Method of moisture content test		Oven drying

Remarks:

DENSITY OF SOIL IN PLACE BY SAND - CONE METHOD (1)

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanma — Date: 31.10.13

Location: Near Dawnyein Village, Pyapon Township, Irrawaddy Region — Operator: T H & K H A

Point No. & Depth: End Point (GL- 0.50 m) — Apparatus No. 3

1.Determination of volume of apparatus

Test No.			1	2	3	4	5
Mass of apparatus with water	m_2	g	6856	6856	6856		
Mass of apparatus	m_1	g	2528	2528	2528		
Mass of water in apparatus	m_2-m_1	g	4328	4328	4328		
Water temperature	t	°C	29	29	29		
Volume of water of 1g at t °C	K	cm^3/g	1.00405	1.00405	1.00405		
Volume of apparatus (1)	V_1	cm^3	4346	4346	4346		
Mean value			V_1 =	4346	cm^3		

2.Determination of bulk density of sand for test

Test No.			1	2	3	4	5
Mass of apparatus with sand	m_3	g	8520	8522	8520		
Mass of apparatus	m_1	g	2528	2528	2528		
Mass of sand in apparatus	$m_4 = m_3 - m_1$	g	5992	5994	5992		
Bulk density of sand for testing (2)	ρ_s	g/cm^3	1.379	1.379	1.379		
Mean value			ρ_s =	1.379	g/cm^3		

3.Determination of mass of sand required to fill the funnel

Test No.			1	2	3	4	5
Mass of apparatus and sand	m_3	g	8508	8516	8508		
Mass of apparatus and remaining sand	m_5	g	7044	7050	7042		
Mass of sand required to fill funnel	$m_6 = m_3 - m_5$	g	1464	1466	1466		
Mean value			m_s =	1465	g		

Remarks:

Density Check by $2000cm^3$ Container

Mass of apparatus and sand	8504	g
Mass of apparatus and remaining sand	4280	g
Mass of sand required to fill funnel	1465	g
Volume of container	2000	cm^3
Bulk density of sand for testing	1.380	g/cm^3

(1) $V_1 = K\ (m_2 - m_1)\ cm^3$

(2) $\rho_s = m_4 / V_1\ \ g/cm^3$

DENSITY OF SOIL IN PLACED BY SAND - CONE METHOD (2)

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date: 31.10.13

Location: Near Dawnyein Village, Pyapon Township, Irrawaddy Region — Operator: T H & K H A

Point No. & Depth: End Point (GL- 0.5 m)

Apparatus No.: 3 — Soil name: Silty clay — Weather: cloudy

Bulk density of sand ρ_s = 1.379 g/cm^3 — Mass of sand required to fill the funnel m_6 = 1465 g

Test hole No.		No. T-1	No. T-2	No. T-3	No.
Container No.		-	-	-	
Mass (removed soil + container)	g	-	-	-	
Mass of container	g	-	-	-	
Mass of removed soil	m_r g	2366	2532	2774	
Dry mass of removed soil	$m_o = \frac{100\, m_r}{w+100}$ g	1802	1919	2111	
Max. grain size	mm	2	2	2	
Mass of apparatus with sand	m_3 g	7528	7528	7528	
Mass of apparatus with remaining sand	m_8 g	4286	4172	4034	
Mass of sand in hole & funnel	$m_9=m_3-m_8$ g	3242	3356	3494	
Mass of sand in test hole	$m_{10}=m_9-m_6$ g	1777	1891	2029	
Volume of test hole	$v_o = \frac{m_{10}}{\rho_s}$ cm^3	1288.3	1371.0	1471.1	
Bulk density	$\rho_t = \frac{m_r}{v_o}$ g /cm^3	1.84	1.85	1.89	
Dry density	$\rho_d = \frac{m_o}{v_o}$ g /cm^3	1.40	1.40	1.44	

Sketch of testing point

Moisture content

No.	C-2	No.	M-3	No.	E-107	No.	
m_a g	186.02	m_a g	214.82	m_a g	197.36	m_a g	
m_b g	149.42	m_b g	171.09	m_b g	158.07	m_b g	
m_c g	31.85	m_c g	33.20	m_c g	33.38	m_c g	
w %	31.13	w %	31.71	w %	31.51	w %	
No.	E-109	No.	C-508	No.	B-10	No.	
m_a g	173.69	m_a g	231.96	m_a g	214.73	m_a g	
m_b g	139.56	m_b g	182.83	m_b g	173.38	m_b g	
m_c g	30.94	m_c g	30.18	m_c g	41.28	m_c g	
w %	31.42	w %	32.18	w %	31.30	w %	
Mean w =	31.276 %	Mean w =	31.949 %	Mean w =	31.4 %	Mean w =	%

Sketch of test hole

No. No. No. No.

Mean value

Moisture content	w =	31.5 %
Bulk density	ρ_t =	1.86 g/cm^3
Dry density	ρ_d =	1.41 g/cm^3
Max. Grain size		2 mm
Method of moisture content test		Oven drying

Remarks:

SUMMARY OF SOIL TEST RESULTS

Project Name : Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar								
Borehole No. -				Location : Near Myogone and Dawnyein Village, Pyapon Township, Irrawaddy Region				
Sample No.				Start Point	End Point			
Depth (m)				GL - 0.50 m ~ -	GL - 0.50 m ~ -	~	~	~
Moisture Content		w	%	30.41	31.54			
Bulk Density		ρ_t	g/cm^3	1.737	1.856			
Atterberg's Limit	Liquid Limit	WL	%	56.65	40.00			
	Plastic Limit	WP	%	22.65	21.88			
	Plasticity Index	IP	%	34.00	18.12			
Grain Size Analysis	Gravel, (76.20 ~ 4.75) mm		%	-	-			
	Sand, (4.75 ~ 0.075) mm		%	0.88	1.30			
	Silt, (0.075 ~ 0.005) mm		%	52.33	62.30			
	Clay, (< 0.005 mm)		%	46.80	36.40			
Specific Gravity of Soil		Gs (20˚C)		2.721	2.706			
Unconfined Compression	Unconfined Compressive Strength	q_u	kgf/cm^2	-	-			
				-	-			
				-	-			
	Failure Strain	ε_f	%	-	-			
				-	-			
				-	-			
Compaction Test	Maximun Dry Density	ρ_d	t/m^3	1.586	1.666			
	Optimun Moisture Content	W_{opt}	%	22.00	19.00			
Direct Shear Test	Cohesion	C_{UU}	kgf/cm^2	-	-			
	Phi Angle	ϕ_{UU}	Degree	-	-			
California Bearing Ratio Test	CBR Value		%	-	-			
Consolidation	Initial Void Ratio	e_0		-	-			
	Conso. Yield Stress	P_y	kgf/cm^2	-	-			
	Compression Index	C_c		-	-			
Soil Classification (ASTM D 2487 - 06)		Group Symbol		CH	CL			
		Group Name		Fat clay	Lean clay			

NOTE

Data used for reference are shown by red color.

TEST FOR MOISTURE CONTENT OF SOIL

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date: 1.11.13

Location: Near Myogone Village, Pyapon Township, Irrawaddy Region — Operator: H M A , C M A

Test Point No.: Start Point

Sample No. & Depth	Measurement of Moisture Content			Mean moisture content
No.T-1 GL- 0.5 m ~ m	No M-4 m_a 207.46 m_b 167.05 m_b 167.05 m_c 32.28 m_w 40.41 m_s 134.77 w = 29.98 %	No. BD-21 m_a 199.83 m_b 159.11 m_b 159.11 m_c 27.21 m_w 40.72 m_s 131.90 w = 30.87 %	No. E-131 m_a 198.54 m_b 162.18 m_b 162.18 m_c 42.83 m_w 36.36 m_s 119.35 w = 30.47 %	w = 30.44 %
No.T-2 GL- 0.5 m ~ m	No. M-1 m_a 181.09 m_b 147.49 m_b 147.49 m_c 32.64 m_w 33.60 m_s 114.85 w = 29.26 %	No. C-5 m_a 206.69 m_b 165.42 m_b 165.42 m_c 24.72 m_w 41.27 m_s 140.70 w = 29.33 %	No. C-521 m_a 203.48 m_b 164.23 m_b 164.23 m_c 31.19 m_w 39.25 m_s 133.04 w = 29.50 %	w = 29.36 %
No.T-3 GL- 0.5 m ~ m	No. BD-23 m_a 201.22 m_b 159.56 m_b 159.56 m_c 25.42 m_w 41.66 m_s 134.14 w = 31.06 %	No. CB-37 m_a 194.11 m_b 155.73 m_b 155.73 m_c 33.06 m_w 38.38 m_s 122.67 w = 31.29 %	No. E-140 m_a 202.33 m_b 163.72 m_b 163.72 m_c 40.19 m_w 38.61 m_s 123.53 w = 31.26 %	w = 31.20 %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %

Remark: Moisture Content $w = \frac{m_a - m_b}{m_b - m_c} \times 100 = \frac{m_w}{m_s} \times 100$ (%)

m_a = mass of moist soil and container (g)

m_b = mass of dried soil and container (g)

m_c = mass of container (g)

m_w = mass of moisture in soil (g)

m_s = mass of dried soil (g)

TEST FOR MOISTURE CONTENT OF SOIL

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date: 1.11.13

Location: Near Myogone Village, Pyapon Township, Irrawaddy Region — Operator: H M A , C M A

Test Point No.: Start Point

Sample No. & Depth	Measurement of Moisture Content			Mean moisture content
No.T-1 GL- 0.5 m ~ m	No M-4 m_a 207.46 m_b 167.05 m_b 167.05 m_c 32.28 m_w 40.41 m_s 134.77 w = 29.98 %	No. BD-21 m_a 199.83 m_b 159.11 m_b 159.11 m_c 27.21 m_w 40.72 m_s 131.90 w = 30.87 %	No. E-131 m_a 198.54 m_b 162.18 m_b 162.18 m_c 42.83 m_w 36.36 m_s 119.35 w = 30.47 %	w = 30.44 %
No.T-2 GL- 0.5 m ~ m	No. M-1 m_a 181.09 m_b 147.49 m_b 147.49 m_c 32.64 m_w 33.60 m_s 114.85 w = 29.26 %	No. C-5 m_a 206.69 m_b 165.42 m_b 165.42 m_c 24.72 m_w 41.27 m_s 140.70 w = 29.33 %	No. C-521 m_a 203.48 m_b 164.23 m_b 164.23 m_c 31.19 m_w 39.25 m_s 133.04 w = 29.50 %	w = 29.36 %
No.T-3 GL- 0.5 m ~ m	No. BD-23 m_a 201.22 m_b 159.56 m_b 159.56 m_c 25.42 m_w 41.66 m_s 134.14 w = 31.06 %	No. CB-37 m_a 194.11 m_b 155.73 m_b 155.73 m_c 33.06 m_w 38.38 m_s 122.67 w = 31.29 %	No. E-140 m_a 202.33 m_b 163.72 m_b 163.72 m_c 40.19 m_w 38.61 m_s 123.53 w = 31.26 %	w = 31.20 %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %
No. m ~ m	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	No. m_a m_b m_b m_c m_w m_s w = %	w = %

Remark: Moisture Content $w = \frac{m_a - m_b}{m_b - m_c} \times 100 = \frac{m_w}{m_s} \times 100$ (%)

m_a = mass of moist soil and container (g)

m_b = mass of dried soil and container (g)

m_c = mass of container (g)

m_w = mass of moisture in soil (g)

m_s = mass of dried soil (g)

SPECIFIC GRAVITY TEST

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Date: 6.11.13

Location: Near Myogon and Dawnyein Village, Pyapon Township, Irrawaddy Region

Operator: H S, C M A

I Calibration of Pycnometer

Number of measurement		1	2	3	1	2	3
Number of Pycnometer		4	8	10	198	199	200
Mass of Pycnometer	m_f g	47.492	46.917	46.341	44.551	57.258	48.967
Mass of (distilled water + pycnometer)	$m_{a'}$ g	150.697	151.273	148.677	138.357	154.163	149.308
Temperature of water	T ' °C	27.5	27.5	27.5	27.5	27.5	27.5
Density of water at T' °C / Density of water at T °C	= $G_T^{(Table)} / G_{T'}$	1.00067	1.00067	1.00067	1.00067	1.00067	1.00067
ma' - mf	g	103.205	104.356	102.336	93.806	96.905	100.341
(1) $G_T / G_{T'} \times (m_a' - m_f)$	g	103.275	104.426	102.405	93.869	96.970	100.409
Convert mass of (water + pycnometer) at T ' °C	$m_a = (1) + m_f$ g	150.767	151.343	148.746	138.420	154.228	149.376

II Specific Gravity Test

Sample No. & Depth		No. Start Point (GL-0.50) m			No. End Point (GL-0.50) m		
Number of measurement		1	2	3	1	2	3
Number of pycnometer		4	8	10	198	199	200
Mass of (oven-dried or wet soil + water + pycnometer)	m_b g	158.843	159.262	156.373	146.269	162.298	157.414
Temperature of contents in pycnometer	T °C	25.0	25.0	25.0	25.0	25.0	25.0
Mass of oven - dried soil in pycnometer	No. of container	-	-	-	-	-	-
	Mass of (oven-dried soil + container) g	-	-	-	-	-	-
m_s g	Mass of container	-	-	-	-	-	-
	m_s g	12.767	12.505	12.049	12.444	12.798	12.735
Converted mass of (water + pycnometer) at T ' °C	m_a g	150.767	151.343	148.746	138.420	154.228	149.376
$m_s + (m_a - m_b)$	g	4.691	4.586	4.422	4.595	4.728	4.697
Gs at T °C , Gs (T °C / T °C) = $m_s / (m_s + (m_a - m_b))$		2.722	2.727	2.725	2.708	2.707	2.712
Correction factor (Table)	K	0.99790	0.99790	0.99790	0.99790	0.99790	0.99790
Gs at 15 °C Gs (T °C / 15 °C) = K .Gs (T °C / T °C)		2.716	2.721	2.719	2.702	2.701	2.706
Mean Value		Gs (T °C / 15 °C) = 2.719			Gs (T °C / 15 °C) = 2.703		
Correction factor 20 °C (Table)	K'	0.99884	0.99884	0.99884	0.99884	0.99884	0.99884
Gs at 20 °C Gs (T °C / 20 °C) = K'.Gs (T °C / T °C)		2.719	2.723	2.722	2.705	2.704	2.708
Mean Value		Gs (T °C / 20 °C) = 2.721			Gs (T °C / 20 °C) = 2.706		

Remarks :

PARTICLE SIZE ANALYSIS TEST (For Hydrometer Test)

Project Name	Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar	Date	7.11.13
Location	Near Myogon Village, Pyapon Township, Irrawaddy Region	Operator	T T H, A S M
Sample No.	Start Point, (GL- 0.5 m)		

Mass of (Air-Dried Soil + Cont:)	= g	Specific Gravity	Gs = 2.719
Mass of Container No. ( )	= g	Plasticity Index	Ip = 34.00
Mass of Air - Dried Soil m_s	= g	Dispersing Agent	*100ml of Na_2SiO_3*
		$\frac{m_2}{m_o}$	= -

1. Measurement of Moisture Content of Air - Dried Soil

												Mean Moisture Content
No.				No.				No.				
m_a		m_b		m_a		m_b		m_a		m_b		
m_b		m_c		m_b		m_c		m_b		m_c		
m_w		m_s		m_w		m_s		m_w		m_s		w = %
w=	%			w=	%			w=	%			

Mass of Dry Soil $m_{so} = \frac{100\, m_s}{100 + w}$ = 40.00 g

2. Hydrometer Test **Container No.** BO-2 **Cylinder No.** G **Hydrometer No.** 198

1		2	3	4	5	6	7	8	9	10	11	12	13
Measured Time	Elapsed	Reading of Hydro:		Water Temp:	Effective Depth L	$\frac{L}{60t}$	$\sqrt{\frac{L}{60t}}$	$\sqrt{\frac{0.018\,\eta}{(Gs-1)\,\rho_w}}$	Particle Size 7 x 8	Correct: factor F	r' + F	P (11) x M	Corrected P P x m_2/m_0
9:30	Time min	Decimal Place	r' 2 + Cm	°C	mm	mm/s			mm			%	%
9:31	1	0.0235	0.0221	25.0	130.7112	2.17852	1.47598	0.03088	0.04558	0.0018	0.0239	94.24	
9:32	2	0.0222	0.0208	25.0	133.0343	1.10862	1.05291	0.03088	0.03252	0.0018	0.0226	89.11	
9:35	5	0.0200	0.0186	25.0	136.9657	0.45655	0.67569	0.03088	0.02087	0.0018	0.0204	80.44	
9:45	15	0.0175	0.0161	25.0	141.4332	0.15715	0.39642	0.03088	0.01224	0.0018	0.0179	70.58	
10:00	30	0.0155	0.0141	25.0	145.0072	0.08056	0.28383	0.03088	0.00877	0.0018	0.0159	62.69	
10:30	60	0.0130	0.0116	25.0	149.4747	0.04152	0.20377	0.03088	0.00629	0.0018	0.0134	52.84	
13:30	240	0.0090	0.0076	25.0	156.6227	0.01088	0.10429	0.03088	0.00322	0.0018	0.0094	37.06	
9:30	1440	0.0054	0.0040	25.0	163.0559	0.00189	0.04344	0.03088	0.00134	0.0018	0.0058	22.87	

$\frac{1}{m_{so}/V}$ = 25.000 cm^3/g $\frac{Gs}{(Gs - 1)} \times \rho_w$ = 1.5772 g/cm^3 $M = \frac{100}{m_{so}/V} \times \frac{Gs}{(Gs - 1)} \times \rho_w$ = 3943.001

m_{so} / V : Mass of dry soil per 1 ml of suspension **Meniscus correction C_m** 0.0008

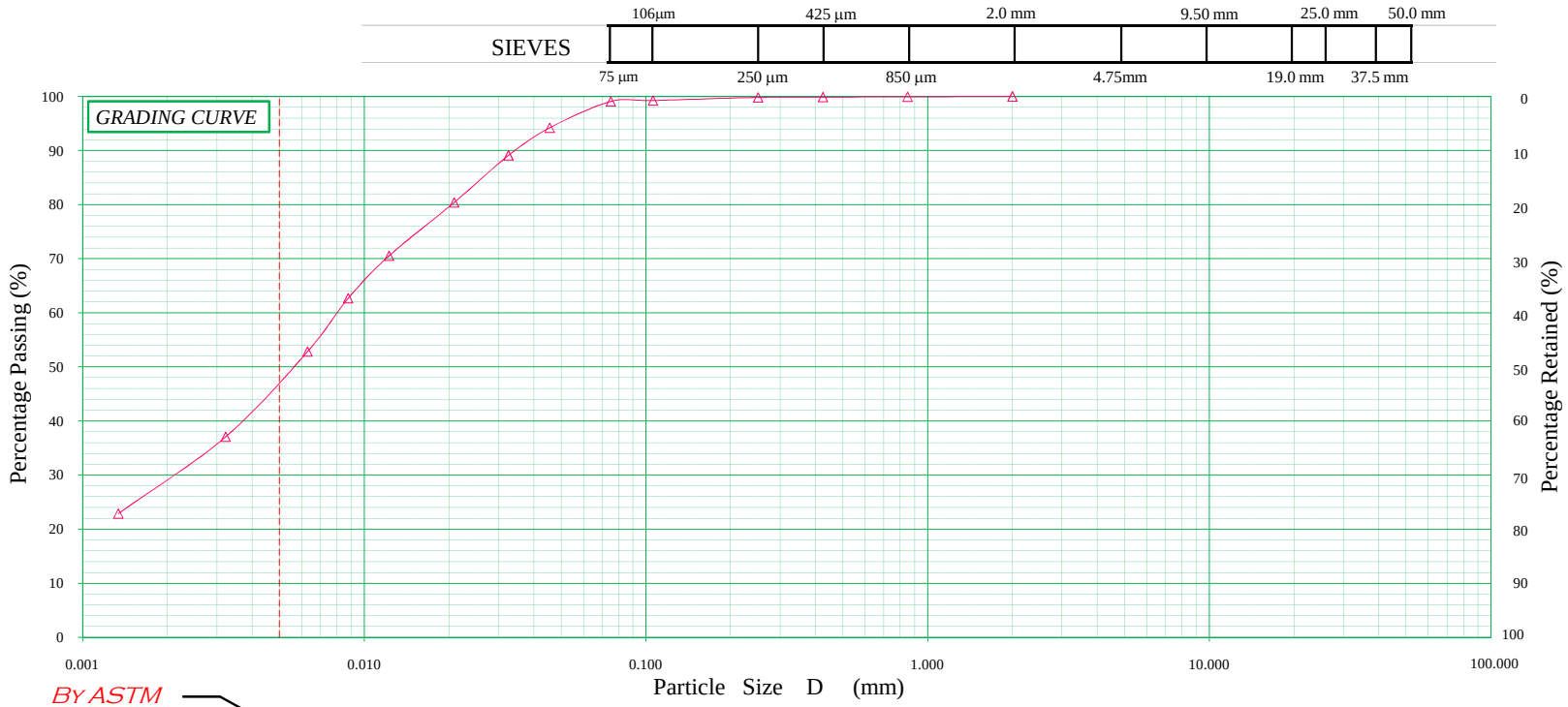
3. Sieve Analysis

Sieve Size (μm)	Container No.	(Retained Soil + Cont :) Mass (g)	Container Mass (g)	Retained Soil Mass (g)	Retained (%)	Accumulative (%)	Accumulative P (%) 100.00	Corrected P P x m_2/m_0 (%)
850				0.01	0.03	0.03	99.98	
425				0.02	0.05	0.08	99.93	
250				0.03	0.08	0.15	99.85	
105				0.22	0.55	0.70	99.30	
75				0.07	0.18	0.88	99.13	

Remarks:

PARTICLE SIZE ANALYSIS TEST (Grain Size Distribution Curve)

SAMPLE No. Start Point, (GL- 0.5 m)	DATE: 7.11.13
PROJECT: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in	LOCATION: Near Myogon Village, Pyapon Township, Irrawaddy Region



Colloids	Fines (Clay)	Fines (Silt)	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Gravel	Cobble
	0.005	0.075	0.425	2.0	4.75	19.00	75.00	

Remarks:		TEST BY:	T T H, A S M
Gravel(%)= -	Silt(%) = 52.33		
Sand(%) = 0.88	Clay(%) = 46.80	CHECK BY:	T H

PARTICLE SIZE ANALYSIS TEST (For Hydrometer Test)

Project Name	Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar	Date	7.11.13
Location	Near Dawnyein Village, Pyapon Township, Irrawaddy Region	Operator	T T H, H M A
Sample No.	End Point, (GL- 0.5 m)		

Mass of (Air-Dried Soil + Cont:) = ____ g
Mass of Container No. ( ) = ____ g
Mass of Air - Dried Soil m_s = ____ g

Specific Gravity Gs = 2.703
Plasticity Index Ip = 18.12
Dispersing Agent *100ml of Na_2SiO_3*
$\frac{m_2}{m_o}$ = -

1. Measurement of Moisture Content of Air - Dried Soil

No.	No.	No.	Mean Moisture Content
m_a m_b m_w m_b m_c m_s	m_a m_b m_w m_b m_c m_s	m_a m_b m_w m_b m_c m_s	w = %
w= ,%	w= ,%	w= ,%	

Mass of Dry Soil $m_{so} = \frac{100\ m_s}{100 + w}$ = 40.00 g

2. Hydrometer Test **Container No.** BO-16 **Cylinder No.** H **Hydrometer No.** 198

1		2	3	4	5	6	7	8	9	10	11	12	13
Measured Time	Elapsed	Reading of Hydro:		Water Temp:	Effective Depth L	$\frac{L}{60t}$	$\sqrt{\frac{L}{60t}}$	$\sqrt{\frac{0.018\ \eta}{(Gs-1)\ \rho_w}}$	Particle Size 7 x 8	Correct: factor F	r' + F	P (11) x M	Corrected P P x m_2/m_0
9:36	Time min	Decimal Place	r' 2 + Cm	°C	mm	mm/s			mm			%	%
9:37	1	0.0215	0.0201	25.0	134.3345	2.23891	1.49630	0.03102	0.04642	0.0018	0.0219	86.64	
9:38	2	0.0190	0.0176	25.0	138.8020	1.15668	1.07549	0.03102	0.03337	0.0018	0.0194	76.75	
9:41	5	0.0160	0.0146	25.0	144.1630	0.48054	0.69321	0.03102	0.02151	0.0018	0.0164	64.88	
9:51	15	0.0130	0.0116	25.0	149.5240	0.16614	0.40760	0.03102	0.01265	0.0018	0.0134	53.01	
10:06	30	0.0110	0.0096	25.0	153.0980	0.08505	0.29164	0.03102	0.00905	0.0018	0.0114	45.10	
10:36	60	0.0100	0.0086	25.0	154.8850	0.04302	0.20742	0.03102	0.00644	0.0018	0.0104	41.15	
13:36	240	0.0070	0.0056	25.0	160.2460	0.01113	0.10549	0.03102	0.00327	0.0018	0.0074	29.28	
9:36	1440	0.0045	0.0031	25.0	164.7135	0.00191	0.04366	0.03102	0.00135	0.0018	0.0049	19.39	

$\frac{1}{m_{so}/V}$ = 25.000 cm^3/g $\frac{Gs}{(Gs - 1)} \times \rho_w$ = 1.5825 g/cm^3 $M = \frac{100}{m_{so}/V} \times \frac{Gs}{(Gs - 1)} \times \rho_w$ = 3956.319

m_{so} / V : Mass of dry soil per 1 ml of suspension **Meniscus correction C_m** 0.0008

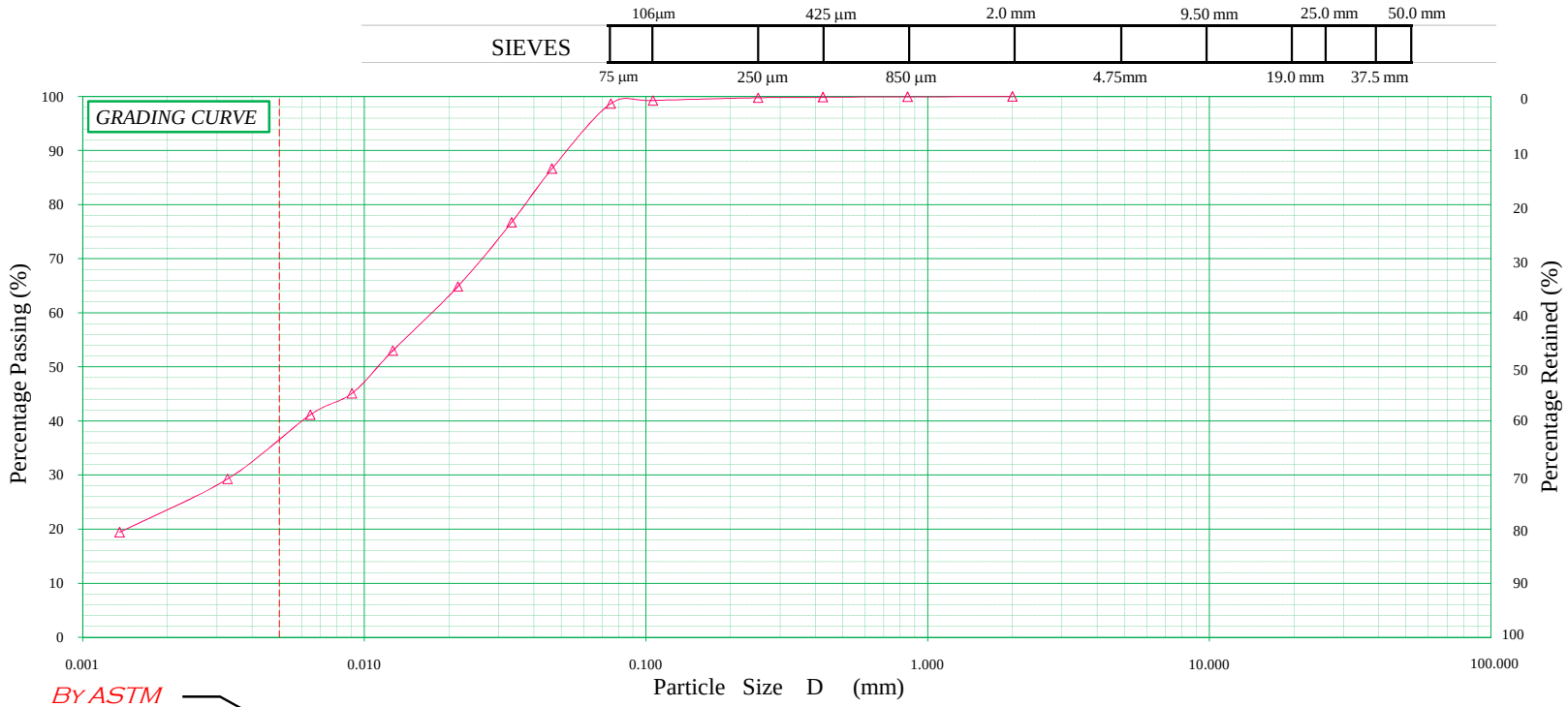
3. Sieve Analysis

Sieve Size (μm)	Container No.	(Retained Soil + Cont :) Mass (g)	Container Mass (g)	Retained Soil Mass (g)	Retained (%)	Accumulative (%)	Accumulative P (%) 100.00	Corrected P P x m_2/m_0 (%)
850				0.02	0.05	0.05	99.95	
425				0.02	0.05	0.10	99.90	
250				0.03	0.08	0.18	99.83	
105				0.22	0.55	0.73	99.28	
75				0.23	0.58	1.30	98.70	

Remarks:

PARTICLE SIZE ANALYSIS TEST (Grain Size Distribution Curve)

SAMPLE No. End Point, (GL- 0.5 m)	DATE: 7.11.13
PROJECT: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in	LOCATION: Near Dawnyein Village, Pyapon Township, Irrawaddy Region



Colloids	Fines (Clay)	Fines (Silt)	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Gravel	Cobble
	0.005	0.075	0.425	2.0	4.75	19.00	75.00	

Remarks:		TEST BY:	T T H, H M A
Gravel(%)= -	Silt(%) = 62.30		
Sand(%) = 1.30	Clay(%) = 36.40	CHECK BY:	T H

ATTERBERG'S LIMITS TEST

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Date: 7.11.13

Location: Near Myogone and Dawnyein Village, Pyapon Township, Irrawaddy Region

Operator: Y Y S

Sample No. & Depth: Start point (GL- 0.50 m)

LIQUID LIMIT TEST

Number of blows	43	Number of blows	34	Number of blows	27
No.	A123	No.	A80	No.	A-111
m_a	31.30	m_b	23.85	m_a	28.99	m_b	22.53
m_b	23.85	m_c	9.97	m_b	25.51	m_c	11.04	m_b	22.53	m_c	10.93
m_w	7.45	m_s	13.88	m_w	7.98	m_s	14.47	m_w	6.46	m_s	11.60
w=	53.67 %	w=	55.15 %	w=	55.69 %

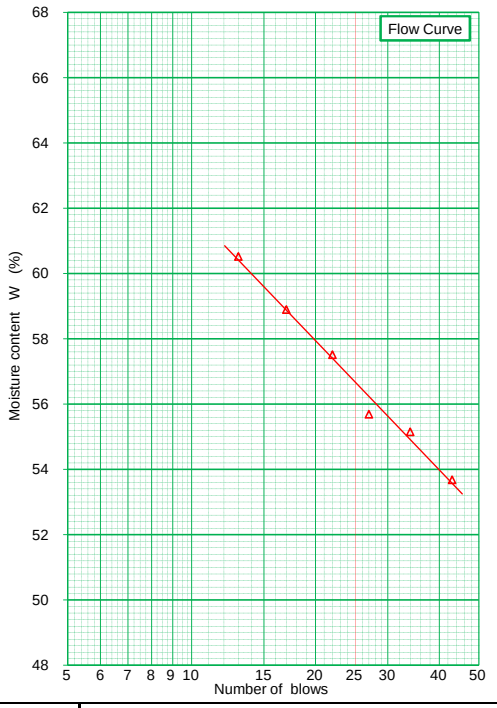
Number of blows	22	Number of blows	17	Number of blows	13
No.	A-84	No.	A-17	No.	A-6
m_a	28.06	m_b	21.40	m_a	36.41	m_b	28.53	m_a	36.28	m_b	28.80
m_b	21.40	m_c	9.82	m_b	28.53	m_c	15.15	m_b	28.80	m_c	16.44
m_w	6.66	m_s	11.58	m_w	7.88	m_s	13.38	m_w	7.48	m_s	12.36
w=	57.51 %	w=	58.89 %	w=	60.52 %

PLASTIC LIMIT TEST

No.	22	No.		No.	
m_a	42.66	m_b	38.26	m_a		m_b		m_a		m_b	
m_b	38.26	m_c	18.83	m_b		m_c		m_b		m_c	
m_w	4.40	m_s	19.43	m_w		m_s		m_w		m_s	
w=	22.65 %	w=	%	w=	%

Liquid limit WL	Plastic limit WP	Plasticity index IP	
56.65 %	22.65 %	34.00	

Remarks:



Sample No. & Depth: End point (GL- 0.50 m)

LIQUID LIMIT TEST

Number of blows	38	Number of blows	30	Number of blows	27
No.	A-38	No.	A-47	No.	A-20
m_a	35.93	m_b	31.01	m_a	35.04	m_b	28.97	m_a	37.14	m_b	31.22
m_b	31.01	m_c	18.20	m_b	28.97	m_c	13.46	m_b	31.22	m_c	16.35
m_w	4.92	m_s	12.81	m_w	6.07	m_s	15.51	m_w	5.92	m_s	14.87
w=	38.41 %	w=	39.14 %	w=	39.81 %

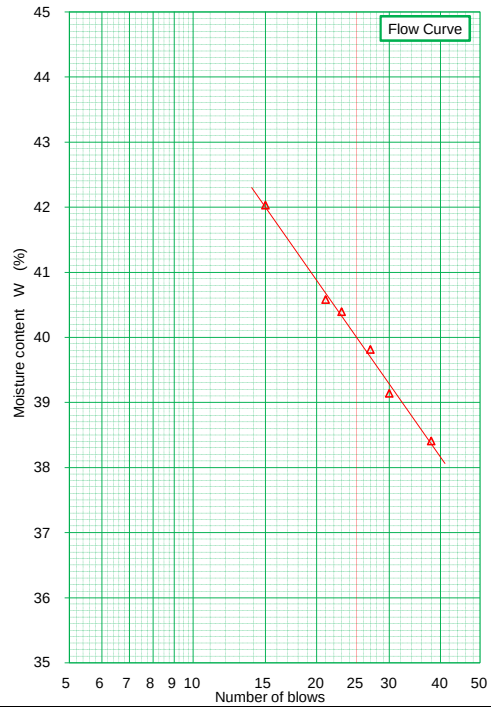
Number of blows	23	Number of blows	21	Number of blows	15
No.	A-17	No.	A-22	No.	A-127
m_a	36.87	m_b	31.09	m_a	39.08	m_b	32.47	m_a	39.47	m_b	32.96
m_b	31.09	m_c	16.78	m_b	32.47	m_c	16.18	m_b	32.96	m_c	17.47
m_w	5.78	m_s	14.31	m_w	6.61	m_s	16.29	m_w	6.51	m_s	15.49
w=	40.39 %	w=	40.58 %	w=	42.03 %

PLASTIC LIMIT TEST

No.	39	No.		No.	
m_a	39.04	m_b	35.24	m_a		m_b		m_a		m_b	
m_b	35.24	m_c	17.87	m_b		m_c		m_b		m_c	
m_w	3.80	m_s	17.37	m_w		m_s		m_w		m_s	
w=	21.88 %	w=	%	w=	%

Liquid limit WL	Plastic limit WP	Plasticity index IP	
40.00 %	21.88 %	18.12	

Remarks:



SOIL CLASSIFICATION

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Location: Near Myogone and Dawnyein Village, Pyapon Township, Irrawaddy Region

Sheet No. 1 of 1

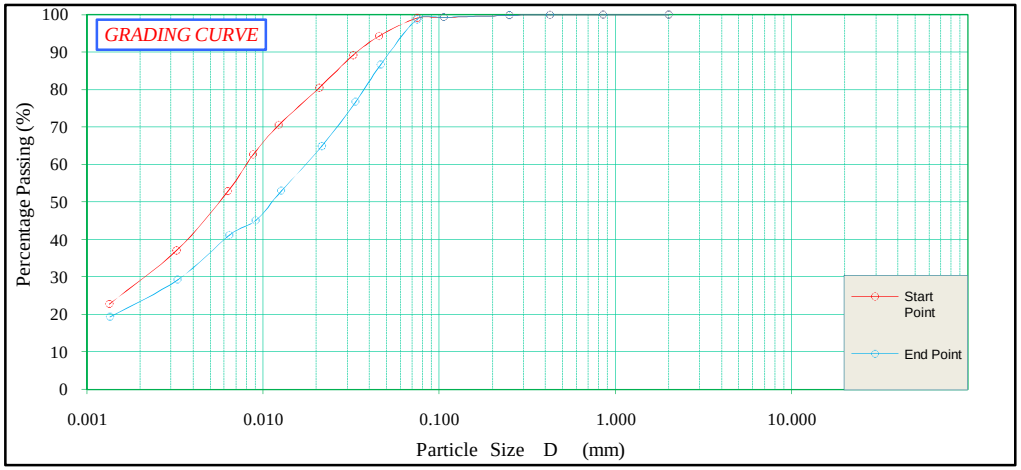
Soil Classification System Unified Soil Classification System of ASTM D 2487 - 06

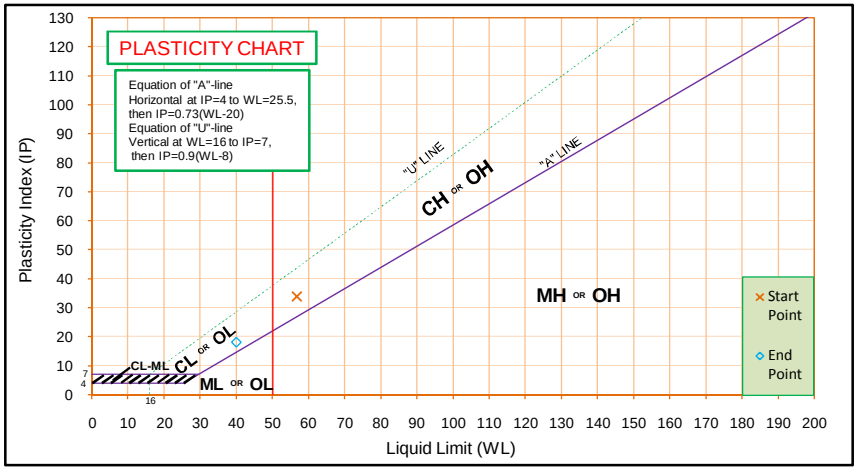
Date 12.11.13

Classified by T H

Check by T H

Sample No. & Depth			Start Point (GL - 0.50)m	End Point (GL - 0.50)m
Gravel	(75.00 ~ 4.75) mm	(%)	-	-
Sand	(4.75 ~ 0.075) mm	(%)	0.88	1.30
Silt	(0.075 ~ 0.005) mm	(%)	52.33	62.30
Clay	< 0.005 mm	(%)	46.80	36.40
Maximum Particle Diameter		(mm)	2.00	2.00
Coefficient of Uniformity	(Cu)		-	-
Coefficient of Curvature	(Cc)		-	-
Liquid Limit	(WL)	(%)	56.65	40.00
Plastic Limit	(WP)	(%)	22.65	21.88
Plasticity Index	(IP)		34.00	18.12
Classified Soil Name (Group Name)			**Fat clay**	**Lean clay**
Classified symbol (Group Symbol)			**CH**	**CL**





COMPACTION TESTS

Project Name : Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date : 16.11.13

Location : Near Myogone Village, Pyapon Township, Irrawaddy Region

Sample No. & Depth : Start Point (GL - 0.5 m) — Operator : T.H & S.O.P

Test Purpose : **Compaction Test** , CBR Test — Testing Method :

Compaction Method : **Class 1** , Class 2 , Other — Preparation : **Dried** , Non - dried

Moisture Content : Before dried 30.41 % After dried 2.64 % — Sample Use : **Repeating** , Non - repeating

Mold : No 1 Mass : (Mold , ~~Baseplate , Spacer disc~~) Total 2.102 kg

Volume : **10 cm Mold 1000 cm³** , 15 cm Mold 2209 cm³ , Other cm Mold cm³

Test Number	1	2	3	4
Mass (sample+mold) kg	3.828	3.932	4.034	4.040
Mass of specimen kg	1.726	1.830	1.932	1.938
Bulk density ρ t t / m³	1.726	1.830	1.932	1.938
Moisture Content	No. D-8 m_a 104.60 m_b 91.71 m_b 91.71 m_c 8.91 m_w 12.89 m_s 82.80 W 15.57 %	No. D-1 m_a 97.08 m_b 83.29 m_b 83.29 m_c 9.56 m_w 13.79 m_s 73.73 W 18.70 %	No. D-14 m_a 105.81 m_b 88.65 m_b 88.65 m_c 9.82 m_w 17.16 m_s 78.83 W 21.77 %	No. D-4 m_a 99.35 m_b 81.18 m_b 81.18 m_c 9.02 m_w 18.17 m_s 72.16 W 25.18 %
	No. D-19 m_a 109.83 m_b 96.36 m_b 96.36 m_c 9.67 m_w 13.47 m_s 86.69 W 15.54 %	No. D-10 m_a 95.54 m_b 81.92 m_b 81.92 m_c 9.44 m_w 13.62 m_s 72.48 W 18.79 %	No. D-22 m_a 104.66 m_b 87.57 m_b 87.57 m_c 9.60 m_w 17.09 m_s 77.97 W 21.92 %	No. D-18 m_a 96.76 m_b 79.26 m_b 79.26 m_c 9.94 m_w 17.50 m_s 69.32 W 25.25 %
Mean value w %	15.55	18.75	21.84	25.21
Dry density ρ d t / m³	1.494	1.541	1.586	1.548

Test Number	5	6	7	8
Mass (sample+mold) kg	4.018	3.990		
Mass of specimen kg	1.916	1.888		
Bulk density ρ t t / m³	1.916	1.888		
Moisture Content	No. D-2 m_a 92.30 m_b 74.43 m_b 74.43 m_c 9.79 m_w 17.87 m_s 64.64 W 27.65 %	No. D-20 m_a 92.33 m_b 73.36 m_b 73.36 m_c 9.36 m_w 18.97 m_s 64.00 W 29.64 %	No. m_a m_b m_b m_c m_w m_s W %	No. m_a m_b m_b m_c m_w m_s W %
	No. D-3 m_a 95.42 m_b 76.76 m_b 76.76 m_c 9.47 m_w 18.66 m_s 67.29 W 27.73 %	No. V-46 m_a 102.97 m_b 81.00 m_b 81.00 m_c 6.66 m_w 21.97 m_s 74.34 W 29.55 %	No. m_a m_b m_b m_c m_w m_s W %	No. m_a m_b m_b m_c m_w m_s W %
Mean value w %	27.69	29.60		
Dry density ρ d t / m³	1.501	1.457		

Remarks :

1 Other Compaction Method Mass of rammer Kg , Drop height cm , Blows per layer( )Layers

2 Dry Density $\rho d = \frac{\rho t}{w + 100} \times 100$ t / m³

COMPACTION TESTS

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Date: 16.11.13

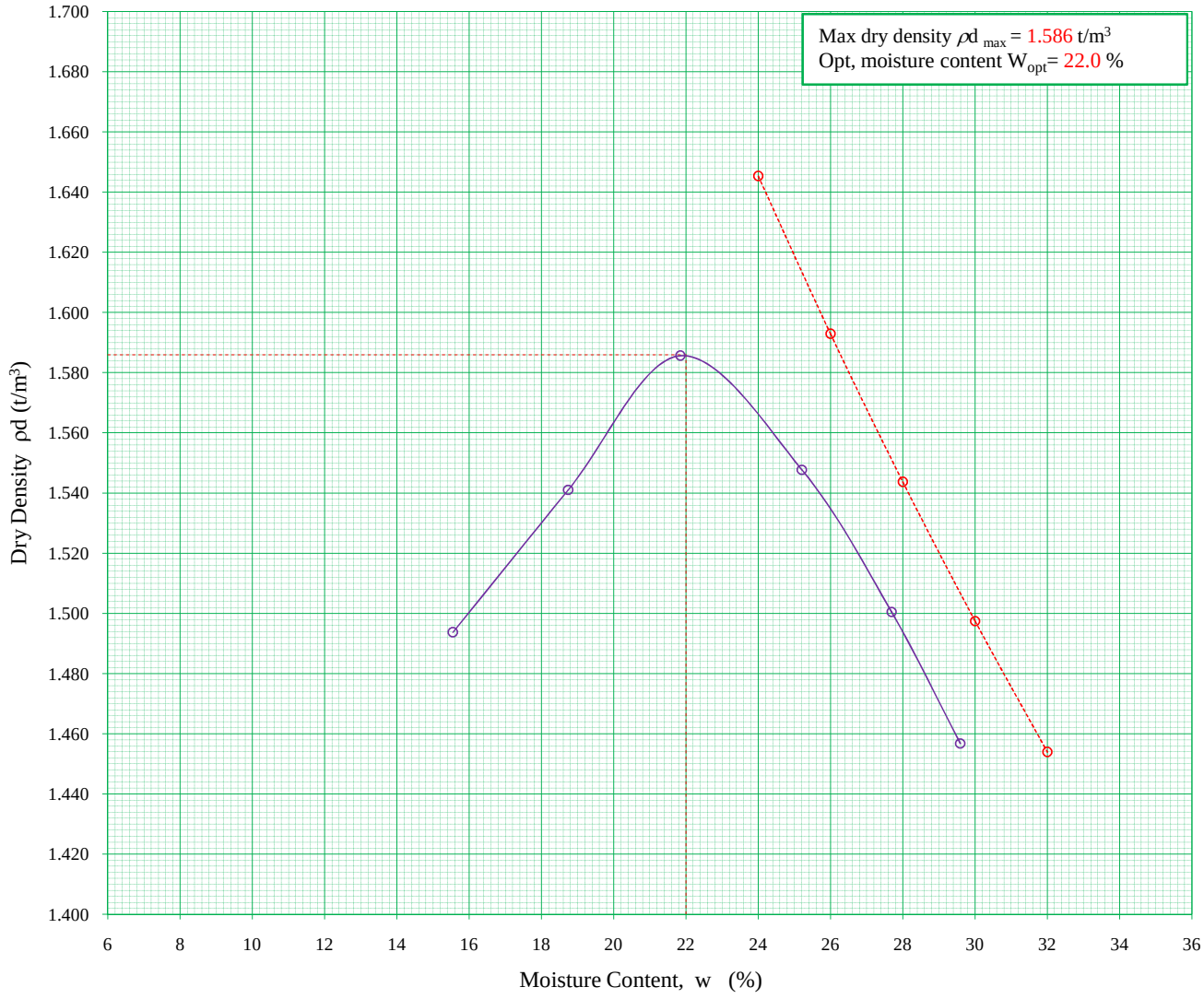
Location: Near Myogone Village, Pyapon Township, Irrawaddy Region

Sample No. & Depth: Start Point (GL - 0.5 m)

Operator: T.H & S.O.P

Test Purpose	, **Compaction Test** , CBR Test	Moisture Content	,Before drying 30.41 %, After drying 2.64 %
Testing Method	, -	Specific Gravity	2.719
Compaction Method	, **Class 1** , Class 2 , Other	Sample Preparation	,**Drying** , Non-drying
Mold	, **10 cm** , 15 cm , cm	Sample Use	,**Repeating** , Non-Repeating
Max . Grain Size	, 2.00 mm		

Test Number	1	2	3	4	5	6	7	8
Dry Density ρd t/m^3	1.494	1.541	1.586	1.548	1.501	1.457		
Moisture Content w %	15.55	18.75	21.84	25.21	27.69	29.60		



Remarks: Other compaction method Mass of rammer ..... kg Drop height ..... cm, Blow per layer ..... ,( )layers

Zero -air void curve $\rho_{d\,sat} = \frac{1}{1/Gs + w/100} \times \rho_w\ (t/m^3)$

COMPACTION TESTS

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar — Date: 16.11.13

Location: Near Dawnyein Village, Pyapon Township, Irrawaddy Region

Sample No. & Depth: End Point (GL - 0.5 m) — Operator: T.H & S.O.P

Test Purpose : **Compaction Test** , CBR Test — Testing Method :

Compaction Method : **Class 1** , Class 2 , Other — Preparation : **Dried** , Non - dried

Moisture Content : Before dried 31.54 % After dried 1.91 % — Sample Use : **Repeating** , Non - repeating

Mold : No 1 Mass : (Mold , ~~Baseplate , Spacer disc~~) Total 2.102 kg

Volume : **10 cm Mold 1000 cm³** , 15 cm Mold 2209 cm³ , Other cm Mold cm³

Test Number	1	2	3	4
Mass (sample+mold) kg	3.794	3.864	3.948	4.042
Mass of specimen kg	1.692	1.762	1.846	1.940
Bulk density ρ t t / m³	1.692	1.762	1.846	1.940
Moisture Content	No. 134 m_a 89.42 m_b 82.70 m_b 82.70 m_c 9.23 m_w 6.72 m_s 73.47 W 9.15 %	No. 142 m_a 84.47 m_b 76.63 m_b 76.63 m_c 8.96 m_w 7.84 m_s 67.67 W 11.59 %	No. V-23 m_a 72.42 m_b 64.21 m_b 64.21 m_c 7.23 m_w 8.21 m_s 56.98 W 14.41 %	No. 187 m_a 91.01 m_b 79.00 m_b 79.00 m_c 8.67 m_w 12.01 m_s 70.33 W 17.08 %
	No. 147 m_a 81.92 m_b 75.70 m_b 75.70 m_c 7.50 m_w 6.22 m_s 68.20 W 9.12 %	No. 231 m_a 83.22 m_b 75.84 m_b 75.84 m_c 12.48 m_w 7.38 m_s 63.36 W 11.65 %	No. 141 m_a 92.38 m_b 81.96 m_b 81.96 m_c 10.01 m_w 10.42 m_s 71.95 W 14.48 %	No. 192 m_a 101.98 m_b 88.83 m_b 88.83 m_c 12.38 m_w 13.15 m_s 76.45 W 17.20 %
Mean value w %	9.13	11.62	14.45	17.14
Dry density ρ d t / m³	1.550	1.579	1.613	1.656

Test Number	5	6	7	8
Mass (sample+mold) kg	4.098	4.070	4.018	
Mass of specimen kg	1.996	1.968	1.916	
Bulk density ρ t t / m³	1.996	1.968	1.916	
Moisture Content	No. V-75 m_a 80.97 m_b 68.24 m_b 68.24 m_c 5.57 m_w 12.73 m_s 62.67 W 20.31 %	No. V-1 m_a 89.40 m_b 73.48 m_b 73.48 m_c 6.08 m_w 15.92 m_s 67.40 W 23.62 %	No. V-24 m_a 107.76 m_b 86.52 m_b 86.52 m_c 5.56 m_w 21.24 m_s 80.96 W 26.24 %	No. m_a m_b m_b m_c m_w m_s W %
	No. 211 m_a 80.66 m_b 68.63 m_b 68.63 m_c 9.07 m_w 12.03 m_s 59.56 W 20.20 %	No. V-3 m_a 94.77 m_b 77.82 m_b 77.82 m_c 6.36 m_w 16.95 m_s 71.46 W 23.72 %	No. V-44 m_a 106.82 m_b 85.91 m_b 85.91 m_c 6.03 m_w 20.91 m_s 79.88 W 26.18 %	No. m_a m_b m_b m_c m_w m_s W %
Mean value w %	20.26	23.67	26.21	
Dry density ρ d t / m³	1.660	1.591	1.518	

Remarks :

1 Other Compaction Method Mass of rammer Kg , Drop height cm , Blows per layer( )Layers

2 Dry Density $\rho d = \frac{\rho t}{w + 100} \times 100$ t / m³

COMPACTION TESTS

Project Name: Subsurface Soil Investigation for The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Date: 16.11.13

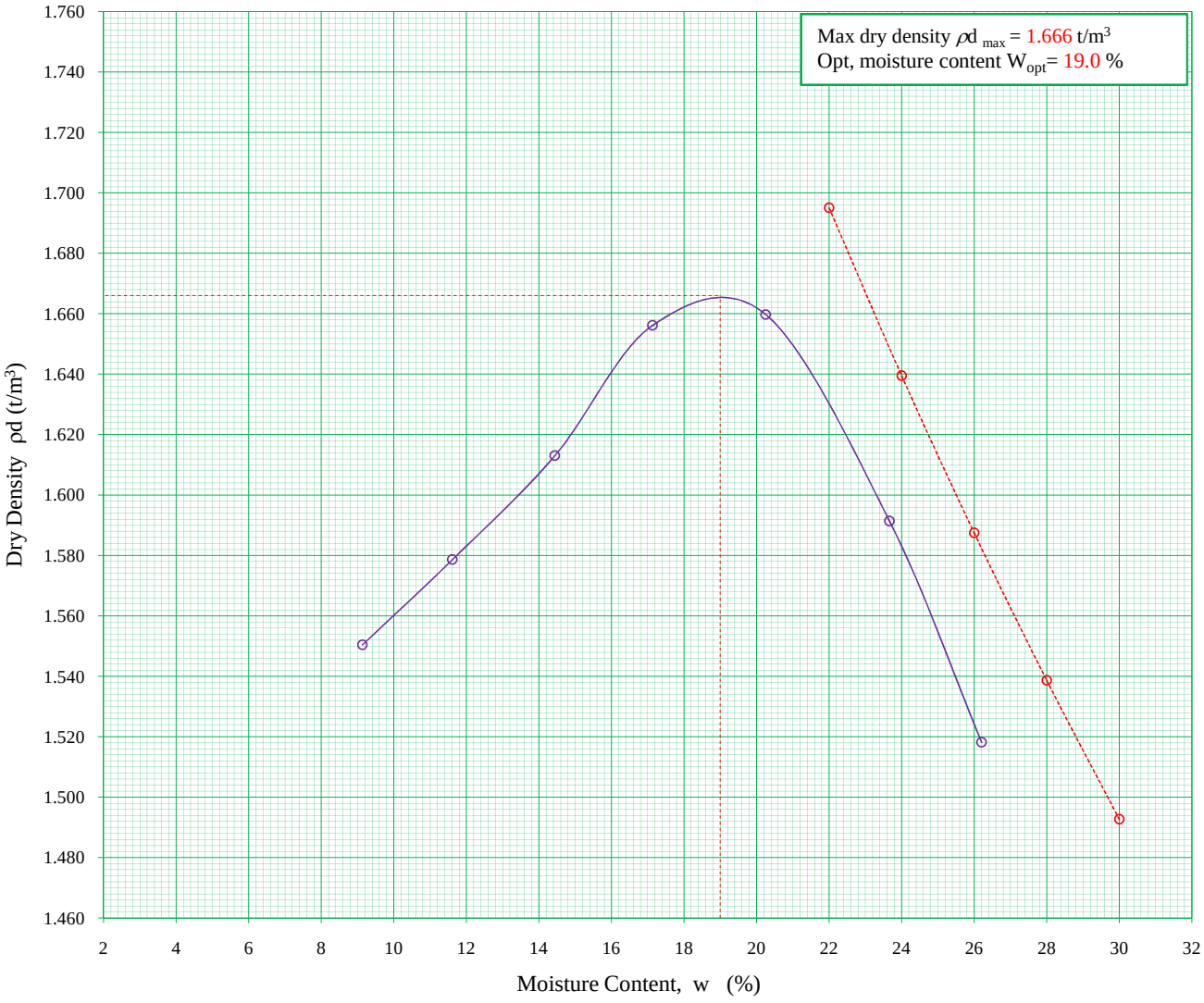
Location: Near Dawnyein Village, Pyapon Township, Irrawaddy Region

Sample No. & Depth: End Point (GL - 0.5 m)

Operator: T.H & S.O.P

Test Purpose	, **Compaction Test** , CBR Test	Moisture Content	,Before drying 31.54 %, After drying 1.91 %
Testing Method	, -	Specific Gravity	2.703
Compaction Method	, **Class 1** , Class 2 , Other	Sample Preparation	,**Drying** , Non-drying
Mold	, **10 cm** , 15 cm , cm	Sample Use	,**Repeating** , Non-Repeating
Max . Grain Size	, 2.00 mm		

Test Number	1	2	3	4	5	6	7	8
Dry Density ρd t/m^3	1.550	1.579	1.613	1.656	1.660	1.591	1.518	
Moisture Content w %	9.13	11.62	14.45	17.14	20.26	23.67	26.21	



Remarks: Other compaction method Mass of rammer ..... kg Drop height ..... cm, Blow per layer ..... ,( )layers

Zero -air void curve

$$\rho_{d\,sat} = \frac{1}{1/Gs + w/100} \times \rho_w \ (t/m^3)$$

APPENDIX "C"

LABORATORY TEST RESULTS

SUMMARY OF SOIL TEST RESULTS

Project Name : Soil Investigation for Road Improvement of Myogone-Dawnyein Region

Borehole No. BH-01 | Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Division

Sample No.				P-1	T-1	T-2	T-3	P-9
Depth (m)				1.00 ~ 1.50	3.00 ~ 3.80	6.00 ~ 6.50	9.00 ~ 9.80	12.00 ~ 12.50
Moisture Content		w	%	43.45	48.89	44.40	55.45	48.23
Bulk Density		ρ_t	g/cm^3	-	1.738	1.758	1.703	-
Atterberg's Limit	Liquid Limit	WL	%	69.50	48.27	36.10	59.80	50.07
	Plastic Limit	WP	%	26.86	30.36	23.52	23.98	22.23
	Plasticity Index	IP	%	42.64	17.91	12.58	35.82	27.84
Grain Size Analysis	Gravel, (76.20 ~ 4.75) mm		%	-	-	-	-	-
	Sand, (4.75 ~ 0.075) mm		%	0.25	16.90	2.04	1.05	1.85
	Silt, (0.075 ~ 0.005) mm		%	57.35	58.80	76.26	48.95	58.45
	Clay, (< 0.005 mm)		%	42.40	24.30	21.70	50.00	39.70
Specific Gravity of Soil		Gs (20˚C)		2.776	2.736	2.741	2.748	2.742
Unconfined Compression	Unconfined Compressive Strength	q_u	kgf/cm^2	-	0.315	0.373	0.501	-
				-	0.374	0.387	0.481	-
	Failure Strain	ε_f	%	-	4.54	6.27	5.14	-
				-	4.78	7.61	4.57	-
Direct Shear Test	Cohesion	C_{UU}	kgf/cm^2	-	0.352	-	0.064	-
	Phi Angle	ϕ_{UU}	Degree	-	16.96	-	35.75	-
Unconsolidated Undrained Triaxial Compression Test	Cohesion	C_{UU}	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ_{UU}	Degree	-	-	-	-	-
Consolidated Undrained Triaxial Compression Test (Measurement of Pore Pressure)	Cohesion	C'	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ'	Degree	-	-	-	-	-
	Cohesion	C	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ	Degree	-	-	-	-	-
Consolidation	Initial Void Ratio	e_0		-	1.560	1.340	1.320	-
	Conso. Yield Stress	P_y	kgf/cm^2	-	1.134	0.385	2.596	-
	Compression Index	C_c		-	0.640	0.310	0.345	-
Soil Classification (ASTM D 2487 - 06)	Group Symbol			CH	ML	CL (or) ML	CH	CH
	Group Name			Fat clay	Silt with sand	Lean clay (or) Elastic silt	Fat clay	Fat clay

NOTE

Data used for reference are shown by red color.

SUMMARY OF SOIL TEST RESULTS

Project Name : Soil Investigation for Road Improvement of Myogone-Dawnyein Region								
Borehole No. BH-01				Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Division				
Sample No.				P-13	P-18	P-23	P-26	
Depth (m)				16.00 ~ 16.50	21.00 ~ 21.50	26.00 ~ 26.50	29.00 ~ 29.50	~
Moisture Content		w	%	37.52	49.99	30.79	41.01	
Bulk Density		ρ_t	g/cm^3	-	-	-	-	
Atterberg's Limit	Liquid Limit	WL	%	43.30	62.44	35.72	49.07	
	Plastic Limit	WP	%	19.53	23.68	18.94	21.00	
	Plasticity Index	IP	%	23.77	38.76	16.78	28.07	
Grain Size Analysis	Gravel, (76.20 ~ 4.75) mm		%	-	-	-	-	
	Sand, (4.75 ~ 0.075) mm		%	18.88	1.98	51.32	13.38	
	Silt, (0.075 ~ 0.005) mm		%	52.13	48.73	30.58	52.63	
	Clay, (< 0.005 mm)		%	29.00	49.30	18.10	34.00	
Specific Gravity of Soil		Gs (20˚C)		2.742	2.759	2.745	2.755	
Unconfined Compression	Unconfined Compressive Strength	q_u	kgf/cm^2	-	-	-	-	
				-	-	-	-	
	Failure Strain	ε_f	%	-	-	-	-	
				-	-	-	-	
Direct Shear Test	Cohesion	C_{UU}	kgf/cm^2	-	-	-	-	
	Phi Angle	ϕ_{UU}	Degree	-	-	-	-	
Unconsolidated Undrained Triaxial Compression Test	Cohesion	C_{UU}	kgf/cm^2	-	-	-	-	
	Phi Angle	ϕ_{UU}	Degree	-	-	-	-	
Consolidated Undrained Triaxial Compression Test (Measurement of Pore Pressure)	Cohesion	C'	kgf/cm^2	-	-	-	-	
	Phi Angle	ϕ'	Degree	-	-	-	-	
	Cohesion	C	kgf/cm^2	-	-	-	-	
	Phi Angle	ϕ	Degree	-	-	-	-	
Consolidation	Initial Void Ratio	e_0		-	-	-	-	
	Conso. Yield Stress	P_y	kgf/cm^2	-	-	-	-	
	Compression Index	C_c		-	-	-	-	
Soil Classification (ASTM D 2487 - 06)		Group Symbol		CL	CH	SC	CL	
		Group Name		Lean clay with sand	Fat clay	Clayey sand	Lean clay	

NOTE

Data used for reference are shown by red color.

SUMMARY OF SOIL TEST RESULTS

Project Name : Soil Investigation for Road Improvement of Myogone-Dawnyein Region

Borehole No. BH-02 | Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Division

Sample No.				P-1	T-1	T-2	T-3	P-10
Depth (m)				1.00 ~ 1.50	3.00 ~ 3.80	6.00 ~ 6.64	9.00 ~ 9.80	13.00 ~ 13.50
Moisture Content		w	%	43.07	54.59	54.39	60.57	41.47
Bulk Density		ρ_t	g/cm^3	-	1.677	1.708	1.587	-
Atterberg's Limit	Liquid Limit	WL	%	68.28	65.70	68.20	75.34	45.30
	Plastic Limit	WP	%	25.65	27.53	26.90	39.11	22.35
	Plasticity Index	IP	%	42.63	38.17	41.30	36.23	22.95
Grain Size Analysis	Gravel, (76.20 ~ 4.75) mm		%	-	-	-	-	-
	Sand, (4.75 ~ 0.075) mm		%	0.72	1.53	0.92	1.95	6.85
	Silt, (0.075 ~ 0.005) mm		%	60.58	54.68	53.08	58.45	62.05
	Clay, (< 0.005 mm)		%	38.70	43.80	46.00	39.60	31.10
Specific Gravity of Soil		Gs (20˚C)		2.806	2.747	2.756	2.639	2.748
Unconfined Compression	Unconfined Compressive Strength	q_u	kgf/cm^2	-	0.350	0.508	0.669	-
				-	0.309	0.484	0.627	-
	Failure Strain	ε_f	%	-	6.79	3.69	8.40	-
				-	9.01	3.71	5.98	-
Direct Shear Test	Cohesion	C_{UU}	kgf/cm^2	-	0.119	-	0.202	-
	Phi Angle	ϕ_{UU}	Degree	-	12.24	-	8.53	-
Unconsolidated Undrained Triaxial Compression Test	Cohesion	C_{UU}	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ_{UU}	Degree	-	-	-	-	-
Consolidated Undrained Triaxial Compression Test (Measurement of Pore Pressure)	Cohesion	C'	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ'	Degree	-	-	-	-	-
	Cohesion	C	kgf/cm^2	-	-	-	-	-
	Phi Angle	ϕ	Degree	-	-	-	-	-
Consolidation	Initial Void Ratio	e_0		-	1.810	1.510	1.520	-
	Conso. Yield Stress	P_y	kgf/cm^2	-	0.600	2.279	1.050	-
	Compression Index	C_c		-	0.745	0.459	0.566	-
Soil Classification (ASTM D 2487 - 06)	Group Symbol			CH	CH	CH	MH	CL
	Group Name			Fat clay	Fat clay	Fat clay	Elastic silt	Lean clay

NOTE

Data used for reference are shown by red color.

SUMMARY OF SOIL TEST RESULTS

Project Name : Soil Investigation for Road Improvement of Myogone-Dawnyein Region								
Borehole No. BH-02			Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Division					
Sample No.			P-13	P-16	P-20	P-25		
Depth (m)			16.00 ~ 16.50	19.00 ~ 19.50	23.00 ~ 23.50	28.00 ~ 28.50	~	
Moisture Content		w %	43.40	34.13	36.60	40.98		
Bulk Density		ρ_t g/cm^3	-	-	-	-		
Atterberg's Limit	Liquid Limit	WL %	50.78	32.18	48.20	57.92		
	Plastic Limit	WP %	22.53	22.28	21.33	24.28		
	Plasticity Index	IP %	28.25	9.90	26.87	33.64		
Grain Size Analysis	Gravel, (76.20 ~ 4.75) mm	%	-	-	-	-		
	Sand, (4.75 ~ 0.075) mm	%	10.75	35.54	19.48	10.18		
	Silt, (0.075 ~ 0.005) mm	%	57.45	52.06	48.43	58.73		
	Clay, (< 0.005 mm)	%	31.80	12.40	32.10	31.10		
Specific Gravity of Soil		Gs (20˚C)	2.760	2.726	2.747	2.763		
Unconfined Compression	Unconfined Compressive Strength	q_u kgf/cm^2	-	-	-	-		
			-	-	-	-		
	Failure Strain	ε_f %	-	-	-	-		
			-	-	-	-		
Direct Shear Test	Cohesion	C_{UU} kgf/cm^2	-	-	-	-		
	Phi Angle	ϕ_{UU} Degree	-	-	-	-		
Unconsolidated Undrained Triaxial Compression Test	Cohesion	C_{UU} kgf/cm^2	-	-	-	-		
	Phi Angle	ϕ_{UU} Degree	-	-	-	-		
Consolidated Undrained Triaxial Compression Test (Measurement of Pore Pressure)	Cohesion	C' kgf/cm^2	-	-	-	-		
	Phi Angle	ϕ' Degree	-	-	-	-		
	Cohesion	C kgf/cm^2	-	-	-	-		
	Phi Angle	ϕ Degree	-	-	-	-		
Consolidation	Initial Void Ratio	e_0	-	-	-	-		
	Conso. Yield Stress	P_y kgf/cm^2	-	-	-	-		
	Compression Index	C_c	-	-	-	-		
Soil Classification (ASTM D 2487 - 06)		Group Symbol	CH	CL	CL	CH		
		Group Name	Fat clay	Sandy lean clay	Lean clay with sand	Fat clay		

NOTE

Data used for reference are shown by red color.

Detailed Test Results
SEE IN ATTACHED CD

APPENDIX “D”

WATER QUALITY TEST RESULTS

ISO TECH LABORATORY
Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

ISO 9001:2008 Cert. No.688283

W1113 228

WATER QUALITY TEST RESULTS FORM

Client: Saramayri - Fuji Construction Co.,Ltd.
Nature of Water: BH - 02 (Soil Investigation For Road Improvement)
Location: Dawnyein - Amar Road, Pyapon Township, Ayeyarwaddy Region
Date and Time of collection:
Date and Time of arrival at Laboratory: 20.11.2013
Date and Time of commencing examination: 21.11.2013
Date and Time of completing: 22.11.2013

Results of Water Analysis

			WHO Drinking Water Guideline (Geneva - 1993)
Phosphate		mg/l	
pH	8.2		6.5 - 8.5
Colour (True)	180	TCU	15 TCU
Turbidity	528	NTU	5 NTU
Conductivity	39700	micro S/cm	
Total Hardness	5200	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	940	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity	Nil	mg/l as $CaCO_3$	
Calcium Hardness	3466	mg/l as $CaCO_3$	
Iron	12.80	mg/l	0.3 mg/l
Magnesium Hardness	1734	mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)	Nil	mg/l as $CaCO_3$	
Chloride (as CL)	13200	mg/l	250 mg/l
Sodium chloride (as NaCL)	21780	mg/l	
Bicarbonate (HCO_3)	940	mg/l as $CaCO_3$	
Sulphate (as SO_4)	680	mg/l	200 mg/l
Total Solids	25185	mg/l	1500 mg/l
Suspended Solids	885	mg/l	
Dissolved Solids	24300	mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by
Signature:
Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by
Signature:
Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

ISO TECH LABORATORY
Laboratory Technical Consultant: U Saw Christopher Maung
B Sc Engg: (Civil), Dip S E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

ISO 9001:2008 Cert. No.688283

WTL-RE-001
Issue Date - 01-12-2012
Effective Date - 01-12-2012
Issue No - 1.0/Page 1 of 1

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WATER QUALITY TEST RESULTS FORM

Client: Saramayri - Fuji Construction Co.,Ltd.
Nature of Water: BH - 01 (Soil Investigation For Road Improvement)
Location: Dawnyein - Amar Road, Pyapon Township, Ayeyarwaddy Region
Date and Time of collection:
Date and Time of arrival at Laboratory: 20.11.2013
Date and Time of commencing examination: 21.11.2013
Date and Time of completing: 22.11.2013

Results of Water Analysis			WHO Drinking Water Guideline (Geneva - 1993)
Phosphate		mg/l	
pH	6.8		6.5 - 8.5
Colour (True)	120	TCU	15 TCU
Turbidity	480	NTU	5 NTU
Conductivity	39400	micro S/cm	
Total Hardness	3100	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	920	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity	Nil	mg/l as $CaCO_3$	
Calcium Hardness	2066	mg/l as $CaCO_3$	
Iron	10.20	mg/l	0.3 mg/l
Magnesium Hardness	1034	mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)	Nil	mg/l as $CaCO_3$	
Chloride (as CL)	13900	mg/l	250 mg/l
Sodium chloride (as NaCL)	22935	mg/l	
Bicarbonate (HCO_3)	920	mg/l as $CaCO_3$	
Sulphate (as SO_4)	650	mg/l	200 mg/l
Total Solids	24920	mg/l	1500 mg/l
Suspended Solids	720	mg/l	
Dissolved Solids	24200	mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by
Signature: Hein
Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
(a division of WEG Co.,Ltd.) ISO TECH Laboratory

Approved by
Signature:
Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

No.18, Lanthit Road, Nanthargone Quarter, Insein Township, Yangon, Myanmar.
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APPENDIX “E”

DAILY RECORDS FOR BORING WORKS

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 1 *Of* 6

Project Name : Soil Investigation for Road Improvement Project
Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
Ground Level : 99.917 m
Coordinate : E 777313.000 ; N 1763141.000
Method for SPT : ASTM

Boring Equipment : TOHO -"D1"
Boring Method : Rotary (Direct Circulation)
Orientation : Vertical
Ground Water Level : 1.00m
Casing Diameter : Ø115mm

Date 26.10.13

Client
ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
26.10.13																
7:00	-	-	-	-	Arrived at site and Preparation											
7:10					Move machine from BH-02 to											
					BH-01											
9:30	1	1	1	1	Install casing Ø-115mm	0.0 ~ 1.0										
9:40					Drilling with TC bit	0.0 ~ 1.0										
9:50					SPT at GL- 1.0 m	1.0 ~ 1.5	SPT	P-1	2	0.41	CLAY, with trace of decayed wood fragments,	0	1	1	2/30	
											mottled brown and gray, moist, medium					
											plasticity, soft (Filled materials)					
9:55	1	1	2	2	Install casing Ø-115mm	1.0 ~ 2.0										
10:00					Drilling with TC bit	1.0 ~ 2.0										
10:10					SPT at GL- 2.0 m	2.0 ~ 2.5	SPT	P-2	1	0.43	Silty CLAY, with trace of organic matter, gray,	0	1	0	1/30	
											wet, low to medium plasticity, very soft					
10:15	1	1	3	3	Install casing Ø-115mm	2.0 ~ 3.0										
10:25					Drilling with TC bit	2.0 ~ 3.0										
10:30					UD at GL- 3.0 m	3.0 ~ 3.8	UD	T-1	-	-	Recovery ratio = 80/80cm	-	-	-	-	

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
26.10.13 7:00	GL- -	GL- -	GL- -
26.10.13 18:00	GL- 3.0m	GL- 20.0m	GL- 1.8m

Note
Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)
Standard Penetration Test Sample (SPT : P)
Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 2 *Of* 6

Project Name : Soil Investigation for Road Improvement Project
Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
Ground Level : 99.917 m
Coordinate : E 777313.000 ; N 1763141.000
Method for SPT : ASTM

Boring Equipment : TOHO -"D1"
Boring Method : Rotary (Direct Circulation)
Orientation : Vertical
Ground Water Level : 1.00m
Casing Diameter : Ø115mm

Date 26.10.13

Client
ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample: Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test: Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
26.10.13																
10:40	-	-	3	3	Drilling with TC bit	3.0 ~ 4.0										
10:45					SPT at GL- 4.0 m	4.0 ~ 4.5	SPT	P-3	1	0.42	Silty CLAY, with trace of organic matter, gray,	0	1	0/30	1/45	
											wet, low to medium plasticity, very soft					
10:50	-	-	3	3	Drilling with TC bit	4.0 ~ 5.0										
11:00					SPT at GL- 5.0 m	5.0 ~ 5.5	SPT	P-4	1	0.43	Silty CLAY, with trace of organic matter, gray,	0	1	0	1/30	
											wet, low to medium plasticity, very soft					
11:10	-	-	3	3	Drilling with TC bit	5.0 ~ 6.0										
11:20					UD at GL- 6.0 m	6.0 ~ 6.8	UD	T-1	-	-	Recovery ratio = 50/80cm	-	-	-	-	
11:30	-	-	3	3	Drilling with TC bit	6.0 ~ 7.0										
11:45					SPT at GL- 7.0 m	7.0 ~ 7.5	SPT	P-5	0	0.44	Silty CLAY, with trace of organic matter, gray,	0	0	0	0/45	
											wet, low to medium plasticity, trace of fine					
											sand and mica, very soft					
11:50	-	-	3	3	Drilling with TC bit	7.0 ~ 8.0										
12:00					SPT at GL- 8.0 m	8.0 ~ 8.5	SPT	P-6	3	0.42	Silty CLAY, with trace of fine sand and mica,	0	1	2	3/30	
											gray, low to medium plasticity, moist, soft					
12:15	-	-	-	-	Lunch break											

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
26.10.13 7:00	GL- -	GL- -	GL- -
26.10.13 18:00	GL- 3.0m	GL- 20.0m	GL- 1.8m

Note
Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)
Standard Penetration Test Sample (SPT : P)
Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 3 *Of* 6

Project Name : Soil Investigation for Road Improvement Project
Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
Ground Level : 99.917 m
Coordinate : E 777313.000 ; N 1763141.000
Method for SPT : ASTM

Boring Equipment : TOHO -"D1"
Boring Method : Rotary (Direct Circulation)
Orientation : Vertical
Ground Water Level : 1.00m
Casing Diameter : Ø115mm

Date 26.10.13

Client
ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample: Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test: Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
26.10.13																
13:00	-	-	3	3	Drilling with TC bit	8.0 ~ 9.0										
13:15					UD at GL- 9.0 m	9.0 ~ 9.8	UD	T-3	-	-	Recovery ratio = 80/80cm	-	-	-	-	
13:30	-	-	3	3	Drilling with TC bit	8.0 ~ 9.0										
13:45					SPT at GL- 10.0 m	10.0~10.5	SPT	P-7	1	0.34	Silty CLAY, with trace of fine sand and mica,	0	0	1	1/30	
											gray, low to medium plasticity, moist, very soft					
13:50	-	-	3	3	Drilling with TC bit	10.0~11.0										
14:00					SPT at GL- 11.0 m	11.0~11.5	SPT	P-8	2	0.41	Silty CLAY, with trace of fine sand and mica,	0	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
14:10	-	-	3	3	Drilling with TC bit	11.0~12.0										
14:25					SPT at GL- 12.0 m	12.0~12.5	SPT	P-9	1	0.42	Silty CLAY, with trace of fine sand and mica,	0	1	0	1/30	
											gray, low to medium plasticity, moist, very soft					
14:35	-	-	3	3	Drilling with TC bit	12.0~13.0										
14:45					SPT at GL- 13.0 m	13.0~13.5	SPT	P-10	1	0.44	Silty CLAY, with trace of fine sand and mica,	0	1	0	1/30	
											gray, low to medium plasticity, moist, very soft					
14:50	-	-	3	3	Drilling with TC bit	13.0~14.0										
15:00					SPT at GL- 14.0 m	14.0~14.5	SPT	P-11	1	0.43	Silty CLAY, with trace of fine sand and mica,	0	1	0	1/30	
											gray, low to medium plasticity, moist, very soft					
15:10	-	-	3	3	Drilling with TC bit	14.0~15.0										
15:30					SPT at GL- 15.0 m	15.0~15.5	SPT	P-12	1	0.40	Silty CLAY, with trace of fine sand and mica,	0	1	0	1/30	
											gray, low to medium plasticity, moist, very soft					

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
26.10.13 7:00	GL- -	GL- -	GL- -
26.10.13 18:00	GL- 3.0m	GL- 20.0m	GL- 1.8m

Note
Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)
Standard Penetration Test Sample (SPT : P)
Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 4 *Of* 6

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region

Ground Level : 99.917 m

Coordinate : E 777313.000 ; N 1763141.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 1.00m

Casing Diameter : Ø115mm

Date 26.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
26.10.13																
15:40	-	-	3	3	Drilling with TC bit	15.0~16.0										
16:00					SPT at GL- 16.0 m	16.0~16.5	SPT	P-13	2	0.39	Silty CLAY, with trace of fine sand and mica,	0	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
16:10	-	-	3	3	Drilling with TC bit	16.0~17.0										
16:30					SPT at GL- 17.0 m	17.0~17.5	SPT	P-14	1	0.42	Silty CLAY, with trace of fine sand and mica,	0	1	0	1/30	
											gray, low to medium plasticity, moist, very soft					
16:40	-	-	3	3	Drilling with TC bit	17.0~18.0										
16:50					SPT at GL- 18.0 m	18.0~18.5	SPT	P-15	2	0.44	Silty CLAY, with trace of fine sand and mica,	0	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
17:10	-	-	3	3	Drilling with TC bit	18.0~19.0										
17:30					SPT at GL- 19.0 m	19.0~19.5	SPT	P-16	6	0.41	Silty CLAY, with trace of fine sand and mica,	2	2	2	4/30	
											gray, low to medium plasticity, moist, soft					
17:40	-	-	3	3	Drilling with TC bit	19.0~20.0										
17:55					SPT at GL- 20.0 m	20.0~20.5	SPT	P-17	2	0.42	Silty CLAY, with trace of fine sand and mica,	0	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
18:00					Housekeeping and Stop Work											

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
26.10.13 7:00	GL- -	GL- -	GL- -
26.10.13 18:00	GL- 3.0m	GL- 20.0m	GL- 1.8m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 5 *Of* 6

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region

Ground Level : 99.917 m

Coordinate : E 777313.000 ; N 1763141.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 1.00m

Casing Diameter : Ø115mm

Date 27.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
27.10.13																
7:30	-	-	-	-	Arrived at site and Preparation											
8:00	-	-	3	3	Drilling with TC bit	20.0~21.0										
8:20					SPT at GL- 21.0 m	21.0~21.5	SPT	P-18	3	0.41	Silty CLAY, with trace of fine sand and mica,	0	1	2	3/30	
											gray, low to medium plasticity, moist, soft					
8:30	-	-	3	3	Drilling with TC bit	21.0~22.0										
8:50					SPT at GL- 22.0 m	22.0~22.5	SPT	P-19	3	0.39	Silty CLAY, with trace of fine sand and mica,	0	1	2	3/30	
											gray, low to medium plasticity, moist, soft					
9:00	-	-	3	3	Drilling with TC bit	22.0~23.0										
9:25					SPT at GL- 23.0 m	23.0~23.5	SPT	P-20	3	0.43	Silty CLAY, with trace of fine sand and mica,	0	1	2	3/30	
											gray, low to medium plasticity, moist, soft					
9:35	-	-	3	3	Drilling with TC bit	23.0~24.0										
10:00					SPT at GL- 24.0 m	24.0~24.5	SPT	P-21	3	0.42	Silty CLAY, with trace of fine sand and mica,	1	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
10:10	-	-	3	3	Drilling with TC bit	24.0~25.0										
10:30					SPT at GL- 25.0 m	25.0~25.5	SPT	P-22	3	0.42	Silty CLAY, with trace of fine sand and mica,	1	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
10:40	-	-	3	3	Drilling with TC bit	25.0~26.0										
10:55					SPT at GL- 26.0 m	26.0~26.5	SPT	P-23	9	0.42	Silty CLAY, with trace of fine sand and mica,	3	3	3	6/30	
											gray, low to medium plasticity, moist, firm					
11:05	-	-	3	3	Drilling with TC bit	26.0~27.0										
11:20					SPT at GL- 27.0 m	27.0~27.5	SPT	P-24	5	0.44	Silty CLAY, with trace of fine sand and mica,	1	2	2	4/30	
											gray, low to medium plasticity, moist, soft					

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
27.10.13 7:30	GL- 3.0m	GL- 21.0m	GL- 1.3m
27.10.13 13:30	GL- 3.0m	GL- 30.0m	GL- 2.0m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-01

BORING LOG RECORD

Job No. 2013-032

Sheet No. 6 *Of* 6

Project Name : Soil Investigation for Road Improvement Project
Location : Dawnyein-Amar road, Pyapon Township, Ayeyarwaddy Region
Ground Level : 99.917 m
Coordinate : E 777313.000 ; N 1763141.000
Method for SPT : ASTM

Boring Equipment : TOHO -"D1"
Boring Method : Rotary (Direct Circulation)
Orientation : Vertical
Ground Water Level : 1.00m
Casing Diameter : Ø115mm

Date 27.10.13

Client
ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample: Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test: Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
27.10.13																
11:30	-	-	3	3	Drilling with TC bit	27.0~28.0										
11:40					SPT at GL- 28.0 m	28.0~28.5	SPT	P-25	1	0.43	Silty CLAY, with trace of fine sand and mica,	1	0	0	1/45	
											gray, low to medium plasticity, moist, very soft					
11:50	-	-	3	3	Drilling with TC bit	28.0~29.0										
12:05					SPT at GL- 29.0 m	29.0~29.5	SPT	P-26	2	0.45	Silty CLAY, with trace of fine sand and mica,	0	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
12:15	-	-	3	3	Drilling with TC bit	29.0~30.0										
12:30					SPT at GL- 30.0 m	30.0~30.5	SPT	P-27	3	0.43	Silty CLAY, with trace of fine sand and mica,	1	1	1	2/30	
											gray, low to medium plasticity, moist, soft					
12:40	-	-	-	-	Lunch break											
13:30	-	-	-	-	Mobilization of drilling machine											
					BH-01 is terminated at 30.00m											

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
27.10.13 7:30	GL- 3.0m	GL- 21.0m	GL- 1.3m
27.10.13 13:30	GL- 3.0m	GL- 30.0m	GL- 2.0m

Note
Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)
Standard Penetration Test Sample (SPT : P)
Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-02

BORING LOG RECORD

Job No. 2013-032

Sheet No. 1 *Of* 5

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyarpon Township, Ayeyarwaddy Region

Ground Level : 99.772 m

Coordinate : E 778178.000 ; N 1761613.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 0.5 m

Casing Diameter : Ø115mm

Date 24.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
24.10.13																
7:00	-	-	-	-	Transportation the drilling											
					machine from Pyapon											
14:00	1	1	1	1	Install casing Ø115mm	0.0 ~ 1.0										
14:10					Drilling with TC bit	0.0 ~ 1.0										
14:20					SPT at GL- 1.0 m	1.0 ~ 1.5	SPT	P-1	2	0.42	CLAY, with trace of decayed wood fragments,	0	1	1	2/30	
											mottled brown and gray, moist, medium					
											plasticity, soft (Filled materials)					
14:35	1	1	2	2	Install casing Ø115mm	1.0 ~ 2.0										
14:40					Drilling with TC bit	1.0 ~ 2.0										
14:50					SPT at GL- 2.0 m	2.0 ~ 2.5	SPT	P-2	0	0.44	Silty CLAY, with trace of organic matter, gray,	0	0	0	0/45	
											wet, low to medium plasticity, very soft					
14:55	1	1	3	3	Install casing Ø115mm	2.0 ~ 3.0										
15:05					Drilling with TC bit	2.0 ~ 3.0										
15:10					UD at GL- 3.0 m	3.0 ~ 3.8	UD	T-1	-	-	Recovery ratio = 80/80cm	-	-	-	-	
15:15	-	-	3	3	Drilling with TC bit	3.0 ~ 4.0										
15:25					SPT at GL- 4.0 m	4.0 ~ 4.5	SPT	P-3	3	0.40	Silty CLAY, with trace of organic matter, gray,	0	1	2	3/30	
											wet, low to medium plasticity, trace of fine sand					
											and mica, soft					

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
24.10.13 7:30	GL- -	GL- -	GL- -
24.10.13 17:50	GL- 3.0m	GL- 10.0m	GL- 1.8m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-02

BORING LOG RECORD

Job No. 2013-032

Sheet No. 2 *Of* 5

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyarpon Township, Ayeyarwaddy Region

Ground Level : 99.772 m

Coordinate : E 778178.000 ; N 1761613.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 0.5 m

Casing Diameter : Ø115mm

Date 24.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
24.10.13																
15:30	-	-	3	3	Drilling with TC bit	4.0 ~ 5.0										
15:40					SPT at GL- 5.0 m	5.0 ~ 5.5	SPT	P-4	4	0.43	Silty CLAY, with trace of organic matter, gray,	1	1	2	3/30	
											moist, trace of fine sand and mica, low to					
											medium plasticity, soft					
15:50	-	-	3	3	Drilling with TC bit	5.0 ~ 6.0										
16:10					UD at GL- 6.0 m	6.0 ~ 6.8	UD	T-1	-	-	Recovery ratio = 64/80cm	-	-	-	-	
16:20	-	-	3	3	Drilling with TC bit	6.0 ~ 7.0										
16:30					SPT at GL- 7.0 m	7.0 ~ 7.5	SPT	P-5	5	0.41	Silty SAND, with clay patches, gray, moist,	1	2	2	4/30	
											trace of fine sand and mica, soft					
16:40	-	-	3	3	Drilling with TC bit	7.0 ~ 8.0										
17:00					SPT at GL- 8.0 m	8.0 ~ 8.5	SPT	P-6	3	0.42	Silty SAND, with clay patches, gray, moist,	1	1	1	2/30	
											trace of fine sand and mica, soft					
17:10	-	-	3	3	Drilling with TC bit	8.0 ~ 9.0										
17:20					UD at GL- 9.0 m	9.0 ~ 9.8	UD	T-3	-	-	Recovery ratio = 80/80cm	-	-	-	-	
17:30	-	-	3	3	Drilling with TC bit	9.0~10.0										
17:40					SPT at GL- 10.0 m	10.0~10.5	SPT	P-7	3	0.38	Silty SAND, with clay patches, gray, moist,	1	1	1	2/30	
											trace of fine sand and mica, soft					
17:50					Housekeeping and Stop work											

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
24.10.13 7:30	GL- -	GL- -	GL- -
24.10.13 17:50	GL- 3.0m	GL- 10.0m	GL- 1.8m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-02

BORING LOG RECORD

Job No. 2013-032

Sheet No. 3 *Of* 5

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyarpon Township, Ayeyarwaddy Region

Ground Level : 99.772 m

Coordinate : E 778178.000 ; N 1761613.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 0.5 m

Casing Diameter : Ø115mm

Date 25.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
25.10.13																
7:30	-	-	-	-	Arrived at site and Preparation											
8:00	-	-	3	3	Drilling with TC bit	10.0~11.0										
8:10					SPT at GL- 11.0 m	11.0~11.5	SPT	P-8	5	0.38	Silty SAND, with clay patches, gray, moist,	1	2	2	4/30	
											trace of fine sand and mica, soft					
8:15	-	-	3	3	Drilling with TC bit	11.0~12.0										
8:25					SPT at GL- 12.0 m	12.0~12.5	SPT	P-9	2	0.37	Silty CLAY, with trace of fine sand and mica	0	1	1	2/30	
											gray, low to medium plasticity, soft					
8:35	-	-	3	3	Drilling with TC bit	12.0~13.0										
8:50					SPT at GL- 13.0 m	13.0~13.5	SPT	P-10	4	0.41	Silty CLAY, with trace of fine sand and mica	1	1	2	3/30	
											gray, low to medium plasticity, soft					
9:00	-	-	3	3	Drilling with TC bit	13.0~14.0										
9:15					SPT at GL- 14.0 m	14.0~14.5	SPT	P-11	1	0.43	Silty CLAY, with trace of fine sand and mica	0	0	1	1/30	
											gray, low to medium plasticity, very soft					
9:30	-	-	3	3	Drilling with TC bit	14.0~15.0										
10:00					SPT at GL- 15.0 m	15.0~15.5	SPT	P-12	1	0.37	Silty CLAY, with trace of fine sand and mica	0	0	1	1/30	
											gray, low to medium plasticity, very soft					
10:15	-	-	3	3	Drilling with TC bit	15.0~16.0										
10:25					SPT at GL- 16.0 m	16.0~16.5	SPT	P-13	1	0.43	Silty CLAY, with trace of fine sand and mica	0	0	1	1/30	
											gray, low to medium plasticity, very soft					
10:35	-	-	3	3	Drilling with TC bit	16.0~17.0										
10:50					SPT at GL- 17.0 m	17.0~17.5	SPT	P-14	2	0.46	Silty CLAY, with trace of fine sand and mica	0	1	1	2/30	
											gray, low to medium plasticity, soft					

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
25.10.13 8:00	GL- 3.0m	GL- 11.0m	GL- 0.8m
25.10.13 17:00	GL- 3.0m	GL- 30.0m	GL- 2.0m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-02

BORING LOG RECORD

Job No. 2013-032

Sheet No. 4 *Of* 5

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyarpon Township, Ayeyarwaddy Region

Ground Level : 99.772 m

Coordinate : E 778178.000 ; N 1761613.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 0.5 m

Casing Diameter : Ø115mm

Date 25.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
25.10.13																
11:00	-	-	3	3	Drilling with TC bit	17.0~18.0										
11:10					SPT at GL- 18.0 m	18.0~18.5	SPT	P-15	1	0.43	Silty CLAY, with trace of fine sand and mica	0	0	1	1/30	
											gray, low to medium plasticity, very soft					
11:15	-	-	3	3	Drilling with TC bit	18.0~19.0										
11:25					SPT at GL- 19.0 m	19.0~19.5	SPT	P-16	9	0.39	Silty CLAY, with trace of fine sand and mica	1	2	6	8/30	
											gray, low to medium plasticity, firm					
11:30	-	-	3	3	Drilling with TC bit	19.0~20.0										
11:40					SPT at GL- 20.0 m	20.0~20.5	SPT	P-17	3	0.43	Silty CLAY, with trace of fine sand and mica	1	1	1	2/30	
											gray, low to medium plasticity, soft					
11:45	-	-	3	3	Drilling with TC bit	20.0~21.0										
12:00					SPT at GL- 21.0 m	21.0~21.5	SPT	P-18	3	0.45	Silty CLAY, with trace of fine sand and mica	1	1	1	2/30	
											gray, low to medium plasticity, soft					
12:05	-	-	3	3	Drilling with TC bit	21.0~22.0										
12:15					SPT at GL- 22.0 m	22.0~22.5	SPT	P-19	3	0.46	Silty CLAY, with trace of fine sand and mica	1	1	1	2/30	
											gray, low to medium plasticity, soft					
12:30	-	-	-	-	Lunch break											
13:30	-	-	3	3	Drilling with TC bit	22.0~23.0										
13:40					SPT at GL- 23.0 m	23.0~23.5	SPT	P-20	3	0.40	Silty CLAY, with trace of fine sand and mica	0	1	2	3/30	
											gray, low to medium plasticity, soft					
13:45	-	-	3	3	Drilling with TC bit	23.0~24.0										
13:50					SPT at GL- 24.0 m	24.0~24.5	SPT	P-21	3	0.42	Silty CLAY, with trace of fine sand and mica	0	1	2	3/30	
											gray, low to medium plasticity, soft					

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
25.10.13 8:00	GL- 3.0m	GL- 11.0m	GL- 0.8m
25.10.13 17:00	GL- 3.0m	GL- 30.0m	GL- 2.0m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

BORE HOLE No. BH-02

BORING LOG RECORD

Job No. 2013-032

Sheet No. 5 *Of* 5

Project Name : Soil Investigation for Road Improvement Project

Location : Dawnyein-Amar road, Pyarpon Township, Ayeyarwaddy Region

Ground Level : 99.772 m

Coordinate : E 778178.000 ; N 1761613.000

Method for SPT : ASTM

Boring Equipment : TOHO -"D1"

Boring Method : Rotary (Direct Circulation)

Orientation : Vertical

Ground Water Level : 0.5 m

Casing Diameter : Ø115mm

Date 25.10.13

Client

ORIENTAL CONSULTANT

Date & Time	Casing No.	Casing Length (m)	Total Casing Length (m)	Depth of Casing (m)	Description of Drilling Work	Soil Sample Depth (m)	Type	No.	Total Blows	Length (m)	Soil Description	Standard Penetration Test Blows per 15 cm	Blows per 15 cm	Blows per 15 cm	*N* Value	Remarks
25.10.13																
13:55	-	-	3	3	Drilling with TC bit	24.0~25.0										
14:10					SPT at GL- 25.0 m	25.0~25.5	SPT	P-22	3	0.43	Silty CLAY, with trace of fine sand and mica	1	1	1	2/30	
											gray, low to medium plasticity, soft					
14:20	-	-	3	3	Drilling with TC bit	25.0~26.0										
14:30					SPT at GL- 26.0 m	26.0~26.5	SPT	P-23	2	0.42	Silty CLAY, with trace of fine sand and mica	1	1	0	1/30	
											gray, low to medium plasticity, very soft					
14:40	-	-	3	3	Drilling with TC bit	26.0~27.0										
14:55					SPT at GL- 27.0 m	27.0~27.5	SPT	P-24	2	0.41	Silty CLAY, with trace of fine sand and mica	0	1	1	2/30	
											gray, low to medium plasticity, soft					
15:10	-	-	3	3	Drilling with TC bit	27.0~28.0										
15:30					SPT at GL- 28.0 m	28.0~28.5	SPT	P-25	4	0.42	Silty CLAY, with trace of fine sand and mica	1	1	2	3/30	
											gray, low to medium plasticity, soft					
15:40	-	-	3	3	Drilling with TC bit	28.0~29.0										
15:55					SPT at GL- 29.0 m	29.0~29.5	SPT	P-26	4	0.44	Silty CLAY, with trace of fine sand and mica	0	1	2	3/30	
											gray, low to medium plasticity, soft					
16:00	-	-	3	3	Drilling with TC bit	29.0~30.0										
16:25					SPT at GL- 30.0 m	30.0~30.5	SPT	P-27	5	0.43	Silty CLAY, with trace of fine sand and mica	1	2	2	4/30	
											gray, low to medium plasticity, soft					
16:30					Measurement of water level and											
17:00					Housekeeping											
					BH-02 is terminated at 30.00 m											

Ground Water Observation

Date & Time	Depth of Casing	Depth of BH	Depth of Water
25.10.13 8:00	GL- 3.0m	GL- 11.0m	GL- 0.8m
25.10.13 17:00	GL- 3.0m	GL- 30.0m	GL- 2.0m

Note

Undisturbed Sample (UD - T : Thin wall sampler, D : Denison sampler)

Standard Penetration Test Sample (SPT : P)

Water Sample (W)

Saramayri - Fuji Construction Co., Ltd.

APPENDIX “F”

SITE PHOTOGRAPHS

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-01

Before commencement of drilling work

Drilling Condition

Standard Penetration Test

S.P.T Sample

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-01

Piston Undisturbed Sampling

Piston Undisturbed Sample

Drilling & Left Length (A)

Drilling & Left Length (B)

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-01

Water Sampling

Water Sample

Panoramic View

After completion of drilling work

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-02

Before commencement of drilling work

Drilling Condition

Standard Penetration Test

S.P.T Sample

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-02

Piston Undisturbed Sampling

Piston Undisturbed Sample

Drilling & Left Length (A)

Drilling & Left Length (B)

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
BH-02

Water Sampling

Water Sample

Panoramic View

After completion of drilling work

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
FIELD DENSITY TEST (START POINT)

Excavation for Field Density Test


Preparation for Field Density Test

Field Density Testing

After completion of Field Density Test

SOIL INVESTIGATION FOR ROAD IMPROVEMENT PROJECT
DAWNYEIN-AMAR ROAD, PYAPON TOWNSHIP, AYEYARWADDY REGION
FIELD DENSITY TEST (END POINT)

Excavation for Field Density Test

Preparation for Field Density Test

Field Density Testing

After completion of Field Density Test