Republic of the Union of Myanmar
Ministry of Construction, PW

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

Implementation Program on Pilot Project (PPII-1)

March 2015

Japan International Cooperation Agency
（JICA）

Pegasus Engineering Corporation
Oriental Consultants Global Co., Ltd.

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JR
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0. Summary

0.1 Background and Purpose of the Project

Road network in the Ayeyarwady Region indicates its fragility because there is no effective alternative route in case that the one road becomes impassable. Furthermore, the road embankment had been constructed by applying local soil classified clay and silt due to locally absence of the appropriate material (e.g. rock aggregate and coarse sand) in the region. The local soils are inappropriate for road construction because of their physical characteristics. Resulting above, frequent road closures have been occurred in many locations due to severe deformation on the embankment in the rainy season. Consequently, this technical cooperation project has been working for transferring technology in the application of suitable remedial methods for the stabilization of the local soils.

Major targets of the capacity development are as follows.

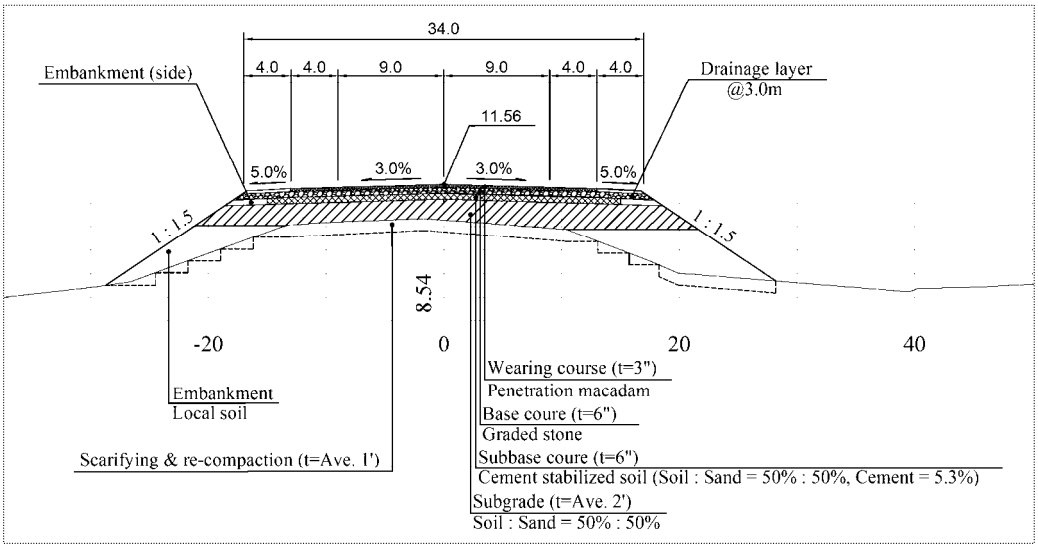
- PW will enhance the capability of quality control in case of applying chemically stabilized soil material.
- PW will enhance the capability of site supervision work and the overall project management.
- PW will obtain comprehensive knowledge of the soil stabilization work and the project management.
- PW will obtain appropriate skill for operation and maintenance of the soil mixing plant newly imported from Japan.

0.2 Contents of the Project Implementation

0.2.1 Project Outline

- Location : 1/4/ – 2/0, Road No.6, Bogale Township, Ayeyarwady Region
- Length : 0.5mile (=800m)
- Period : February/2015 – May/2015
- Major works :
  - ✓ Subgrade construction
  - ✓ Cement stabilization of sub-base course
  - ✓ Mechanically stabilized crush stone base course
  - ✓ Wearing course (Penetration macadam)
  - ✓ Drainage layer on road shoulder
  - ✓ Sodding work on slope

- Typical cross section (Unit: Feet) :



0.2.2 Work Implementation Team

Member List of Work Implementation Team

No.	Task	Name	Position	JICA Expert
1	Planning & design stage			
1.1	Road & pavement design	Daw Mya Mya Win	Deputy Superintending Engineer, RRL	H. Kobayashi
1.2	Soil investigation & material mix design	U Nyi Nyi Kyaw	Assistant Engineer, RRL	H. Miyamoto
1.3	Topographic survey & drawing preparation	Daw Aye Aye Thwin	Executive Engineer, Road Design Dept., HQ	
1.4	Implementation program	U Thet Zaw Win	Executive Engineer, Phyapon District Office	H. Kobayashi
2	Work implementation stage			
2.1	Project management	U Thet Zaw Win	Executive Engineer, Phyapon District Office	H. Kobayashi
2.2	Mobilization of soil plant	U Nyi Nyi Win	Assistant Engineer, Mechanical Dept.	H. Kobayashi
2.3	Construction work supervision	U Win Naing	Assistant Engineer, Bogale Township	N. Akmar
2.4	Material quality control	Daw Htar Zin Thin Zaw	Executive Engineer, RRL	H. Miyamoto
2.5	Machinery work	U Hlaing Min Zaw	Junior Engineer (2), Mechanical Dept.	N. Akmar
2.6	Dimension control	U Tun Min Oo	Assistant Engineer, Road Design Dept., HQ	N. Akmar
2.7	Work progress control	U Tun Tun Naing	Junior Engineer (2), Phyapon District Office	N. Akmar

0.2.3 Design Result

(1) Pavement Design

Pavement Formation in the PP-2

Layer	Code ORN	Material	Layer coefficient (a_n)	Thickness (inch)	SN
Wearing course	BC	Penetration macadam	0.30	**3.0**	0.90
Base course	GB	Crush stone	0.14	**6.0**	0.84
Sub-base course	CB2	Cement stabilized	0.12	**6.0**	0.72
Total SN					2.46

(2) Mix Design of Stabilized Material

Mix Design Ratios & Target Values of FDT

Layer type	Material mixing ratio	Target value	
		Dry density (kg/cm3)	Moisture content (%)
Existing embankment (scarifying & re-compaction)	Local soil = 100%	1.58	16.5
Subgrade (bucket mixing in yard)	Soil : Sand = 50% : 50% (weight basis), or Soil : Sand = 0.91 : 1.00 (volume basis)	1.95	10.0
Subbase course (plant mixing in yard)	Soil : Sand = 50% : 50% (weight basis) or Soil : Sand = 0.91 : 1.00 (volume basis), & 5.3% of (soil+sand) for Cement (weight basis)	Not completed	Not completed
Base course (bucket mixing in yard)	1"x1" : 1/2"x3/4" : 3/8" : sand = 20% : 23% : 45% : 12%	Not completed	Not completed

0.2.4 Work Implementation Procedures

(1) Preparation work
- (1)-1 Open temporary yard
- (1)-2 Construction of traffic diversion road
- (1)-3 Engineering survey

(2) Earthworks
- (2)-1 Scarifying & re-compaction
- (2)-2 Embankment work for subgrade (Ave. thickness = 600mm)

(3) Pavement work
- (3)-1 Subbase installation work (Cement stabilization)
- (3)-2 Base course installation work (Graded crush stone)
- (3)-3 Wearing course (Penetration macadam)

(4) Apparatus work
- (4)-1 Drainage layer
- (4)-2 Slope sodding work

(5) Demobilization work

0.2.5 Quality Assurance of the Work

(1) Dimension control of the work

✧ Measurement of finishing level by applying the survey pegs installed on road sides and recording of the measurement result in the inspection form.

(ii) Quality control of stabilized material

✧ Filed density test to confirm the compaction degree after the compaction work

✧ Alkaline digestion method to identify content of hexavalent chromium (Cr^{6+}) in the cement

(iii) Project management

✧ Establishment of communication system

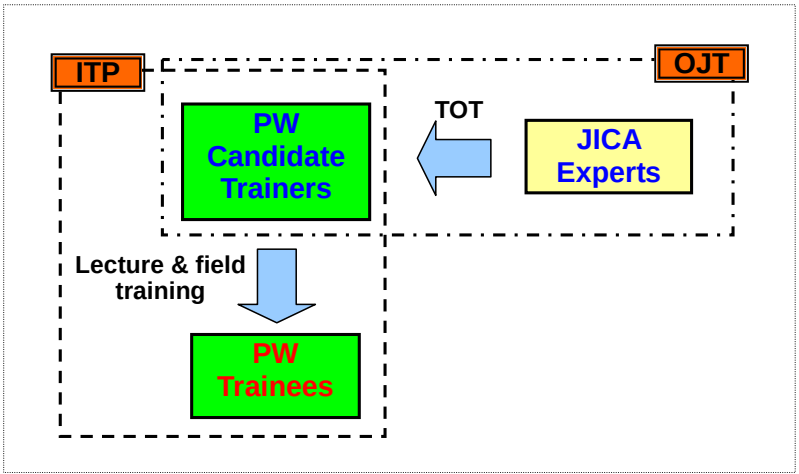
✧ Recording the field activities in the report form

✧ Hold meeting to share the common understandings

0.3 Technical Transfer Program

0.3.1 Approach

Technical transfer program will be implemented through On-the-Job-Training (OJT) and Intensive Training Program (ITP) as illustrated in the following figure.



(Note) TOT: Training of Trainers

Frame of Technical Transfer Program

0.3.2 Intensive Training Program

The Team will implement the Intensive Training Program (ITP) as outlined below.

- Date & period : 1st week in April, 2015 (2days)
- Venue : PW Bogale Bridge office
- Subject : (i) Pavement design
  (ii) Material mix design of stabilized material
  (iii) Material test at site
  (iv) Operation method of the soil mixing plant
- Participants : Approximately 30 persons

1. Introduction

1.1 Background

Road network in the Ayeyarwady Region indicates its fragility because there is no effective alternative route in case that the one road becomes impassable. Furthermore, the road embankment had been constructed by applying local soil classified clay and silt due to locally absence of the appropriate material (e.g. rock aggregate and coarse sand) in the region. The local soils are inappropriate for road construction because of their physical characteristics. Resulting above, frequent road closures have been occurred in many locations due to severe deformation on the embankment in the rainy season. Consequently, this technical cooperation project has been working for transferring technology in the application of suitable remedial methods for the stabilization of the local soils.

1.2 Purpose of Pilot Project (Phase-2)

PW and JICA will implement the Pilot Project (Phase-2) (hereinafter referred to as "PP-2") on Road No. 10 in Bogale Township in Ayeyarwady Region. PW/JICA will attempt the capacity development of PW through the OJT and the intensive training program during the project period. Major targets of the capacity development are as follows.

- PW will enhance the capability of quality control in case of applying chemically stabilized soil material.
- PW will enhance the capability of site supervision work and the overall project management.
- PW will obtain comprehensive knowledge of the soil stabilization work and the project management.
- PW will obtain appropriate skill for operation and maintenance of the soil mixing plant newly imported from Japan.

2. Contents of Pilot Project (Phase-2)

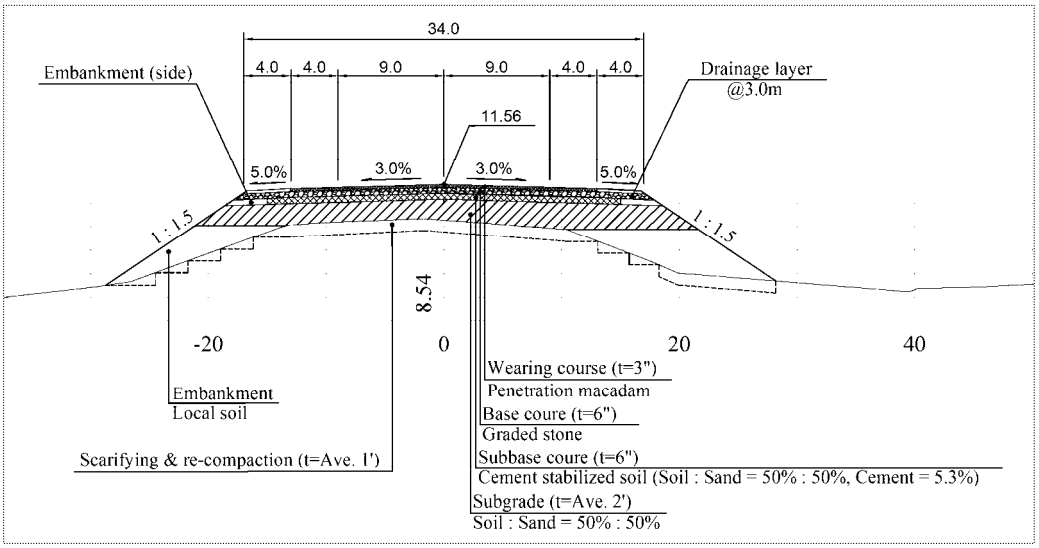
2.1 Project Outline

Outline of the PP-2 is described below.

- Location : 1/4/ – 2/0, Road No.6, Bogale Township, Ayeyarwady Region (see Location Map)
- Length : 0.5mile (=800m)
- Period : February/2015 – May/2015
- Major works :

- ✓ Subgrade construction
- ✓ Cement stabilization of sub-base course
- ✓ Mechanically stabilized crush stone base course
- ✓ Wearing course (Penetration macadam)
- ✓ Drainage layer on road shoulder
- ✓ Sodding work on slope

➢ Typical cross section (Unit: Feet) :



➢ Implementation schedule (provisional) :

Construction schedule in PP-2

Category	Work item	Code (ORN31)	Specification	Quantity	Unit	February						March						April						May					
						5	10	15	20	25	28	5	10	15	20	25	31	5	10	15	20	25	30	5	10	15	20	25	30
1. Earthwork																													
1.1 Scarifying & re-compaction				3,274.4	cu.m																								
1.2 Embankment	(1) Lower		Local soil	2,490.1	cu.m																								
	(2) Road side		Local soil	582.6	cu.m																								
1.3 Subgrade			t=Ave.2ft, Soil : Sand = 50% : 50% (weight basis)	6,884.2	cu.m																								
1.4 Slope trimming				7,372.3	sq.m																								
2. Pavement																													
2.1 Wearing course		BC	Penetration macadam, t=3in, w=26ft	4,389.1	sq.m																								
2.2 Hard shoulder			Graded crush stone, t=3in, w=8ft	1,950.7	sq.m																								
2.3 Base course		GB	Crush stone, CBR=100, t=6in, w=28ft	1,040.5	cu.m																								
2.4 Subbase course		CS	Cement stabilized, UCS=1.125MPa, t=6in, w=30ft, Soil : Sand = 50% : 50%, Cement = 5.3%	1,114.8	cu.m																								
3. Drainage layer			Crush stone, L = 1.2m, t=0.15m, w=0.5m	540	No.																								
6. Inspection			Monthly & final																										

Operation in off-site mixing yard

Category	Work item	Code	Specification	Quantity	Unit	February						March						April						May					
						5	10	15	20	25	28	5	10	15	20	25	31	5	10	15	20	25	30	5	10	15	20	25	30
1. Temporary yard	(1) Site opening		Bush cut, grading, removal of surface soil (t=0.3m)	20,000.0	sq.m																								
	(2) Site clearance		Grading	20,000.0	sq.m																								
2. Diversion road				3,200.0	sq.m																								
3. Material production	(1) Subgrade		Soil : Sand = **50% : 50%** (weight basis), compaction rate=1.3	9,000.0	cu.m																								
	(2) Subbase		Soil : Sand = **50% : 50%**, Cement = 5.3**%**, compaction rate=1.3	1,500.0	cu.m																								
	(3) Base course		Crush stone, compaction rate=1.3	1,400.0	cu.m																								
	(4) Hard shoulder		Crush stone, compaction rate=1.3	200.0	cu.m																								
	(5) P-macadam		Crush stone, compaction rate=1.3	500.0	cu.m																								
3. Plant matters	(1) ETA to YGN port		Leave JPN at 17/Feb																										
	(2) Domestic transport		Custom clearance, YGN => Bogale																										
	(3) Setting		Setting on site, trial operation, training for operators																										

2.2 Work Implementation Team

PW and JICA Expert Team will jointly work for implementation of the PP-2. PW Pyapon District Office is in charge of the overall project management by having substantial cooperation from the other departments in PW and JICA. Members of the work implementation team (the Team) are listed in Table 2.2.1

Table 2.2.1 Member List of Work Implementation Team

No.	Task	Name	Position	JICA Expert
1	Planning & design stage			
1.1	Road & pavement design	Daw Mya Mya Win	Deputy Superintending Engineer, RRL	H. Kobayashi
1.2	Soil investigation & material mix design	U Nyi Nyi Kyaw	Assistant Engineer, RRL	H. Miyamoto
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2.1	Project management	U Thet Zaw Win	Executive Engineer, Phyapon District Office	H. Kobayashi
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2.6	Dimension control	U Tun Min Oo	Assistant Engineer, Road Design Dept., HQ	N. Akmar
2.7	Work progress control	U Tun Tun Naing	Junior Engineer (2), Phyapon District Office	N. Akmar

2.3 Planning and Design Work

2.3.1 Pavement Design

PW/JICA designed pavement structure to be applied for the PP-2 in 2 steps namely (i) AASHTO empirical method and (ii) Structural Number (SN) principle in ORN31. The design result is summarized in the following sections. Note the detailed design procedure is described in Appendix-A.

(i) AASHTO

PW/JICA carried out the initial design by applying AASHTO empirical method. Pavement formation is as shown in Table 2.3.1.

Table 2.3.1 Pavement Formation at Initial Design Result

Layer	Code ORN	Material	Layer coefficient (a_n)	Thickness (inch)	SN
Wearing course	BC	Penetration macadam	0.30	**4.5**	1.35
Base course	GB	Crush stone	0.14	4.0	0.56
Sub-base course	CB2	Cement stabilized	0.12	4.0	0.48
Total SN					**2.39**

(ii) Modification by ORN31

PW/JICA considered reduction of the wearing course thickness from 4.5" to 3.0" to conform to the previous projects of PW. PW/JICA applied the SN principle stipulated in ORN31 for this approach. That is, the strength of reduced thickness will be substituted by increment of the lower layers' thicknesses (i.e. base and subbase). Modified pavement formation is as shown in Table 2.3.2.

Table 2.3.2 Modified Pavement Formation

Layer	Code ORN	Material	Layer coefficient (a_n)	Thickness (inch)	SN
Wearing course	BC	Penetration macadam	0.30	**3.0**	0.90
Base course	GB	Crush stone	0.14	6.0	0.84
Sub-base course	CB2	Cement stabilized	0.12	6.0	0.72
Total SN					**2.46**

(iii) Trial Approach of Thickness Reduction by Multi-layer Analysis Method

PW/JICA attempted the thickness reduction by applying free software as called "GAME" which is based on multi-layer analysis method. The result is as shown in Table 2.3.3. Note the result will not be applied in the PP-2 because that PW recognizes that further examination and analysis will be required for broadly application of this approach. Detailed description of the approach is attached in Appendix-B.

Table 2.3.3 Pavement Formation by GAME (for Reference)

Layer	Code ORN	Material	Young's modulus (MPa)	Poisson's ratio	Thickness (inch)
Wearing course	BC	Penetration macadam	1,379	0.40	3.0
Base course	GB	Crush stone	207	0.35	4.0
Sub-base course	CB2	Cement stabilized	1,500	0.20	6.0

2.3.2 Mix Design of Material Stabilization

PW/JICA conducted trial mixing test for determination of mixing ratio of base course and subbase course. The test result is as shown in 2.3.4. The detailed design procedure

is described in Appendix-C.

Table 2.3.4 Result of Trial Mixing Test (Weight Ratio)

Layer	Code (ORN31)	Material category	Local soil	Imported material		Chemical additive		Target CBR	Target UCS
				Sand	Stone	Cement	Lime		
Base	GB	Granular	0%					100%	
	CB2	Stabilized soil							
Sub-base	CS	Stabilized soil	50%	50%	0%	(5.3%)	0%		1.125MPa

(Note) % of chemical additives is excluded from soil and imported materials.

2.3.3 Drainage Layer

Water being infiltrated into the pavement structure should be promptly drained for protection of the structure. In particular, the soil material shows higher deterioration level to the water than the granular one. Therefore, PW/JICA decided to install buried drain called as “drainage layer” at both sides of the base course with intervals of every 3meters.

2.4 Work Quantity

The work quantities of the PP-2 namely construction work and off-site work were calculated on the basis of the design result. The quantities are summarized in Table 2.4.1. Breakdown of the quantities is attached in Appendix-D.

Table 2.4.1 Total Quantities of Construction Work

I. Construction work	Total length =	800	m (1/4 - 2/0)		
Category	Work item	Code (ORN)	Specification	Quantity	Unit
1. Earthwork					
1.1 Scarifying & re-compaction			t=Ave. 1ft	3,274.4	cu.m
1.2 Embankment	(1) Lower		Local soil	2,490.1	cu.m
	(2) road side		Local soil	582.6	cu.m
1.3 Subgrade			t=Ave.2ft, Soil : Sand = 50% : 50% (weight basis)	6,884.2	cu.m
1.4 Slope trimming				7,372.3	sq.m
2. Pavement					
2.1 Wearing course		BC	Penetration macadam, t=3in, w=18ft	4,389.1	sq.m
2.2 Hard shoulder			Graded crush stone, t=3in, w=8ft	1,950.7	sq.m
2.3 Base course		GB	Crush stone, CBR=100, t=6in, w=28ft	1,040.5	cu.m
2.4 Subbase course		CS	Cement stabilized, UCS=1.125MPa, t=6in, w=30ft, Soil : Sand = 50% : 50%, Cement = 5.3%	1,114.8	cu.m
3. Drainage layer	(1) Install crush stone		Crush stone, L = 1.2m, t=0.15m, w=0.5m	540	No.
				48.6	cu.m

Table 2.4.1 Total Quantities of Construction Work (Cont'd)

II. Off-site work					
Category	Work item	Code	Specification	Unit	Unit
1. Temporary yard	(1) Site opening		Bush cut, grading, removal of surface soil (t=0.3m)	20,000.0	sq.m
	(2) Site clearance		Grading	20,000.0	sq.m
2. Diversion road			Filling & grading of local soil, L = 800m, W = 4m	3,200.0	sq.m
III. Import materials					
Item	Work item	Code	Specification	Quantity	Unit
1. Cement	Subbase course		Soil=1.8t/cu.m, **Cement=5.3%**, Loss=10%	120.0	ton
2. Sand	(1) Subbase course		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	1,110.0	ton
	(2) Subgrade		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	6,820.0	ton
	(3) Embankment (roadbed)		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	2,470.0	ton
			Total	**10,400.0**	**ton**
3. Crush stone	(1) Base course		Weight=2.0t/cu.m, Loss=10%	2,290.0	ton
	(2) Hard shoulder		Weight=2.0t/cu.m, Loss=10%	330.0	ton
	(2) P-macadam		Weight=2.0t/cu.m, Loss=10%	730.0	ton
	(3) Drainage		Weight=2.0t/cu.m, Loss=10%	110.0	ton
			Total	**3,460.0**	**ton**
4. Straight asphalt	(1) Prime coat		1 - 1.5ltr/sq.m, Loss=10%	6,100.0	ltr
(80/100)	(2) P-macadam		0.7 - 2.3ltr/sq.m (2layers), Loss=10%	14,500.0	ltr
			Total	**20,600.0**	**ltr**
5. Fuel	Operation of equipment		Diesel		ltr

2.5 Work Implementation Procedures

The Team will implement the following work procedures to accomplish the PP-2. Furthermore, detailed work approaches are described in Appendix-E.

1. Preparation work
    - 1.1 Open temporary yard
    - 1.2 Construction of traffic diversion road
    - 1.3 Engineering survey
2. Earthworks
    - 2.1 Scarifying & re-compaction
    - 2.2 Embankment work for subgrade (Ave. thickness = 600mm)
3. Pavement work
    - 3.1 Subbase installation work (Cement stabilization)
    - 3.2 Base course installation work (Graded crush stone)
    - 3.3 Wearing course (Penetration macadam)
4. Apparatus work
    - 4.1 Drainage layer
    - 4.2 Slope sodding work
5. Demobilization work

2.6 Quality Assurance of the Work

The Team will apply the following approaches for quality assurance of the works in the PP-2.

2.6.1 Dimension Control

The Team will measure elevation at each layer by applying the survey peg (see Figure 2.6.1) whether it complies with the designed thickness. Contents of the measurement work are stipulated in Table 2.6.1. Form of inspection sheet (sub-base course) is as shown in Figure 2.6.2. Furthermore, all of the forms are attached in Appendix-F.

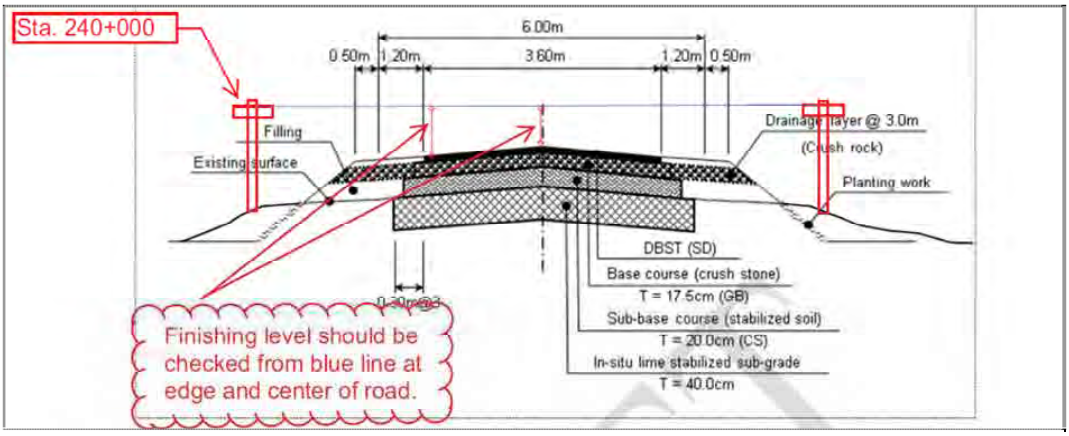

Figure 2.6.1 Image of Elevation Check of Finishing Level (Not to Scale)

Table 2.6.1 Item/Interval/Tolerance of Measurement Work

Layer	Measure Item	Interval	Tolerance
Sub-grade	Elevation (Center & both side)	Every 30m	±5cm
	Width		−10cm
Sub-base course	Elevation (Center & both side)	Every 30m	±4cm
	Thickness		−4.5cm
	Width		−5cm
Base course	Thickness	Every 30m	−3cm
	Width		−5cm
Wearing course	Thickness	Every 30m	−1.5cm

Inspection Sheet for Road Works (Subbase course)

Location: Road No.6, Bogale Township, Ayeyarwady Region — Inspection Date:

Section: 1/4 – 2/0 (L=800m) — Measured by:

Thickness tolerance: −0.045m — Checked by:

	Elevation Level Data														
	Left side 4.5m Offset					Center line					Right side 4.5m Offset				
Station	Top of subgrade	Design		Measurement	Thickness	Top of subgrade	Design		Measurement	Thickness	Top of subgrade	Design		Measurement	Thickness
	m	Ft	m	m	m	m	Ft	m	m	m	m	Ft	m	m	m
	(a)		(b)	(c)	(c) − (a)	(a)		(b)	(c)	(c) − (a)	(a)		(b)	(c)	(c) − (a)
79		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
80		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
81		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
82		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
83		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
84		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
85		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
86		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
87		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
88		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
89		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
90		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
91		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
92		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
93		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
94		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
95		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
96		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
97		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
98		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
99		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
100		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
101		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
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104		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
105		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
106		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		

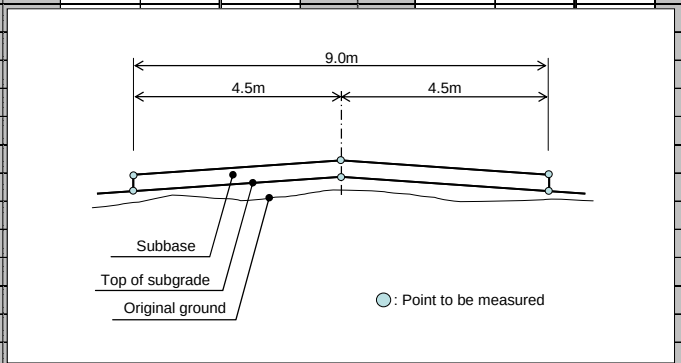


Figure2.6.2 Form of Inspection Sheet of Elevation & Thickness (Subbase Course)

2.6.2 Quality Control of Materials

(1) Field Density Test (FDT)

The Team will implement field dry density test (FDT) (see Figure 2.6.3 & Figure 2.6.4) whether the result achieves target value to examine the compaction degree of material. Target densities and their moisture contents of each layer are summarized in Table 2.6.2. Note the Team also will implement 2nd and 3rd test after re-compaction work, in case if former test is failed. Form of test sheet (sub-base course) is as shown in Figure 2.6.5. Furthermore, all of the forms are attached in Appendix-G.

Figure 2.6.3 Work View of FDT (sand replacement method)

Table 2.6.2 Target Values of FDT

Layer type	Material mixing ratio	Target value	
		Dry density (kg/cm3)	Moisture content (%)
Existing embankment (scarifying & re-compaction)	Local soil = 100%	1.58	16.5
Subgrade (bucket mixing in yard)	Soil : Sand = 50% : 50% (weight basis), or Soil : Sand = 0.91 : 1.00 (volume basis)	1.95	10.0
Subbase course (plant mixing in yard)	Soil : Sand = 50% : 50% (weight basis) or Soil : Sand = 0.91 : 1.00 (volume basis), & 5.3% of (soil+sand) for Cement (weight basis)		
Base course (bucket mixing in yard)	1"x1" : 1/2"x3/4" : 3/8" : sand = 20% : 23% : 45% : 12%		

(Note) Loose densities of materials: Soil = 1,217kg/cm3, Sand = 1,332kg/cm3, Cement = 1,400kg/cm3

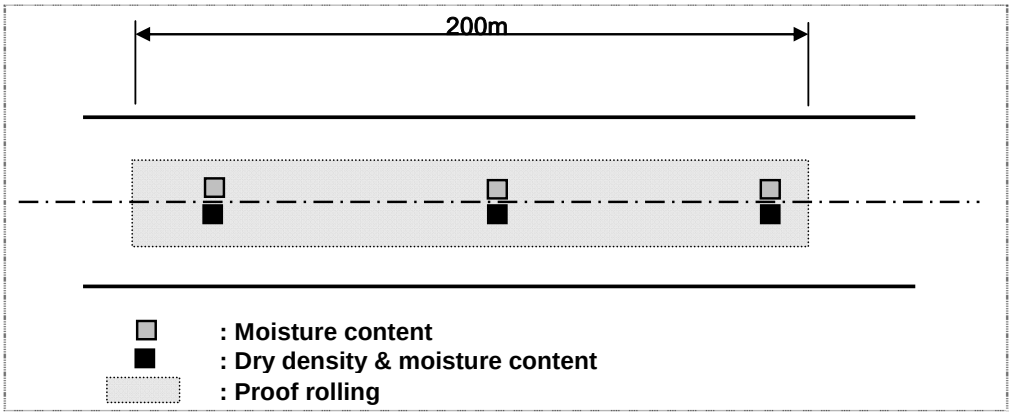


Figure 2.6.4 Test Location of Field Test

Test Sheet (Subbase Course)

Project Title	
Date	
Parson in charge	
Wearher / Temperature	
Additve	
Testing Method	

No	No	No	No	No	No	No	No

1. Moisture content at borrow pit

(1) Soil

Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

(2) Sand

Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

2. Moisture content before rolling

Station					
Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

3. Dry Density and Moisture Content after Rolling

Station						
Wet Density γ_t (g/cm3)						
Dry Density γ_d (g/cm3)						
Moisture Content Wn (%)						
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

4. Extra

Station						
Wet Density γ_t (g/cm3)						
Dry Density γ_d (g/cm3)						
Moisture Content Wn (%)						
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

Figure 2.6.5 Form of Test Sheet (Subbase Course)

(2) Control of Hexavalent Chromium

Road agency should be cautious in case of applying cement for mixing with soil because there is a risk of elution of a heavy metal called as “hexavalent chromium (Cr^{6+})” from the mixture. Therefore, the agency should examine the elution in advance to the project and during the project implementation.

(i) Elution Test in the PP-1

The Team conducted the elution test by applying “simplified method” prior to the project commencement. As a test result, the elution was not observed from the all soil samples. Photos of the testing work are as shown in Figure 2.6.6.

(i) Test kit

(ii) Shaking the solution of mixture and solvent

(iii) Extracting the solution

(iv) Checking by color chart (less than 0.05g/ltr)

Figure 2.6.6 Elution Test of Hexavalent Chromium

(ii) Alkaline Digestion Method in the PP-2

The Team applied another approach to the PP-1 as called "Alkaline Digestion Method" to examine the existence of Cr^{6+} in the cement itself (see Figure 2.6.7) to be applied in the PP-2. Work flow of this approach is illustrated in Figure 2.6.8. The test result indicates 15mg/kg of Cr^{6+} was extracted from the sample. This value is lower than the allowable value (20mg/kg) regulated in Japan Cement Association (JCA). Therefore, the Team will be able to apply this cement in the PP-2. The test report is attached in Appendix-H.

Figure 2.6.7 Cement to be applied in the PP-2

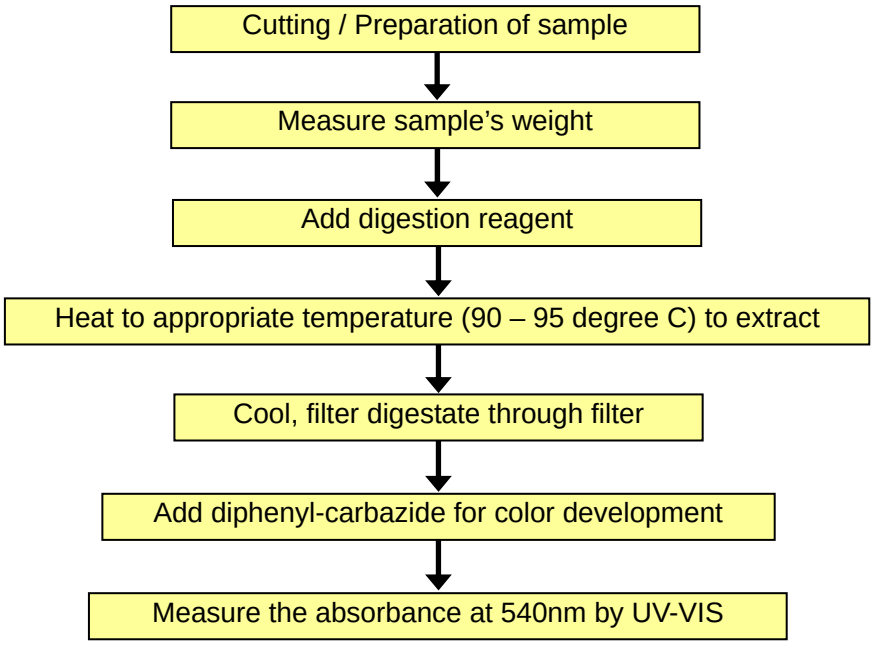


Figure 2.6.8 Work Flow of Alkaline Digestion Method

2.6.3 Approach for Project Management

Close communication between the site and the management level is one of the key elements for successful implementation of the project. The Team will apply the following approaches to accomplish smooth communication and sufficient common understanding through the PP-2.

(1) Establishment of Communication System

Communication system between the site and the management level by clarifying the role each group through the PP-2 is illustrated in Figure 2.6.9. The Team also will apply report forms namely daily report and weekly report for using at the site. The site group will note work record and identified issues down to the forms for the submission to the management group for the review work. Then the management group will consider the appropriate project implementation based on the report. Form of the daily report is as shown in 2.6.10. Furthermore, form the weekly report is attached in Appendix-I.

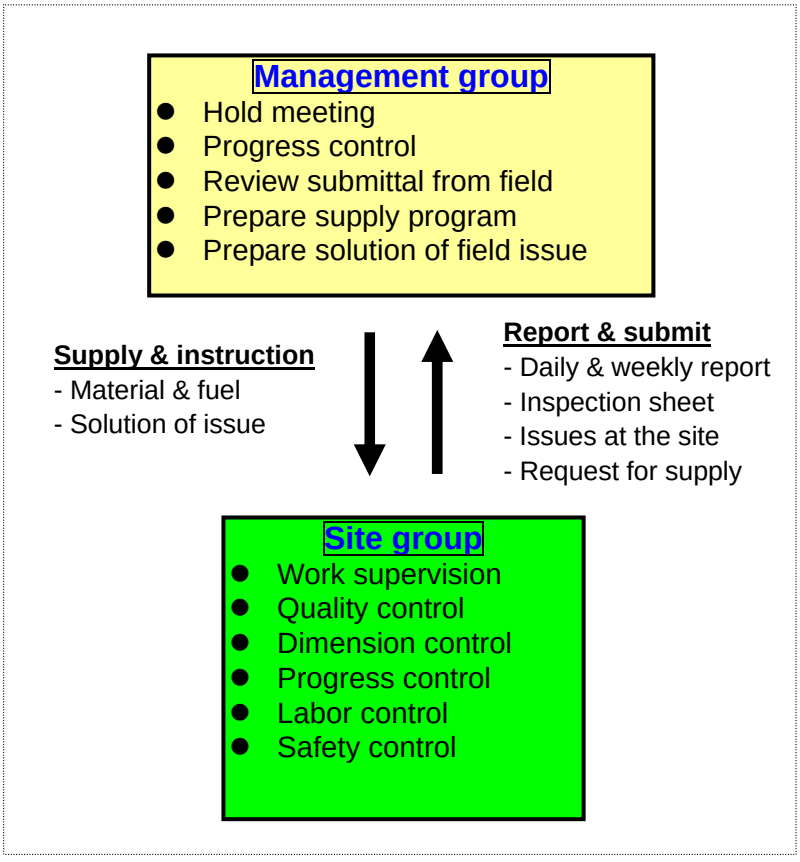


Figure 2.6.9 Communication System and Roles of Each Groups in the PP-2

Pilot Project (Phase-2) on Road No.10, Bogale Township, Aeyarwaddy Region

Contract/Force account

Section: 1/4 - 2/0 (L=800m)

Construction :Public Works (PW)

Date:

Weather

Temparature: C

Humidity %

DAILY PROGRESS REPORT

No.	Work items	Station	Description of Works	Remarks

EQUIPMENTS				*Materials*		*MAN POWERS*			
Type	No.	Type	No.	Type	Quantity	Type	No.	Type	No.
						Project Manager		Oprerator	
						Deputy PM		Worker	
						Site Engineer			
						Foreman			
						Surveyor			

Confirmed by: _____ Date : Approved by: _____ Date :

PW Engineer (PW Resident Representative)

Figure 2.6.10 Form of Daily Progress Report

(2) Hold Meeting

1) Pre-implementation Conferences

The Team will hold pre-implementation conferences prior to commencement of the construction work at the site. The attendants will confirm and share the information related to principal considerations and rules through the project as stated below.

- Each role of key person
- Work implementation schedule
- Procurement and supply program of material and equipment
- Specific caution and requirement during the work
- Environmental mitigations
- Traffic safety control
- Frequency and type of test and inspection
- Format of sheet for inspection and test to be used

2) Weekly Meeting

The Team will hold weekly meeting to share common understanding regarding current site condition and the issues to be solved among key persons for the project management. Possible meeting agenda are listed below.

- Confirm work progress in this week and work program in next week
- Confirm resources (i.e. material, fuel, labor and equipment) spent in this week and consider supply program for next week
- Confirm issues occurred at the site and discuss for the solution

3. Technical Transfer Program

3.1 Approach and Methodology

Technical transfer program in the PP-2 consisted of On-the-Job-Training (OJT) and Intensive Training Program (ITP) as applied in the PP-1. JICA Experts will attempt training of trainers (TOT) to the engineers appointed as candidate trainers by PW through the OJT in the implementation period of the PP-2. As a result of the TOT, the trainers of PW will carry out training to the trainees in the ITP. Note the trainees of the ITP also will be dispatched from PW. Frame of the technical transfer approach is illustrated in Figure 3.1.1. Furthermore, list of the candidate trainers in the ITP is as shown in Table 3.1.1.

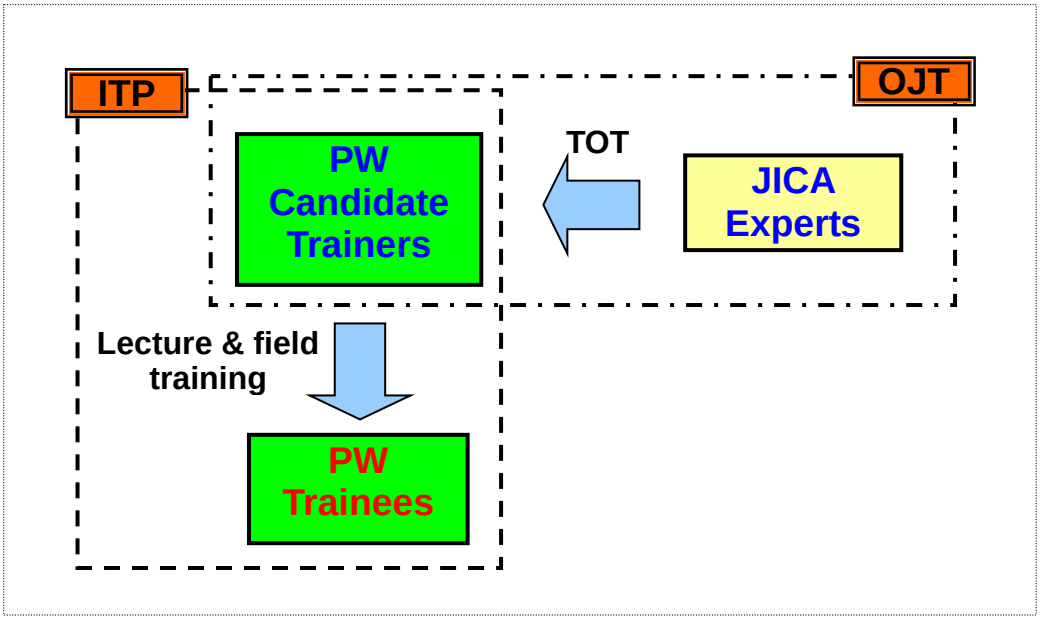


Figure 3.1.1 Frame of Technical Transfer Approach in the PP-2

Table 3.1.1 Candidate Trainers in the ITP

No.	Name	Position	JICA Expert in Charge	Subject
	Design work			
1	Daw Mya Mya Win	Deputy Superintending Engineer, RRL	H. Kobayashi (Mr.)	Pavement deign
2	U Nyi Nyi Kyaw	Assistant Engineer, RRL	H. Miyamoto (Mr.)	Material mix design
	Machinery work			
3	U Hlaing Min Zaw	Junior Engineer (2), Mechanical Dept.	N. Akmar (Mr.)	Plant operation
	Quality control			
4	U Nyi Nyi Kyaw	Assistant Engineer, RRL	H. Miyamoto (Mr.)	Material test at site

3.2 Intensive Training Program

The Team will implement the Intensive Training Program (ITP) as outlined below.

- Date & period : 1st week in April, 2015 (2days)
- Venue : PW Bogale Bridge office
- Subject : (i) Pavement design
  (ii) Material mix design of stabilized material
  (iii) Material test at site
  (iv) Operation method of the soil mixing plant
- Participants : PW/HQ, RRL, Pyapon District Office, Bogale Township Office, Mechanical Dept. and so on (Approximately 30 persons)

Pavement Design Report in the PP-2

1. Introduction

The project implementation team composed of PW and JICA Experts conducted pavement design work to be applied for the PP-2 on Road No. 10 in Bogale Township. The PP-2 will be commenced in February, 2015. Approach and conditions for the design work are described in the following chapters.

2. Design Approach

PW/JICA designed pavement structure to be applied for the PP-2 in 2 steps namely (i) AASHTO empirical method and (ii) Structural Number (SN) principle in ORN31. The design procedures will be described in the following chapters.

3. Design Conditions

3.1 Estimated Traffic Volume in Design Period

(1) Diverted and Generated Traffic

Currently, there is 6 numbers of heavy vehicles in the PP-2 section on Road No. 10 based on the estimate of the District Engineer in PW Pyapon District Office. They have been applied for construction work of Kyaw Chan Ye Kyaw Bridge (KCYK-B). The bridge will be opened in 2017 on the basis of the recent construction schedule. PW/JICA made assumption that the traffic will be certainly increased in the PP-2 section through the following routes once the bridge opens.

- ✓ Traffic of Maubin-Pyapon-Bogale will be diverted to Maubin-Kyaikpi-Bogale.
- ✓ Traffic of Mawgyun-Bogale will be generated.

Current daily traffic volume (heavy vehicle only) on the related routes are as shown in Table 3.1.1. Furthermore, road network related to the PP-2 is as shown in Figure 3.1.1.

Table 3.1.1 Daily Traffic Volume of Heavy Vehicle (2014)

Route	Road No.	Traffic volume (both directions)
Maubin-Pyapon-Bogale		29
Maubin-Kyaikpi(KYCK-B)-Bogale	Rd-1 & Rd-10	6
Mawgyun-(KYCK-B)-Bogale	Rd-10	0

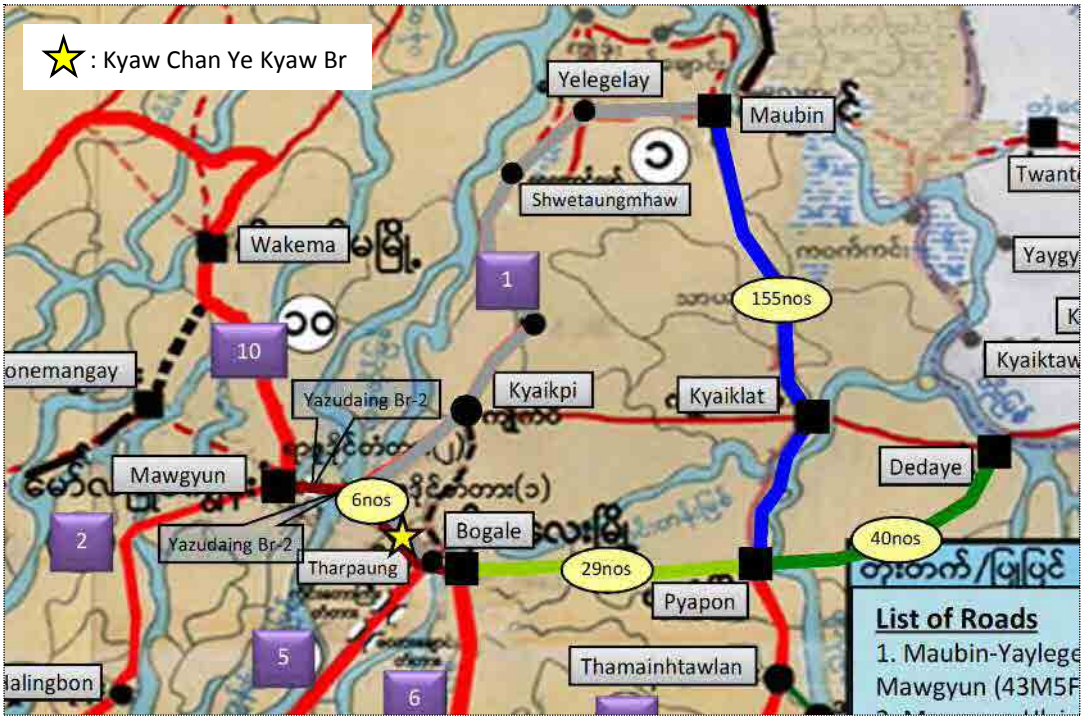


Figure 3.1.1 Road Network Map related to the PP-2

(2) Traffic Growth Ratio

PW/JICA set up the traffic growth ratio in the design period (2015 – 2024) as follows.

- ✓ 2015 – 2016 : 4.5 % per year (Middle value (3.0 – 6.0%) of the design manual)
- ✓ 2017 – 2024 : 6.0 % per year (The ratio will be increased after opening of KYCK bridge)

(3) Cumulative Traffic Volume in the Design Period

PW/JICA estimated the cumulative traffic volume in the PP-2 section during the design period by considering diverted/generated traffic and traffic growth ratio stated above. Result of the estimate is summarized in Table 3.1.2. Note PW/JICA made the following assumptions for the estimate.

- ✓ Numbers of construction vehicles for KCYK-B construction work will not be increased by applying the traffic growth ratio because of their specific purpose to use. Furthermore, they will be removed once the construction work is completed (2017).
- ✓ Traffic volume via Maubin-Pyapon-Bogale will be diverted once KYCK-B opens (2017).
- ✓ Traffic volume via Mawgyun-(KYCK-B)-Bogale also will be generated once KYCK-B opens (2017). 10 numbers were set up as the traffic volume in 2017.

Table 3.1.2 Cumulative Traffic Volume in the PP-2 Section in the Design Period (Nos.)

Year	Maubin-Kyaikpi-(KCYK-B)-Bogale Rd1+Rd10	Mawgyun-(KYCK-B)-Bogale Rd10	Maubin-Pyapon-Bogale
2014	*6.00*	*0.00*	*29.00*
2015	*6.00*	0.00	*30.31*
2016	*6.00*	0.00	*31.67*
2017	*33.09*	**10.00**	
2018	35.08	10.60	
2019	37.18	11.24	
2020	39.42	11.91	
2021	41.78	12.62	
2022	44.29	13.38	
2023	46.94	14.19	
2024	49.76	15.04	
Total (per day)	339.54	98.97	
		438.52	
10 years (x365)		**160,059.68**	

Exist till KYCK-B opening

Generated

Diverted

3.2 Estimated Cumulative Equivalent Standard Axle Loads (ESAL) in Design Period

(1) Vehicle Type, Distribution Ratio and Damage Factor (DF)

PW/JICA set up the target vehicle types and their distribution ratio in accordance with the PW regulation as follows.

(i) 16tons, 2-axles : 15%

(ii) 13tons, 2-axles : 29%

(iii) <13tons, 2-axles : 56%

DF will be slightly varied depending on the design manual to be applied. Calculated DFs by the manual namely ORN31 and AASHTO are listed in Table 3.2.1. The values of AASHTO will be applied for the PP-2.

Table 3.2.1 DF by the Manual

Vehicle type	ORN31	AASHTO
(i) 16tons, 2-axles	2.74	**2.41**
(ii) 13tons, 2-axles	2.00	**1.86**
(iii) <13tons, 2-axles	0.50	**0.55**

(2) Lane Distribution Factor

Proposed lane formation is as shown in Figure 3.2.1. Carriageway is composed of 2 lanes (9 feet per lane). This formation is designated as 1.5 lanes in accordance with the PW regulation. Therefore, cumulative ESAL (both directions) will be multiplied by **0.75**.

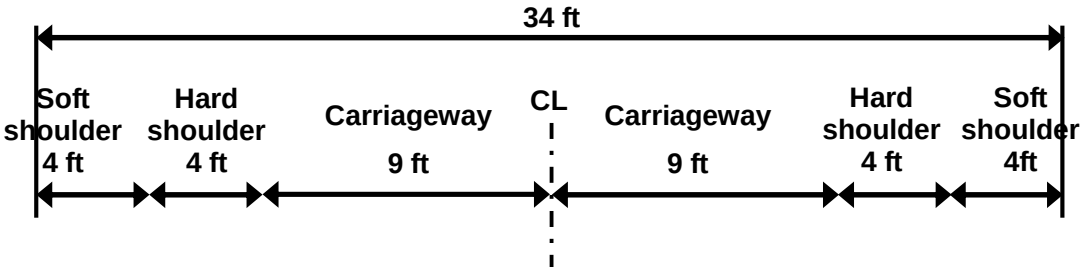


Figure 3.2.1 Proposed Lane Formation in the PP-2

(3) Estimate of Cumulative ESAL in the Design Period

PW/JICA estimated the cumulative ESAL by considering the above stated factors. The result is summarized in Table 3.2.2. The value of **145,122** will be applied for the PP-2.

Table 3.2.2 Cumulative ESAL in the Design Period

Vehicle type	i. 16t, 2-axles	ii. 13t, 2-axles	iii. <13t, 2-axles
Percentage	15%	29%	56%
DF (PW/ORN31)	2.74	2.00	0.50
DF (AASHTO)	2.41	1.86	0.55
Cummulative vehicle numbers	24,009	46,417	89,633
Cummulative ESAL (PW/ORN31)	65,785	92,835	44,817
Total ESAL (2-directions)			203,436
Total ESAL per direction (x 75%)			**152,577**
Cummulative ESAL (AASHTO)	57,862	86,336	49,298
Total ESAL (2-directions)			193,496
Total ESAL per direction (x 75%)			**145,122**

3.3 Reliability (R)

Reliability (R) is the probability that the pavement structure will fulfill the desired performance under the estimated traffic volume and environment in the design period. R is classified according to required function (i.e. importance) of the road in the AASHTO method. Table 3.3.1 indicates the recommended values of R. Further, Reliability coefficient (Z_R) is determined according to the classified R as shown in Table 3.3.2.

PW/JICA assumed Road No. 10 would be categorized to “Local road” in accordance with the American Classification. Therefore, **R = 70%** and **Z_R = -0.524** will be applied. Furthermore, standard deviation (S_0) in case of flexible pavement will be between 0.40 and 0.50 also in accordance with AASHTO. Therefore, **S_0 = 0.45** will be applied.

Table 3.3.1 Recommended R by Road Function

Function	Recommended R (%)	
	Urban	Rural
Interstate road & freeway	85 – 99.9	80 – 99.9
Principal arterial	80 – 99	75 – 95
Collectors	80 – 95	75 – 95
Local	50 – 80	50 – 80

Table 3.3.2 Reliability Coefficient (Z_R) by Determined R

R (%)	Z_R
50	0.000
60	-0.253
70	-0.524
75	-0.674
80	-0.841
85	-1.037
90	-1.282
95	-1.645
99.9	-3.090

3.4 Serviceability

The team determined 2 types of serviceability values namely initial serviceability (**$P_0 = 4.2$**) and terminal serviceability (**$P_t = 2.0$**) in accordance with AASHTO.

3.5 Material Coefficient of Each Layer

Strength (e.g. UCS, CBR) of the each layer is able to convert to layer coefficient (a_n) the following graphs (Figure 3.5.1 to Figure 3.5.3). The determined coefficients are summarized in Table 3.5.1.

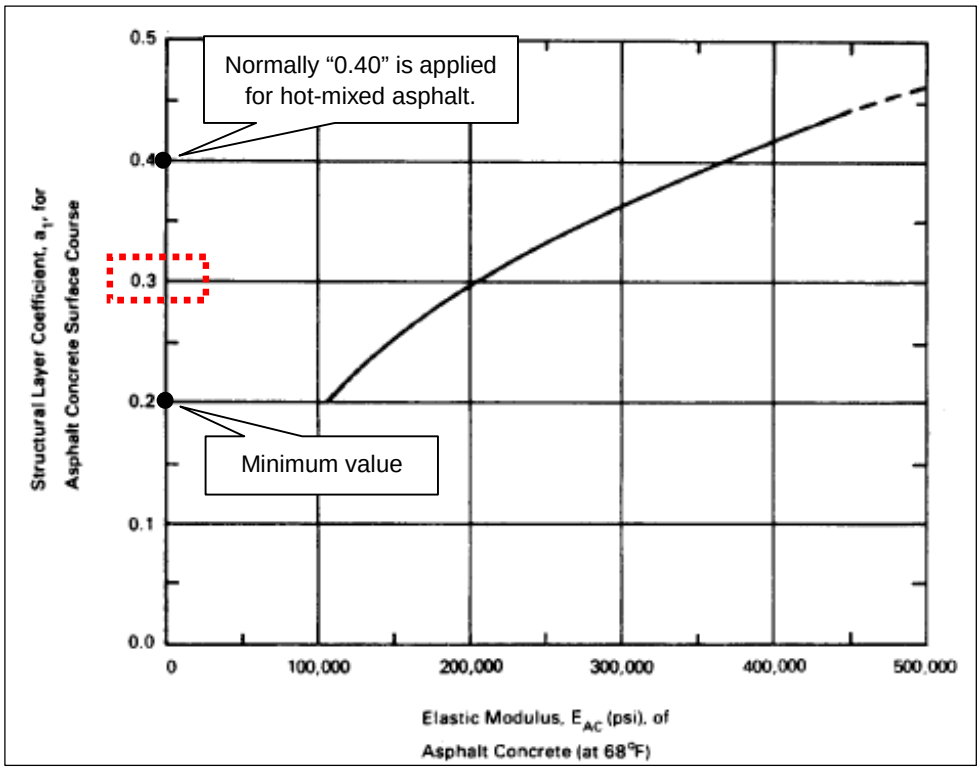


Figure 3.5.1 Correlations between Elastic Modulus & Layer Coefficient in Asphalt Concrete

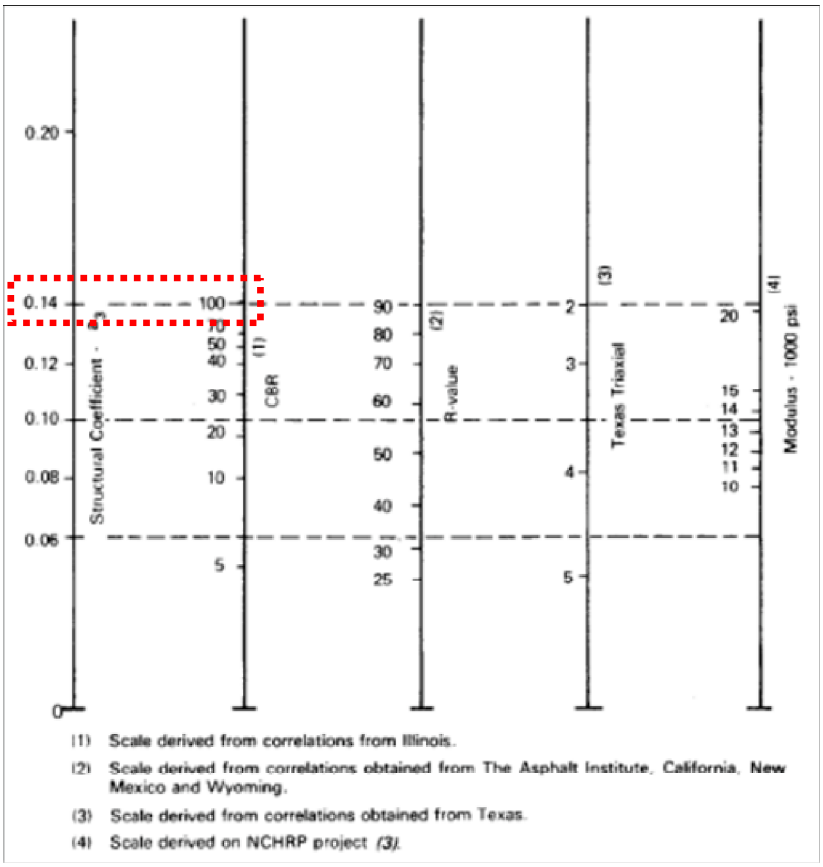


Figure 3.5.2 Correlations between CBR & Layer Coefficient in Granular Base

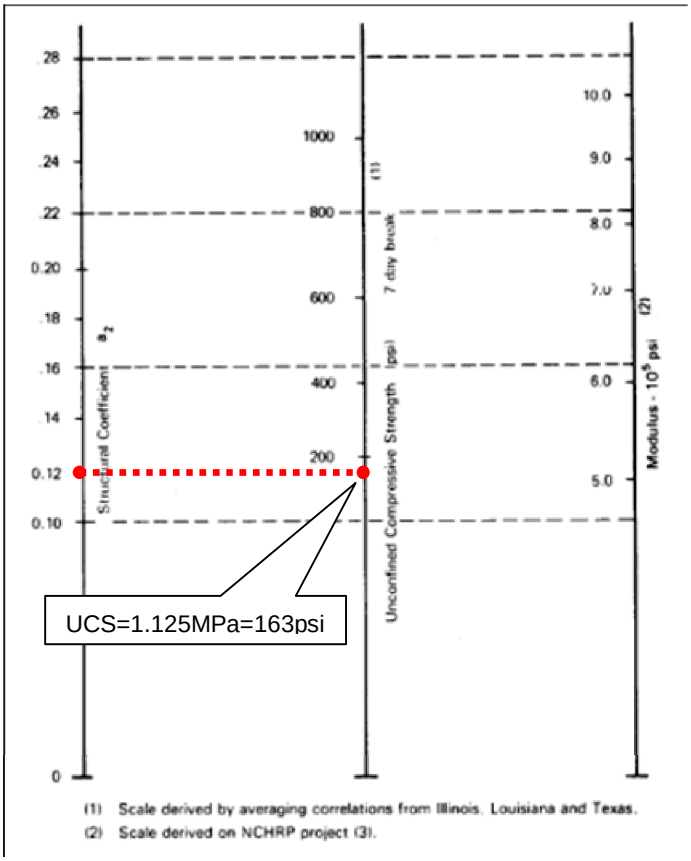


Figure 3.5.3 Correlations between UCS & Layer Coefficient in Cement Treated Base

Table 3.5.1 Layer Coefficient in AASHTO

Layer	Material	Strength	Coefficient (a_n)	Remarks
Wearing	P-macadam	Not available in numeral	0.30	Interim value in Fig.3.5.1
Base	Graded crush stone	CBR=100%	0.14	See Fig.3.5.2
Subbase	Cement stabilized soil	UCS=1.125MPa	0.12	See Fig.3.5.3

(Note) 1.0psi = 0.0069MPa

3.6 Drainage Coefficient of Each Layer

Bottom of subbase course will be set on 3feet higher than previous high water level in accordance with the PW regulation. Therefore, drainage coefficients (m_n) of subbase course and base course will not be considered (i.e. m_n=1.00).

4. Determination of Pavement Formation

4.1 Determination Approach in AASHTO

Required strength of whole pavement structure, which is called the Structure Number (SN), will be calculated by the following formula and the conditions determined in above sections.

$$\log_{10}(W18) = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \times \log_{10}(M_R) - 8.07$$

W18 : Estimated cumulative ESAL (=145,122)

M_R : Resilient coefficient of subgrade (CBR × 1,500 = 4 × 1,500 = 6,000)

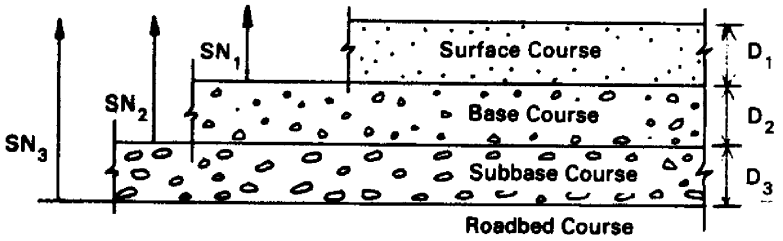
SN : Structure Number (Required strength of whole pavement structure = 2.38)

Z_R : Reliability coefficient (= -0.524 in case of R = 70%)

S_0 : Standard deviation (= 0.45)

⊿PSI : $P_0 - P_t$ (Difference between initial serviceability index and terminal serviceability index of pavement (initial: P_0=4.2, terminal: P_t=2.0)

Furthermore, each layer's thickness should be determined by fulfilling the correlations as illustrated in Figure 4.1.1. Consequently, pavement formation was determined as shown in Table 4.1.1.



$$D^*_1 \geq \frac{SN_1}{a_1}$$

$$SN^*_1 = a_1 D^*_1 \geq SN_1$$

$$D^*_2 \geq \frac{SN_2 - SN^*_1}{a_2 m_2}$$

$$SN^*_1 + SN^*_2 \geq SN_2$$

$$D^*_3 \geq \frac{SN_3 - (SN^*_1 + SN^*_2)}{a_3 m_3}$$

1) a, D, m and SN are as defined in the text and are minimum required values.

2) An asterisk with D or SN indicates that it represents the value actually used, which must be equal to or greater than the required value.

Figure 4.1.1 Procedure for Determining Thickness of Layers by a Layered Analysis Approach

Table 4.1.1 Pavement Formation in AASHTO

Layer	Material	a_n	m_n	Min. thickness (inch)	D_n (inch)	D_n* (inch)
Wearing	P-macadam	0.30		2.00	4.17	**4.50**
Base	Graded crush stone	0.14	1.00	4.00	-1.86	**4.00**
Subbase	Cement stabilized soil	0.12	1.00		3.92	**4.00**

(Note) D_n: minimum required value, D_n^*: actually applied value

4.2 Thickness Modification by ORN31

PW/JICA considered reduction of the wearing course thickness from 4.5" to 3.0" to conform to the previous projects of PW. PW/JICA applied the SN principle stipulated in ORN31 for this approach. That is, the strength of reduced thickness will be substituted by increment of the lower layers' thicknesses (i.e. base and subbase). SN of modified pavement structure (SN_m) will be calculated by the following formula. Furthermore, SN_m should exceed SN of whole pavement structure (=2.38) stated in section 4.1.

$$SN_m = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$$

SN_m : Structure Number of modified pavement structure
a_n : Material coefficient of each layer
D_n : Thickness of each layer (inch)
m_n : Drainage coefficient of each layer

Modified pavement formation to be applied in the PP-2 is as shown in Table 4.2.1.

Table 4.2.1 Modified Pavement Formation

Layer	Material	a_n	m_n	D_n (inch)	SN_m
Wearing	P-macadam	0.30		**3.00**	0.90
Base	Graded crush stone	0.14	1.00	**6.00**	0.84
Subbase	Cement stabilized soil	0.12	1.00	**6.00**	0.72
				Total SN_m	**2.46**

Approach for Thickness Reduction of Pavement Layers by Multi-layer Analysis Method (GAME)

1. Pavement Structure

(1) Cross section

Fig-1 shows the pavement structure proposed by JICA study team

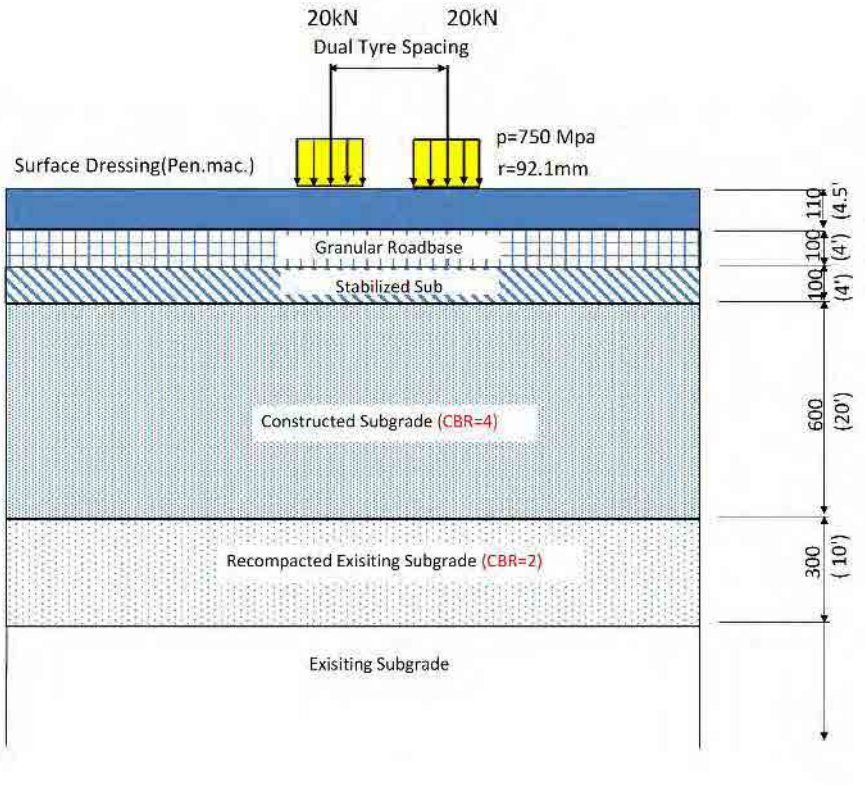
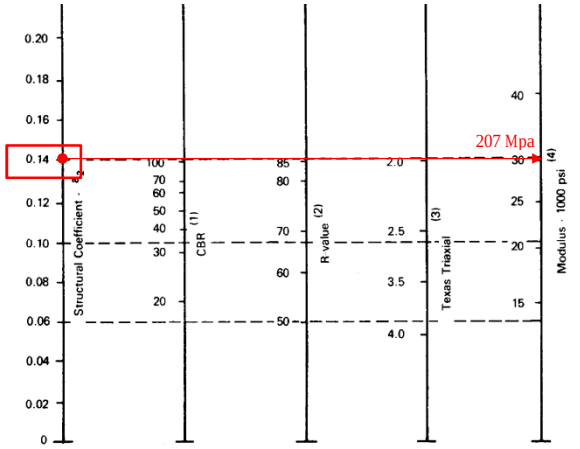


Fig-1 Pavement Structure Proposed by JICA study team

(2) Design property

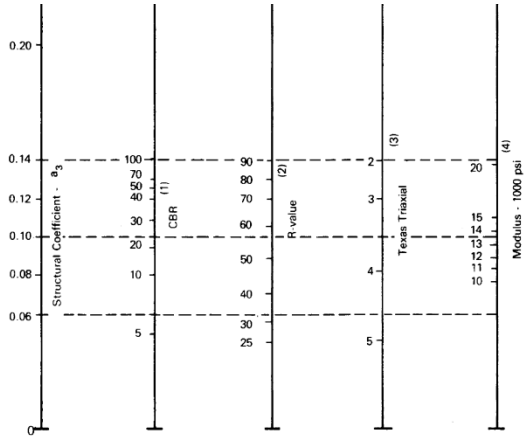
		ASSHOTO Design	Remarks		
		Mr (Mpa)	CBR (%)	UCS (Mpa)	Poisson's Ratio ν
1	Surface Course	1,379 (200,000 psi)	—	—	0.40
2	Road-base	207 (30,000 psi)	80	—	0.35
3	Stabilized Sub-base	258 →1,500*[1] (40,000 psi)	— (for granular 30)	(0.75-1.5)	0.20 (for gr 0.35)
4	Constructed subgrade	40	4	—	0.45
5	Re compacted existing sub-grade	20	2	—	0.45
6	Existing embankment		(less than 2)	—	0.45

＊1: source South Africa Pavement Engineering Manual, UCS=1.125 Mpa



(1) Scale derived by averaging correlations obtained from Illinois.
(2) Scale derived by averaging correlations obtained from California, New Mexico and Wyoming.
(3) Scale derived by averaging correlations obtained from Texas.
(4) Scale derived on NCHRP project *(3)*.

Figure 2.6. Variation in Granular Base Layer Coefficient (a_2) with Various Base Strength Parameters (*3*)

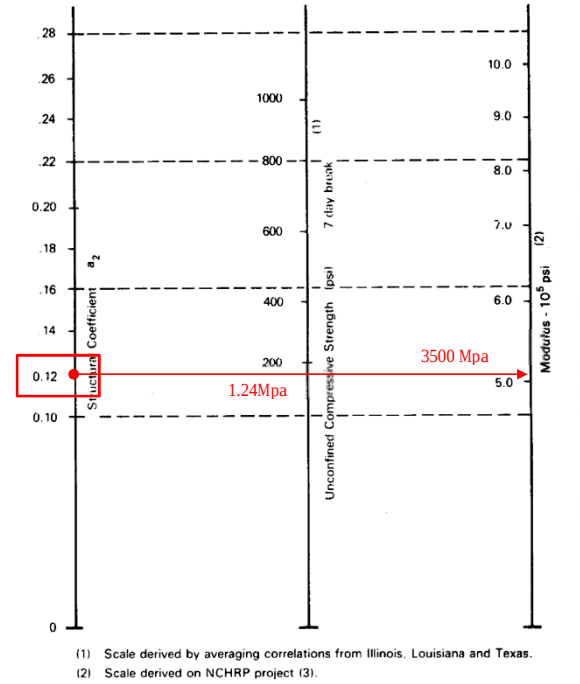


(1) Scale derived from correlations from Illinois.
(2) Scale derived from correlations obtained from The Asphalt Institute, California, New Mexico and Wyoming.
(3) Scale derived from correlations obtained from Texas.
(4) Scale derived on NCHRP project *(3)*.

Figure 2.7. Variation in Granular Subbase Layer Coefficient (a_3) with Various Subbase Strength Parameters (*3*)

(1) Road base layer (b) Sub-base layer

Fig- Modulus on granular Layer



(1) Scale derived by averaging correlations from Illinois, Louisiana and Texas.
(2) Scale derived on NCHRP project (3).

Figure 2.8. Variation in a for Cement-Treated Bases with Base Strength Parameter (*3*)

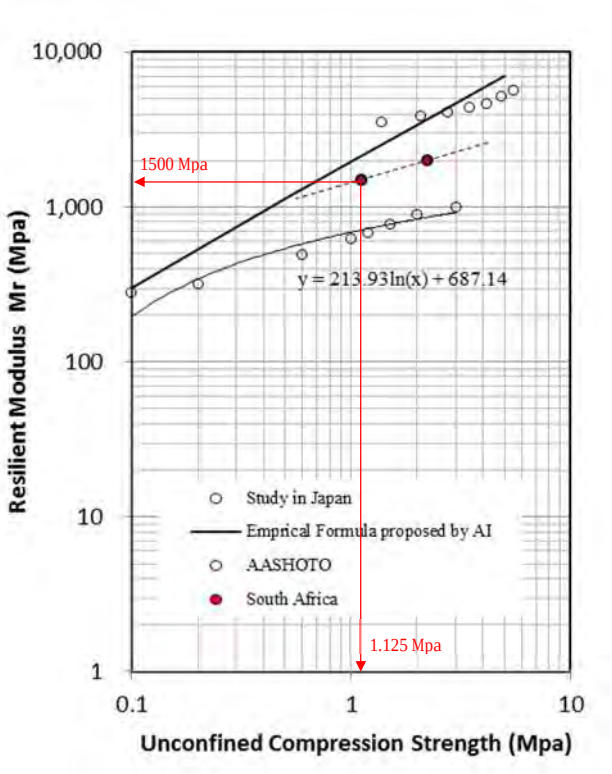


Fig- Modulus on Cement-Treated Bases

2. Multi-Layer Elastic Analysis (MLET)

2.1 Analysis Result for AASHOTO Design Pavement Structure

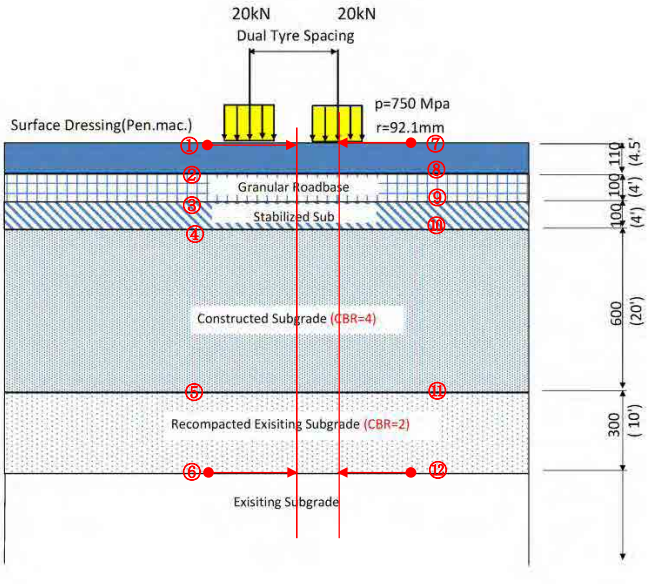
LAYER NUMBER	YOUNG'S MODULUS(MPa)	POISSON'S RATIO	THICKNESS (cm)	SLIP RATE
1	1379	0.4	11	0
2	207	0.35	10	0
3	1500	0.2	10	0
4	40	0.45	60	0
5	20	0.45	30	0
6	10	0.45		

	X (cm)	Y (cm)	Z (cm)	Strain		
				EPSx	EPSy	EPSz
1	0	0	0	-3.74E-05	-3.51E-04	2.59E-04
2	0	0	11	-1.59E-04	**2.47E-04**	-4.34E-04
3	0	0	21	-3.01E-06	-1.11E-05	-4.69E-05
4	0	0	31	1.77E-04	2.66E-04	**-5.62E-04**
5	0	0	91	1.89E-04	1.99E-04	-4.06E-04
6	0	0	121	1.80E-04	1.86E-04	-4.09E-04
7	16.5	0	0	-3.09E-04	-4.00E-04	2.17E-04
8	16.5	0	11	2.49E-04	3.32E-04	-1.02E-03
9	16.5	0	21	8.54E-06	-5.40E-06	-6.70E-05
10	16.5	0	31	1.70E-04	2.48E-04	**-5.28E-04**
11	16.5	0	91	1.78E-04	1.95E-04	-3.90E-04
12	16.5	0	121	1.73E-04	1.83E-04	-3.99E-04

Elastic Modulus and Material Properties for Cemented Materials in 1996 SAMDM

	Initial Class	Strain-at-Break (εb)	UCS (kPa)	Equivalent Granular Class	Modulus (MPa)
C3	2 000	125	2.25	EG4	300
C4	1 500	145	1.125	EG5	200

	Maximum Strain	
	compression ε_z	tension ε_x or ε_y
Surface Course	—	2.47×10^{-4} (point ②)
Sub-grade	-5.62×10^{-4} (point ④)	
Stabilized Sub Road-base	-6.70×10^{-5} (pion ⑨)	2.66×10^{-4} (point ④)



2.2 Criteria

2.2.1 Penetration Macadam (Hot Mixed Asphalt)

Asphalt Institute Cumulative Failure Criteria

Fatigue cracking equation for 20 percent of the area cracked

$$N_{fa} = 0.0796 \times \varepsilon_t^{-3.291} \times E^{-0.854}$$

where

Nfa = number of load repetitions to fatigue cracking

ε t = tensile strain at the bottom of the HMA layer

E = HMA modulus

$$Nfa = 0.0796 \times (2.47 \times 10^{-4})^{-3.291} \times 1379^{-0.854}$$

$$= 1.23 \times 10^{8} \geqq ESA, \quad ESA=145,122$$

2.2.2 Sub-grade

Definition of the Failure from AI

The Asphalt Institute defines a rut depth of 0.5 in. and models the rutting due to the subgrade permanent deformation

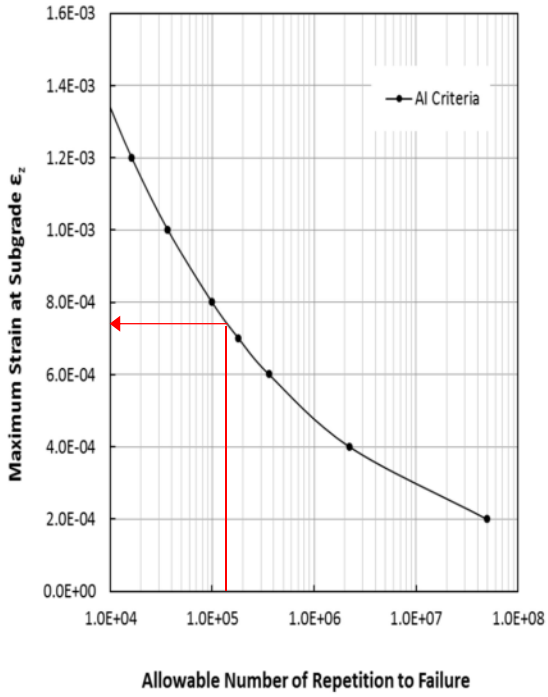
$$N_{fs} = 1.365 \times 10^{-9} \times \varepsilon_z^{-4.477}$$

where

Nfs = number of load repetitions to cause permanent deformation on the subgrade

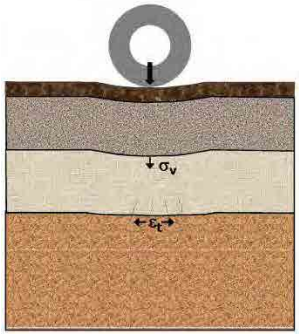
ε c = vertical compressive strain on top of the subgrade(un-stabilized)

$N_{fs} = 1.365 \times 10^{-9} \times 0.000562^{-4.477} = 4.856 \times 10^{5} \geqq ESA, \quad ESA=145,122$



2.2.3 Cement Stabilized Sub-base

(1) South Africa Pavement Engineering Manual



South Africa Pavement Engineering Manual take account 2 stage in accordance with advancing crush for compression, and this define safety for not only compression but also tensile strain at bottom stabilized sub-base

1) For Crush Initiation and Advanced Crushing

$$N_{ci/ca} = 10^{a\left(1-\frac{\sigma v}{b \bullet UCS}\right)}$$

Where Nci/ca= Standard axles to crack initiation or advanced crushing

σ v = Vertical compressive stress at top of layer

UCS = Unconfined compressive strength (kPa), recommended values

a, b = Constants, given below

2) For Effective Fatigue

$$N_{eff} = SF \times 10^{c\left(1-\frac{\varepsilon t}{d \bullet \varepsilon b}\right)}$$

Where Neff = Effective fatigue life

ε = Horizontal tensile strain at bottom of layer (microstrain)

ε_b = Strain-at-break, recommended values

c,d = Constants, given below

SF = Shift Factor for crack propagation

t = Layer thickness

Shift Factor(SF) to Account for Layer Thickness	
t ≦ 102 mm	1
102 mm ＜ t ≦ 319 mm	$10^{(0.00285t-0.293)}$
319mm ＜t	8

Reliability Level	Compression				Tensile	
	Crush Initiation		Advanced Crushing		Effective Fatigue	
	a	b	a	b	c	d
50% (Category D)	7.386	1.09	8.064	1.19	6.72	7.49
80% (Category C)	7.506	1.10	8.184	1.20	6.84	7.63
90% (Category B)	7.706	1.31	8.384	1.23	6.87	7.66
95% (Category A)	8.216	1,21	8.894	1.31	7.06	7.86

(2) Pavement Structural Design, Austroads 2012

$N = (k / \varepsilon)^b$

Where N = number of passes of a given axle

k = material constant, derived through testing

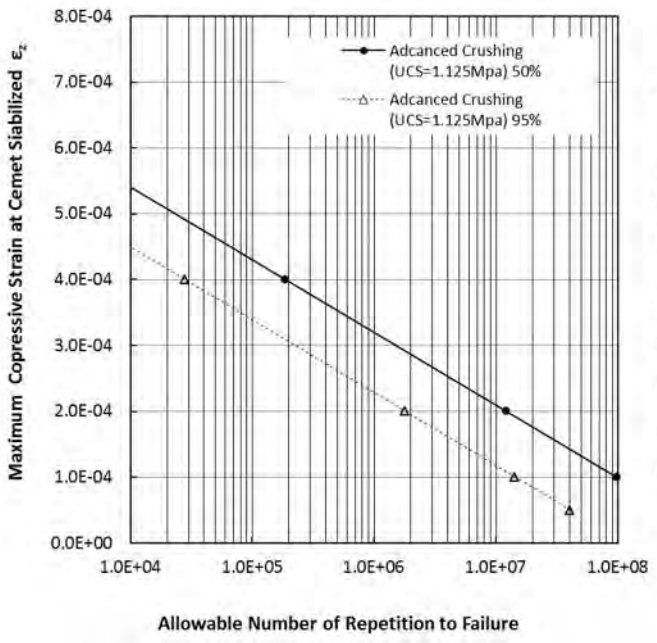
ε = induced strain in the pavement layer

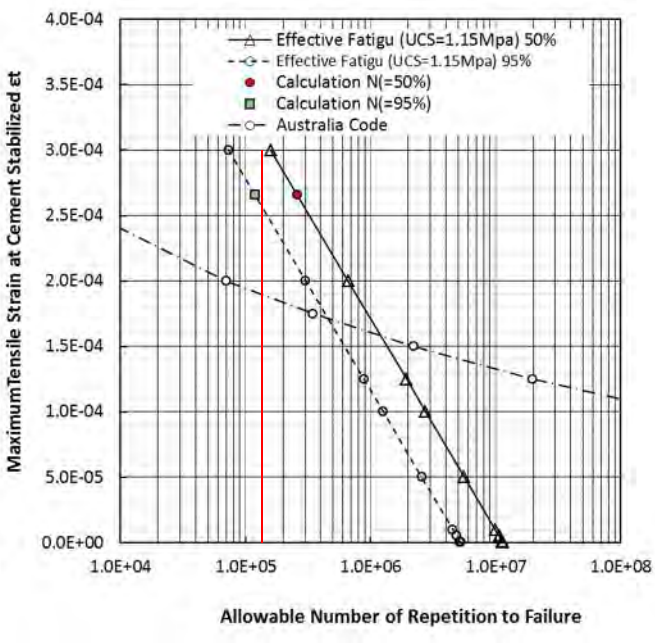
$k = (113{,}000/E^{0.804} + 191)$

E = resilient modulus of cemented material, and b = 12

(3) Number of load repetitions to cause permanent deformation on Cement Stabilized Sub-base

			Compression	Tension
			Advanced Crushing	Effective Fatigue
Analyzed Strain			-6.70×10^{-5}	2.66×10^{-4}
Number of load repetitions	South Africa	Reliability 50 %	1.94×10^{8}	2.58×10^{5}
		Reliability 95 %	2.88×10^{7}	1.19×10^{5}
	Australia			2.20×10^{3}
Design EAS			145,122 (1.5×10^{5})	





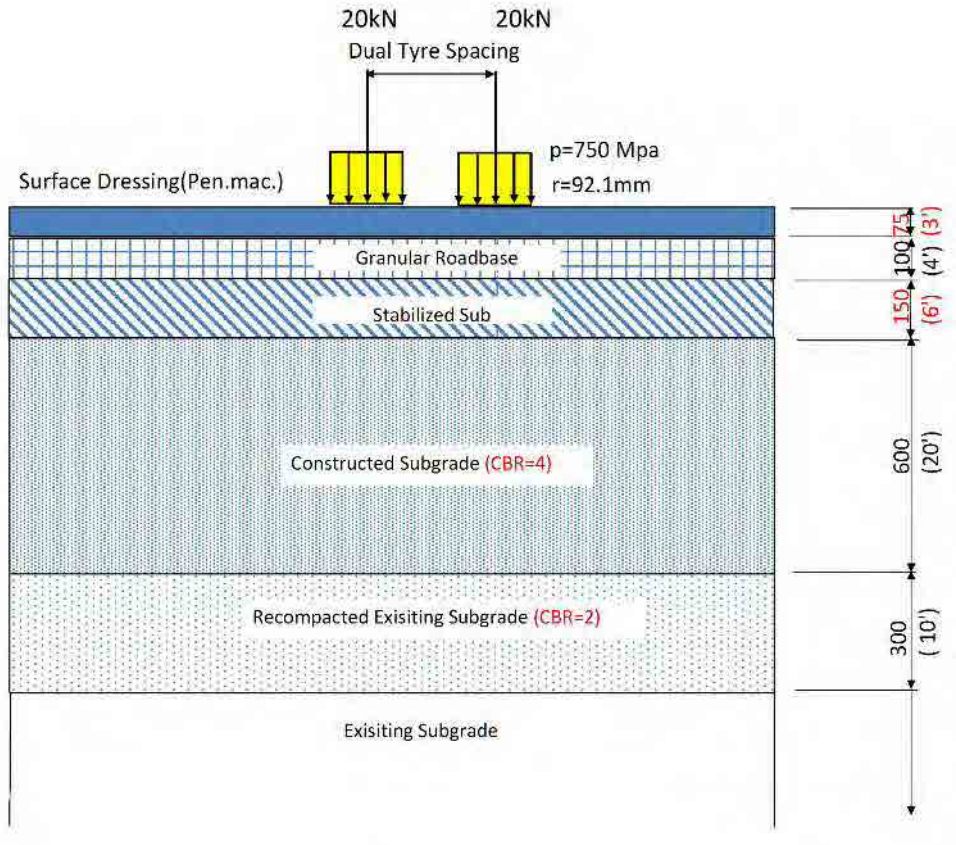
3. Revised Pavement Structure

3.1 Cross section

The bellow table shows revised the pavement structure considering follows;

- Thickness of Surface Dressing (pen. Mac.) is 7.5cm (3fet) according to achievement in Myanmar.
- The horizontal tensile strain at top of stabilized sub-base is nearly equal with criteria given by south Africa pavement design manual.

LAYER NUMBER	YOUNG'S MODULUS(MPa)	POISSON'S RATIO	THICKNESS (cm)	SLIP RATE
1	1379	0.4	**11→7.5**	0
2	207	0.35	10	0
3	1500	0.2	**10→15**	0
4	40	0.45	60	0
5	20	0.45	30	0
6	10	0.45		



	X (cm)	Y (cm)	Z (cm)	Strain		
				EPSx	EPSy	EPSz
1	0	0	0	1.08E-04	-3.52E-04	1.63E-04
2	0	0	7.5	-3.65E-04	2.13E-04	-3.39E-04
3	0	0	17.5	-6.53E-05	-6.34E-05	-4.14E-05
4	0	0	32.5	1.72E-04	**2.58E-04**	**-5.31E-04**
5	0	0	92.5	1.76E-04	1.85E-04	-3.78E-04
6	0	0	122.5	1.70E-04	1.75E-04	-3.88E-04
7	16.5	0	0	-4.12E-04	-4.79E-04	3.38E-04
8	16.5	0	7.5	3.36E-04	3.95E-04	-1.52E-03
9	16.5	0	17.5	-2.82E-05	-5.15E-05	**-9.54E-05**
10	16.5	0	32.5	1.64E-04	2.40E-04	-4.98E-04
11	16.5	0	92.5	1.66E-04	1.81E-04	-3.63E-04
12	16.5	0	122.5	1.64E-04	1.73E-04	-3.78E-04

3.2 Analysis Result

	Revised pavement Structure		Original Design	
	Maximum Strain		Maximum Strain	
	compression ε_z	tension ε_x or ε_y	compression ε_z	tension ε_x or ε_y
Surface Course	—	2.13×10-4 (point ②)	—	2.47×10-4 (point ②)
Sub-grade	-5.31×10^{-4} (point ④)		-5.62×10^{-4} (point ⑩)	
Stabilized Sub Road-base	-9.54×10^{-5} (pion ⑨)	2.58×10^{-4} (point ④)	-6.70×10^{-5} (pion ⑨)	2.66×10^{-4} (point ④)

Cement Stabilized Sub-base

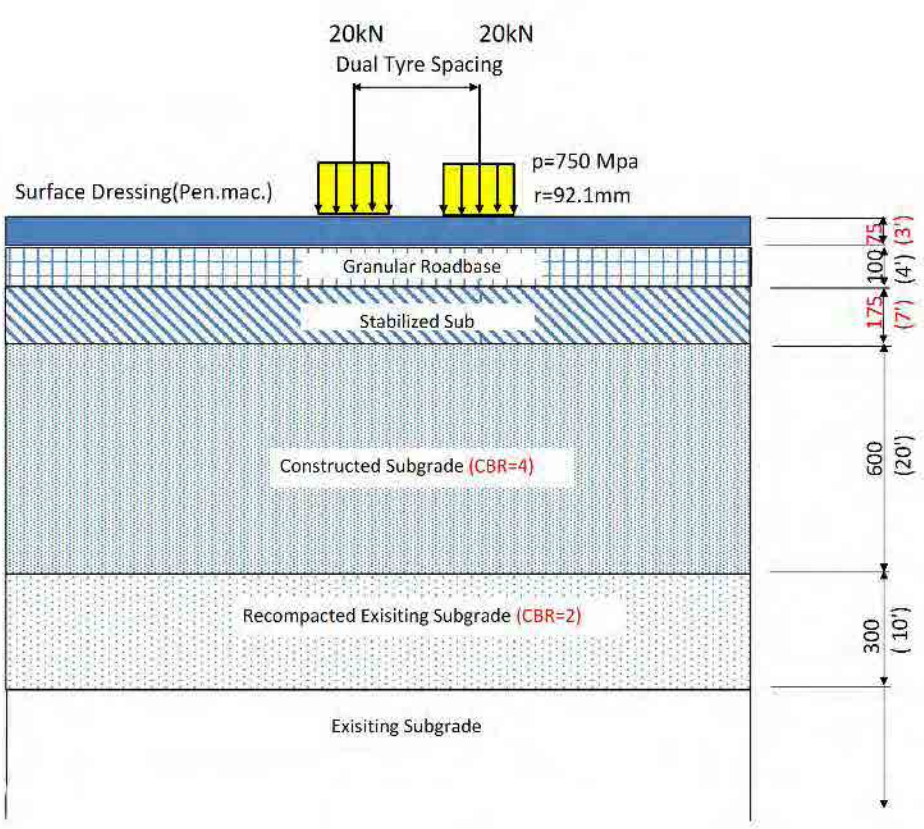
			Revised pavement Structure		Original Design	
			Compression	Tension	Compression	Tension
			Advanced Crushing	Effective Fatigue	Advanced Crushing	Effective Fatigue
Analyzed Strain			-9.54×10^{-5}	2.58×10^{-4}	-6.70×10^{-5}	2.66×10^{-4}
Number of load repetitions	South Africa	Reliability 50 %	1.07×10^{8}	2.89×10^{5}	1.94×10^{8}	2.58×10^{5}
		Reliability 95 %	1.59×10^{7}	1.33×10^{5}	2.88×10^{7}	1.19×10^{5}
	Australia			3.31×10^{3}		2.20×10^{3}
Design EAS			145,122 (1.5×10^{5})			

	Revised pavement Structure	Original Design
Sub grade compressive strain	-5.31×10^{-4}	-5.61×10^{-4}
Allowable number of load repetitions	6.26×10^{5}	4.90×10^{5}

Alternative (Revised-2)

For Reliability 95%

LAYER NUMBER	YOUNG'S MODULUS(MPa)	POISSON'S RATIO	THICKNESS (cm)	SLIP RATE
1	1379	0.4	**7.5**	0
2	207	0.35	10	0
3	1500	0.2	**15→17.5**	0
4	40	0.45	60	0
5	20	0.45	30	0
6	10	0.45		



	X (cm)	Y (cm)	Z (cm)	Strain		
				EPSx	EPSy	EPSz
1	0	0	0	1.23E-04	-3.30E-04	1.38E-04
2	0	0	7.5	-3.67E-04	2.11E-04	-3.46E-04
3	0	0	17.5	-7.10E-05	-6.17E-05	-4.56E-05
4	0	0	35	1.60E-04	**2.28E-04**	**-4.71E-04**
5	0	0	95	1.59E-04	1.66E-04	-3.40E-04
6	0	0	125	1.55E-04	1.59E-04	-3.54E-04
7	16.5	0	0	-3.99E-04	-4.59E-04	3.16E-04
8	16.5	0	7.5	3.35E-04	3.93E-04	-1.53E-03
9	16.5	0	17.5	-3.15E-05	-5.07E-05	**-9.95E-05**
10	16.5	0	35	1.49E-04	2.13E-04	-4.39E-04
11	16.5	0	95	1.51E-04	1.63E-04	-3.28E-04
12	16.5	0	125	1.50E-04	1.57E-04	-3.46E-04

	Revised-2 pavement Structure		Original Design	
	Maximum Strain		Maximum Strain	
	compression ε_z	tension ε_x or ε_y	compression ε_z	tension ε_x or ε_y
Surface Course	—	2.11×10-4 (point ②)	—	2.47×10-4 (point ②)
Sub-grade	-4.71×10^{-4} (point ④)		-5.62×10^{-4} (point ⑩)	
Stabilized Sub Road-base	-9.95×10^{-5} (pion ⑨)	2.28×10^{-4} (point ④)	-6.70×10^{-5} (pion ⑨)	2.66×10^{-4} (point ④)

Cement Stabilized Sub-base

			Revised pavement Structure		Original Design	
			Compression	Tension	Compression	Tension
			Advanced Crushing	Effective Fatigue	Advanced Crushing	Effective Fatigue
Analyzed Strain			-9.95×10^{-5}	2.28×10^{-4}	-6.70×10^{-5}	2.66×10^{-4}
Number of load repetitions	South Africa	Reliability 50 %	9.85×10^{7}	4.443×10^{5}	1.94×10^{8}	2.58×10^{5}
		Reliability 95 %	1.46×10^{7}	2.038×10^{5}	2.88×10^{7}	1.19×10^{5}
	Australia			1.457×10^{4}		2.20×10^{3}
Design EAS			145,122 (1.5×10^{5})			

Material Mix Design

Report in the PP-2

February, 2015

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

Ministry of Construction	JICA Expert Team

CONTENTS

1. INTRODUCTION

Laboratory test are carried out to determine mixing ratio of the materials. Therefore, we need to examine the properties of soil such as dry density, moisture content, plasticity index and so on.

In order to find out the soil properties the following soil test should be done. These testing will be done in laboratory.

No.	TEST	PURPOSE
1	Grain Size Distribution Analysis	To identify the grain size distribution of Soil, Sand, River shingle and so on.
2	Compaction Test (laboratory test)	To determine the Optimum Moisture Content and Maximum Dry Density for existing embankment, subgrade, subbase and base course
3	Atterberg Limit Test	To check the Plasticity Index for existing embankment, subgrade, subbase. In case of using soil material we shall conducted Atterberg limit test. In case of using crush stone for base course, we don't need to propose Atterberg limit test.
4	CBR Test(California Bearing Ratio Test)	To check the bearing capacity of existing embankment and materials mixed design for subgrade.

1.1 Overview for stabilized material

Based on the results of mixing tests conducted until now, the cases that comply with site conditions where the required strength can be identified, and the relationship that exists between the quantities of stabilizer required for test mix design and the manifested strength will be meet.

We need to examine the properties of each material such as liquid limit, plastic limit. In addition require to examine the mixing ratio. These are based on the laboratory test results. Laboratory technician and designer need to consider the actual site condition. Because laboratory results are done by the procedure of testing methods step by step, have sufficient equipment and time. But in the site condition, will be different especially insufficient time.

In this pilot project, we used the stabilized method for subbase course and base course.

Subbase course stabilization (borrow soil, selected sand + cement):

- Target improvement strength UCS ≧ 0.75 ～1.50 MPa

Base course stabilization (selected sand, river shingle + cement)

- Target improvement strength UCS ≧ 1.50～3.00 MPa

Table for required test for mixing design in laboratory is shown in Figure 1.1.1. And the procedure on design of stabilized materials is shown in Figure 1.1.2.

	Contents	Index
Material	Type of Stabilizing Agent	Plasticity Index(PI)of mixing soil Organic in soils
	Property each soil Mixing ratio of each soil	Consistency(LL,PI) Sieve Distribution
Compaction	Dry density Moisture Content	Maximum Dry Density(MDD) Optimum Moisture Content (OMC)
Curing	Curing Duration	
Strength	Mixing ratio of Agent	Unconfined Compression Strengh (UCS), or CBR for Subgrade

Figure 1.1.1 Required test for mixing design in laboratory

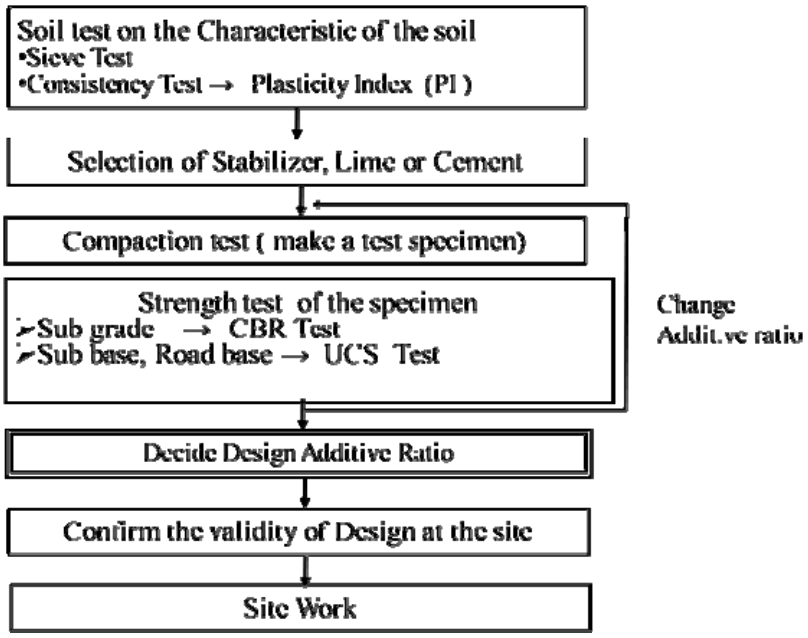


Figure 1.1.2. The Procedure on design of stabilized materials

Guideline for stabilization types to be effective that described in below Table 1.1.1.

Table 1.1.1. Criteria for allowable plasticity index of material stabilization.

Type of stabilization	Soil Properties					
	More than 25% passing the 0.075 mm sieve			Less than 25% passing the 0.075 mm sieve		
	PI≤10	10<PI<20	PI≥20	PI<6 PP<60	PI≤10	PI>20
Cement	Yes	Yes	-	No	Yes	Yes
Lime	-	Yes	Yes	No	-	Yes
Lime-Pozzolan	Yes	-	No	Yes	Yes	-

1.2 Compaction test method

RRL used 105mm mold and 4.5 kg rammer with ϕ105mm mold for compaction test at lab test. This test method used for embankment and subgrade.

Table 1.2.1 Compaction test (subgrade)

	British Standard (BS) RRL						Remarks (JIS D-method)
Inside Diameter Of Mold (cm)	Height of Mold (cm)	Rammer Weight (kg)	Impact Height (cm)	Number of Tamping Layer	Tamping Numbers per each Layer	Allowable Maximum article Size (mm)	
15.20	12.70	4.50	45.00	5	27	20	ϕ15cm 5 layer 55 each layer

1.3 CBR test method

We shall hold four cases CBR test changed compaction energy to compact soil. The different CBR cases are described in Table 1.3.1. The moisture content using for compacting soil are same as the optimum moisture content or slightly more than optimum moisture content.

Table 1.3.1 CBR test (Sub-grade)

		British Standard (BS) RRL						Remarks (JIS Modified CBR)
	Inside Diameter Of Mold (cm)	Height of Mold (cm)	Rammer Weight (kg)	Impact Height (cm)	Number of Tamping Layer	Tamping Numbers per each Layer	Soaked Duration (days)	
1 2 3	15.20	12.70	4.50	45.00	5	15 30 62	4	

4	15.20	12.70	4.50	45.00	3	67	4	Additional case JIS Design CBR

1.4 Compaction test method for all stabilized materials in RRL

We shall do compaction test to obtain maximum dry density of the mixed soil

Table 1.4.1 Compaction test method for stabilized materials

	ORN-31 Modified RRL						Remarks (JIS D-method)
Inside Diameter Of Mold (cm)	Height of Mold (cm)	Rammer Weight (kg)	Impact Height (cm)	Number of Tamping Layer	Tamping Numbers per each layer	Allowable Maximum particle Size (mm)	
10.00	20.00	2.50	30.00	3	25	20	ϕ 15cm 5 layer 56 each layer

1.5 Preparing the specimen and UCS test

The specimen with optimum moisture content shall be made the same way as the compaction test. But, if we don't have enough number of molds the modification shown in Table 1.5.1 is reasonable.

(Notes） The stabilizing additive amount is shown as percentage of the dry mass of soil materials.

The moisture content of the stabilizing additive compound mixture is shown as percentage of the stabilizing additive and specimen dry mass.

In this test, we shall take 7 days for indoor curing and 7 days for water immersion, total 14 days (in case of BS).

We used the ORN-31 modified mold in the PP-2.

Table 1.5.1 Mold size and compaction energy by standard

Mold Type	Mold size		Rammer Weight (kg)	Impact Height (cm)	Number of Tamping Layer	Tamping Numbers per each layer	Compaction Energy Ec (KJ/m^3)
	Diameter (cm)	Height (cm)					
BS Mold	10.50	11.55	2.50	30.00	3	27	595.60
JIS Mold	10.00	12.70	2.50	30.00	3	25	552.90
ORN-31 Mold ϕ 100mm h=200mm	10.00	20.00	2.50	30.00	5	24	561.80

$$Compaction \quad Energy \quad E_c = \frac{W \times H \times Layer \times Blowtimes}{Volume}$$

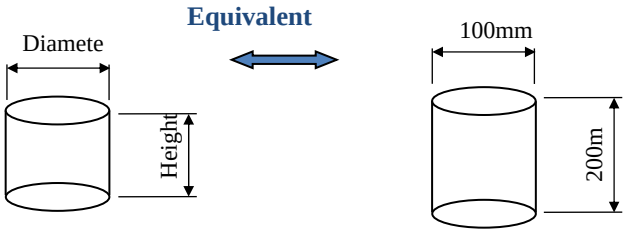


Figure 1.5.1 Equivalent Compaction Energy

2. INVESTIGATION FOR BORROW SOIL

We need to examine the borrow soil condition such as grain size distribution, water content, density and so on. These procedures are basically requirement for road improvement construction work. Before the construction work, RRL tested the classification and properties of borrow soil that shown in Table 2.1.

Table 2.1 Classification and properties of borrow soil (before construction work)

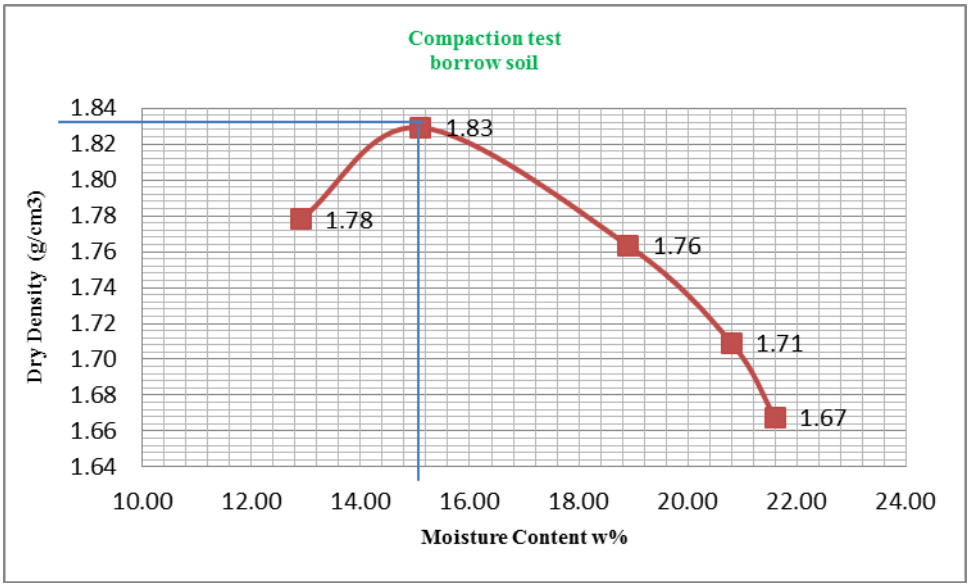
Material	Soil classification	Unified Soil Group	Passing No. 200 Sieve	PI	LL (%)	MDD (g/cm^3)	OMC (%)	Blow per layer	CBR (95% DOC)
Borrow Soil	Yellowish Grey SILT & CLAY trace Sand	MH	99	33.00	56.00	1.83	15.10	62/5	3.00

*4 days soaked

After compaction test for borrow soil, we obtained the maximum dry density and optimum moisture content. The compaction test data and graph of borrow soil are shown in below. Table 2.2 and Graph 2.1.

Table 2.2. Compaction test data of borrow soil

Avg; Moisture Content (w %)	12.90	**15.10**	18.90	20.80	21.60
Dry Unit Weight (g/cm3)	1.78	**1.83**	1.76	1.71	1.67



Graph 2.1. The relationship between dry density and moisture contents of borrow soil.

When we start the construction work, we checked the properties of soil from three borrow pits. These borrow pits called borrow pit A, borrow pit B and borrow pit C. This data are shown in Table 2.3. These testing results data are different with the Table 2.1 results. Therefore, we cannot use the Table 2.1 data in the actual work. Because we cannot identify the location clearly and we cannot represent the actual used borrow soil regarding with this data.

Location of Borrow Pit (photo attached)

- Borrow pit A- near the soil plant (beside the Bogalay bridge)
- Borrow pit B- left hand side of Bogalay bridge approach road.
- Borrow pit C- right hand side of Bogalay bridge approach road.

Table 2.3 Classification and properties of borrow soil

Item	Soil classification	Unified Soil Group	Passing No. 200 Sieve	PI	LL (%)	MDD (g/cm^3)	OMC (%)
Borrow Pit A	Yellowish Grey SILT & CLAY trace Sand	SC	29	15.00	35.00	1.92	10.50
Borrow Pit B	Yellowish Grey SILT & CLAY trace Sand	MH	94	30.00	59.00	1.76	13.50
Borrow Pit C	Yellowish Grey SILT & CLAY trace Sand	MH	92	29.00	57.00	1.79	13.00

According the testing data we decided

- Borrow pit B and borrow pit C for subgrade
- Borrow pit A, borrow pit B and borrow pit C for subbase course.

The borrow pit A, at the construction work, we used only few amount for subbase course. There have covered with filling soil and sand, mixed with debris, mixed with organic soil and roots. If we used this soil, cannot get uniform quality for subbase course. Therefore, we used only a few amounts.

3. EVALUATION FOR EMBANKMENT

The procedure of evaluation for embankment process:

- DCP Test to understand the CBR value when road survey by RRL
- Classification and properties of soil that used in existing embankment
- Compaction test for existing embankment
- Target dry density and target moisture content.

3.1 DCP test to understand the CBR value when road survey by RRL

RRL investigated the strength of existing embankment by using DCP to get CBR value (refer in Table 3.1.1) while we were proposed road survey.

The CBR values are very low. Therefore, we shall evaluate to existing embankment that scarifying and re-compaction of 1 feet layer below existing embankment to get more CBR value.

Table 3.1.1 Results of DCP test on existing embankment before the construction work of project.

Job and Location: Pilot Project 2, Road No. 10 (M 1/4 to M 2/0)

Test Point No.	Location	DCP		CBR value (%)	Remarks
		Depth (mm)	Value (mm/blow)		

1	M 1/4	120-400	56	2.00	
		400-500	100	1.00	
		500-850	350	1.00	
2	M 1/4 + 300'	40-210	170	1.00	
		210-330	120	1.00	
		330-700	370	1.00	
3	M 1/5	50-320	270	1.00	
		320-450	130	1.00	
		450-800	350	1.00	
4	M 1/5+ 300'	50-480	430	1.00	
		480-820	340	1.00	
5	M 1/6	40-250	210	1.00	
		250-370	120	1.00	
		370-730	360	1.00	
6	M 1/6+ 300'	50-170	120	1.00	
		170-460	290	1.00	
		460-690	230	1.00	
7	M 1/7	50-180	130	1.00	
		180-340	160	1.00	
		340-780	440	1.00	
8	M 1/7+ 300'	40-450	410	1.00	
		450-610	160	1.00	
		610-770	160	1.00	
Test Point No.	**Location**	**DCP**		**CBR value (%)**	**Remarks**
		Depth (mm)	**Value (mm/blow)**		
9	M 2/0	70-550	430	1.00	
		550-820	340	1.00	

3.2 Classification and properties of soil that used in existing embankment

After finished the DCP Test, RRL tested the detail soil classification and properties of existing embankment. The results are shown in Table 3.2.1. RRL proposed many testing for existing embankment by using different compaction energy four cases that described in Table 3.2.2. These data used for three point method (Japanese manual) which can compare the dry density and CBR value.

Table 3.2.1. Soil classification and properties of embankment

Item	Soil classification	Unified Soil Group	Passing No. 200 Sieve	PI	LL (%)	MDD (g/cm^3)	OMC (%)	Blow	CBR * (95% DOC) (%)	CBR (DCP, field test) (%)
Embankment	Yellowish Grey Clayey SILT trace Sand	MH	91	30.00	58.00	1.60	16.50	62/ 5 layer	2.00	1.00

*4 days soaked

Table 3.2.2 The relationship of dry density and CBR value by using three points method

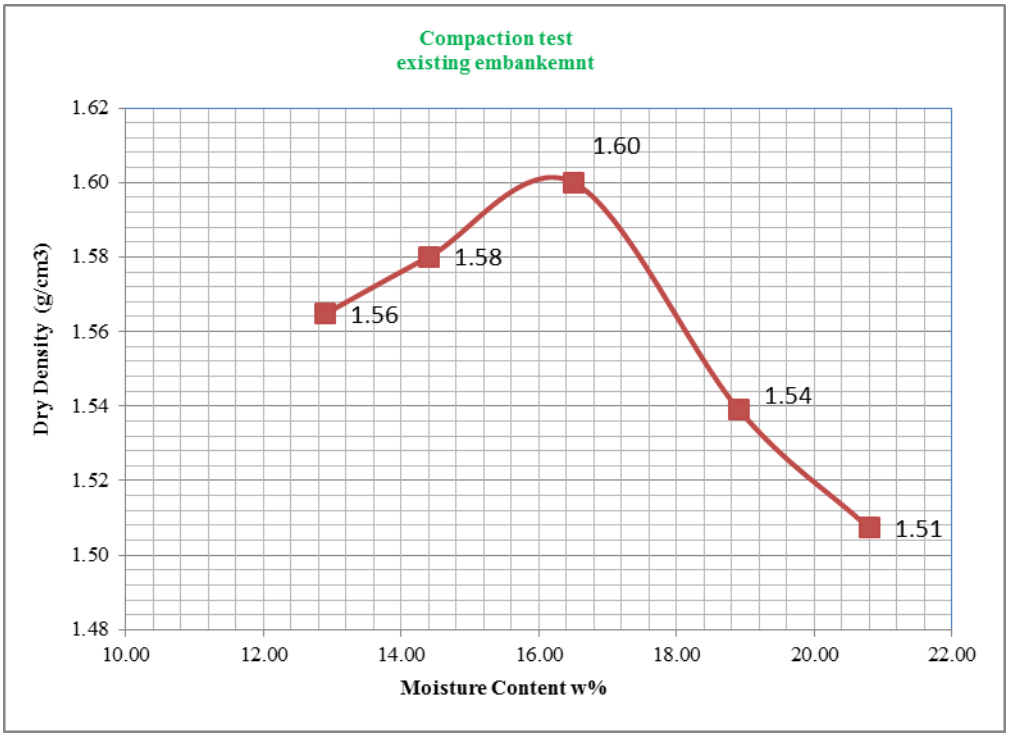
Three Point Method			
Case	Compaction	**Dry Density (g/cm^3)**	**4 days CBR (%)**
1	15 blows/ 5 layer	**1.57**	**1.60**
2	30 blows/ 5 layer	**1.58**	**1.70**
3	67 blows/ 3 layer	**1.59**	**1.80**
4	62 blows/ 5 layer	**1.60**	**2.00**

We used No.4 case (62blows/5 layer) because it was the highest CBR value among the 4 cases. We described the compaction graph by using compaction data of existing embankment, Table 3.3.1.

3.3 Compaction test for existing embankment

Table 3.3.1 Compaction test data for existing embankment

Avg; Moisture Content (w %)	12.90	14.4	**16.50**	18.90	20.80
Dry Unit Weight (g/cm^3)	1.56	1.58	**1.60**	1.54	1.51



Graph 3.3.1 Relationship between dry density and moisture contents

3.4 Target dry density and target moisture content

We need to determine the target dry density in the field because due to the difficulties to achieve 95% of compaction at site. And the roller compaction passes is reduced and reduced the expenditure on diesel consumption too.

The embankment, specify that a minimum level of 93 % MDD, (ORN-31, Page 15). Therefore, we calculated, **MDD*93% = 1.49g/cm^3**.

According the laboratory test, Graph 3.3.1 is out of range to examine the 93% of DOC and target moisture content. Therefore, regarding with the target moisture content, we considered the field compaction test to examine maximum dry density and optimum moisture content. In addition, we should test moisture content in construction site.

4 EVALUATION FOR SUBGRADE

In order to achieve higher CBR value, subgrade compacted at its optimum moisture content in order to get the higher CBR value.

- We proposed to apply the Japanese Industrial Standard (JIS) and also the consent of PW and JICA, subgrade constructed using materials with composed of soil50%+sand50% weight basis in laboratory test.

- According to the experience of PP1, PW and JICA nominated to use the Japanese Industrial Standard (JIS). Therefore, the CBR test for subgrade soil50%+sand50% is proposed with JIS method.

Furthermore, the criteria for determination of mixing ratio are also guided by the following.

ORN-31, Page 12

a) Indicated that PI < 20.00

Discussion with PW

b) Indicated that subgrade class shall be S2 which its CBR range is between3.00% and 4.00%.

The procedure of evaluation for subgrade:

- To examine the embankment's strength
- To consider the borrow soil and sand properties, determine the mixing ratio by using CBR value

4.1 To examine the embankment's strength

- After scarifying and re-compaction, the CBR value for embankment is 2.00% .The resistance for existing embankment is still weak. Therefore, PW and JICA consent to use the borrow soil for subgrade

4.2 To consider the borrow soil and sand properties, determine the mixing ratio by using CBR value

- The CBR value for borrow soil is 3.00%. (refer in Table 2.1)

In case of borrow soil strength, if it is enough desire resistant for subgrade, we don't need to use other materials. But CBR value for borrow soil is only 3.00%. Therefore, PW and JICA consent to use mixed borrow soil and sand.

- We examined the strength of sand from the various sources.

Among them, we selected sand that near the Bogalay Bridge.

Table 4.2.1. CBR results of Mixture No.1 for subgrade (JIS method)

No	*Mixture	Sand FM	LL (%)	PI	OMC (%)	MDD (g/cm^3)	CBR (%) 4 days soaked	CBR (%) 7 days soaked	CBR (%) 28 days soaked

1	**Mixture No.1**	**2.00**	**31.00**	**18.00**	**10.00**	**2.10**	**4.00**	**4.00**	**2.80**
2	Mixture No.2	2.20	31.00	17.00	10.00	2.12	6.00	-	-
3	Mixture No.3	1.60	32.00	19.00	11.50	2.08	4.00	-	-

*Mixture means soil 50% + sand 50%

In this time, we used 3 types of different sand. This 3 types are different fine modulus (FM), and Plasticity Index. (see in photo attach). We investigated for sand location, near Kywe Chan Ye Kyaw Bridge, Tha Byu Gone village and near Bogalay Bridge, Thar Paung village. From these 2 locations, sand properties are nearly the same (in visual). Therefore, we selected the near Bogalay Bridge, sand pit based on economical consideration. We use same borrow soil for mixing.

Hence, referring to the above, (Table 4.2.1 CBR results of soil and sand mixes for subgrade), mixed ratio Mixture No.1 is selected. Because CBR value is 4.00%, FM is medium range of grain size. FM =1.60 is very fine grain, FM=2.20 is rather good (larger grain) but difficult to collect when we start construction work. FM is related that consist of silt. Very fine sand is consists of much silt. Therefore we choose selected sand (Mixture No.1)

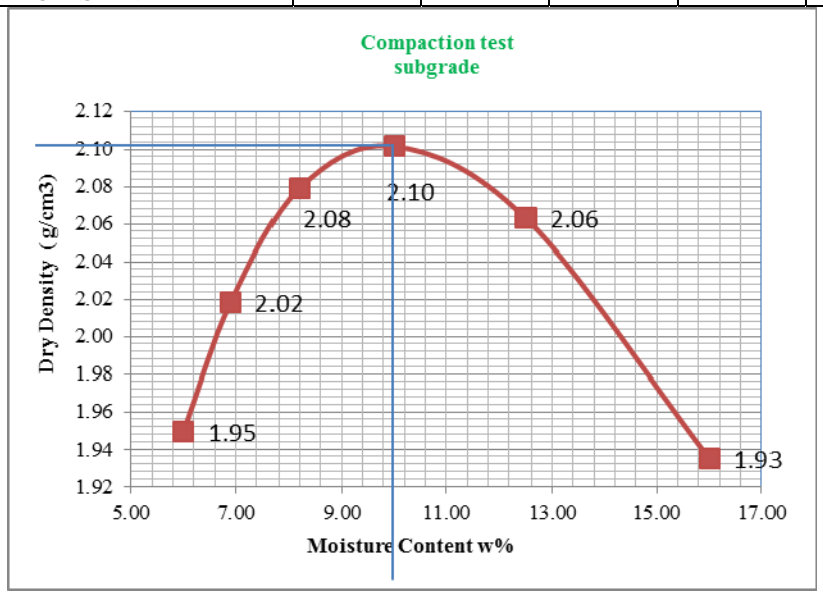
Even though, Mixture No.2 mixed ratio consists of PI=17.00 which indicated slightly better work ability, we discarded Mixture No.2 mix ratio due to its procurement difficulties.

As for Mixture No. 3 mixed ratio which has higher PI than Mixture No.1 and Mixture No.2. In addition, Mixture No.3 has higher LL and lower FM. Therefore, we discarded Mixture No.3 mix ratio.

We need to determine the target dry density for subgrade because due to the difficulties to achieve 95% of compaction at site. Therefore, firstly we nominated the compaction test for Mixture No.1.

Table 4.2.2. Compaction test data for Mixture No.1.

Avg; Moisture Content (w %)	6.90	8.20	**10.00**	12.50	16.00
Dry Unit Weight (g/cm^3)	2.02	2.02	**2.10**	2.06	1.93



Graph 4.2.1.The relationship of dry density and moisture content of Mixture No.1.

According to the laboratory testing data, maximum dry density is 2.10g/cm^3. Table 4.2.1.

In accordance to ORN-31, Page-11, it is stated that at least 93% of MDD is necessary.

Hence, our project target dry density, **MDD*93% = 1.95g/cm^3** and target moisture content at 6.00% (assumed).

5. EVALUATION FOR SUBBASE COURSE

Our selection criteria is based upon the fellowship

a. Allowable requirement of UCS value for stabilized subbase course is 0.75~1.50MPa. (ORN-31, Table 7.1, page 27)
b. Allowable value of maximum PI for subbase is 20.00% (ORN-31, Table 7.3, page 28)

As our intention is to select the minimum cement content within the UCS range 0.75MPa~1.50MPa, it is important to decide either lime or cement.

The procedure of evaluation for subbase course:

We used same sand type among subgrade and subbase.

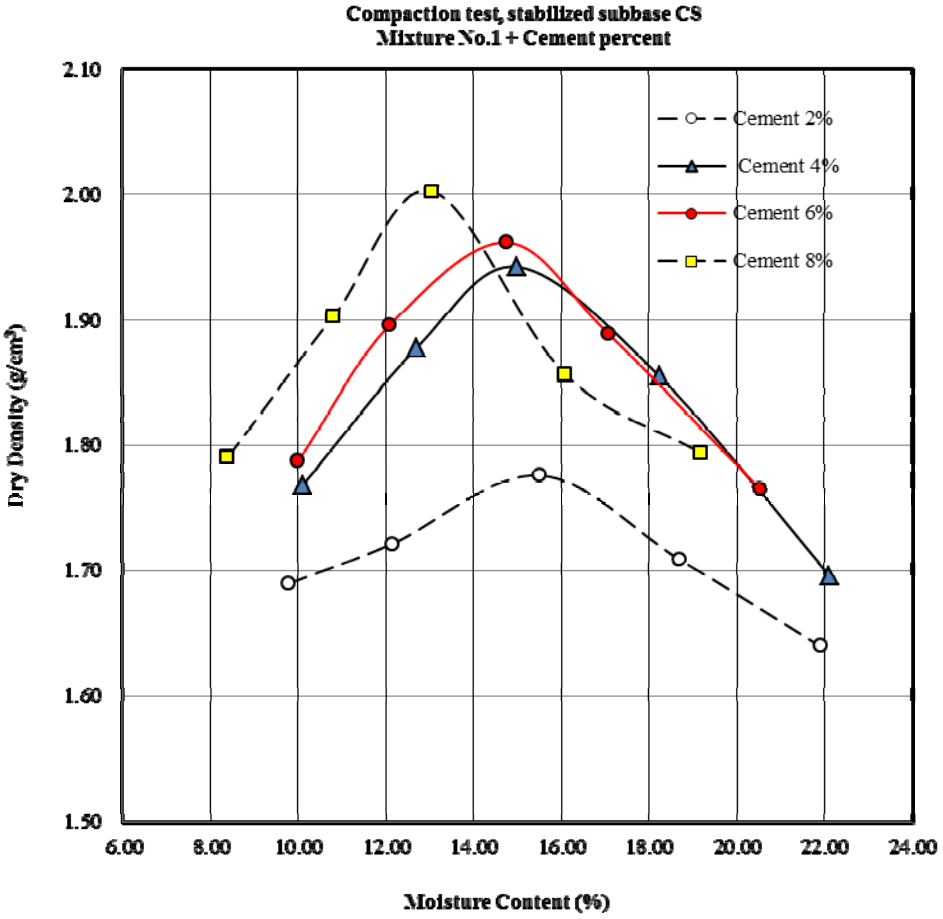
- Study on Mixture No.1 and cement additive percent
- Determine the stabilizer additive content by using premium rate
- Determine the stabilizer additive content by using premium rate (after New Year Festival)

5.1 Study on Mixture No.1 and cement additive percent

We conducted the selection of additive type in accordance to JIS and BS in which Mixture No.1, weight basis in laboratory test and varied the addition of cement from 2% to 8% in each case. There we tested the compaction test for maximum dry density and UCS test for compressive strength. From table 5.1.1, adding suitable to apply in accordance with a.

Table 5.1.1 Materials mixed ratio, compaction test and UCS result

No	Mixture	LL	PI	OMC	MDD	Soil	Cement	Sand	Water	Stress	Strain	UCS Value
		(%)		(%)	(g/cm^3)	(g)	(g)	(g)	(ml)	(lb)	(in)	(MPa)
1	cement 2%	39.00	18.00	15.50	1.78	1420.00	57.00	1420.00	449.00	448.80	0.07	0.26
2	cement 4%	37.00	17.00	15.00	1.94	1553.00	124.00	1553.00	484.00	1127.10	0.08	0.62
3	cement 6%	37.00	16.00	14.80	1.96	1568.00	188.00	1568.00	492.00	1683.00	0.02	0.92
4	cement 8%	38.00	14.00	13.00	2.00	1600.00	256.00	1600.00	449.00	2193.00	0.038	1.21



Graph 5.1.1 Comparison of cement stabilized materials for stabilized subbase course.

Regarding with the Table 5.1.1, the experiment results are obtained.

According to the laboratory results data, we varied the cement additive percentage from 2% to 8% (BS). According to the above table, the cement additive ratio 6% and 8% are situated with the allowable value of PI and having the lowest additive content of UCS strength. (ORN-31, Page, 27-28). Therefore, we selected the cement additive content 6% because base on the economic.

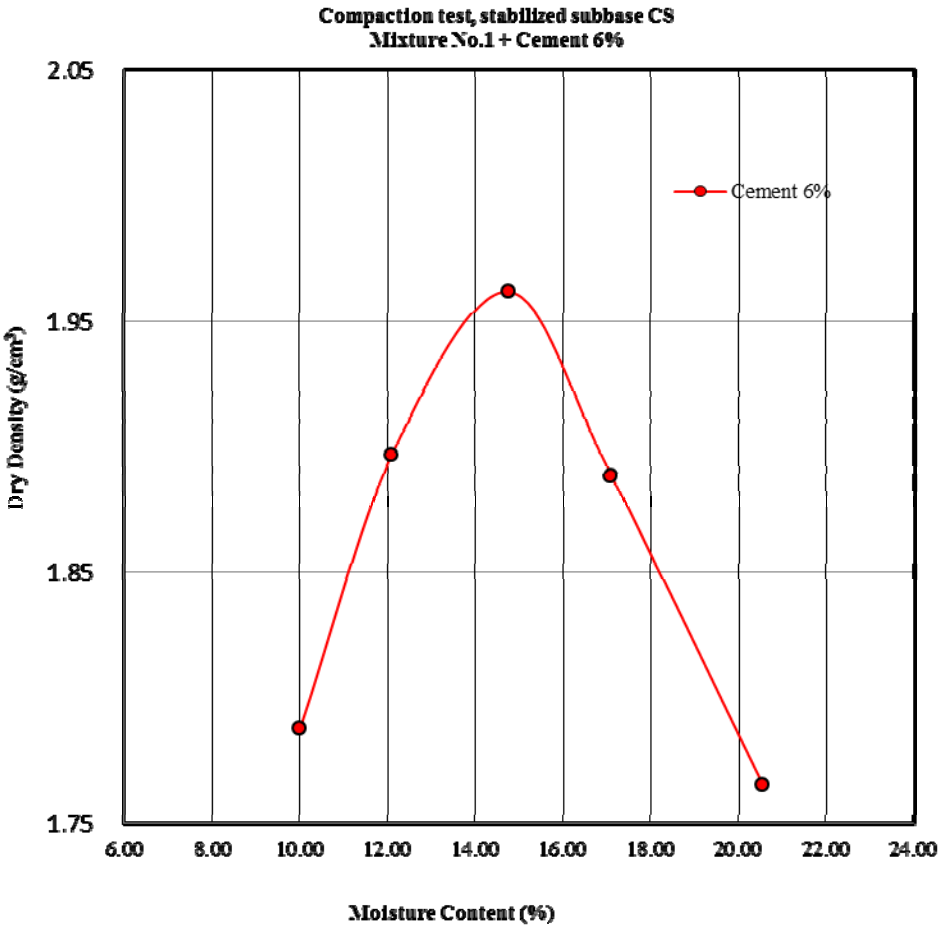
We shall calculate that exact cement additive percent base on the above table cement additive ratio. And also we described with graph that the comparison of cement stabilized materials, Graph 5.1.1.

We described separately that Table 5.1.2 and Graph 5.1.2 are based on above table and graph.

Table 5.1.2. Compaction test data for Mixture No.1 + cement 6%

Avg: Moisture Content	10.00	12.10	**14.75**	17.10	20.55
Dry Unit Weight (g/cm^3)	1.79	1.90	**1.96**	1.89	1.77

According to the laboratory testing data, Maximum Dry Density is 1.96g/cm^3. (Table 5.1.2)



Graph 5.1.2 The relationship of dry density and moisture content for Mixture No.1 and cement 6%.

In order to determine the target dry density in the field for subbase we referred to ORN-31, Page 25 which stated that 95% of MDD is necessary. Therefore, we calculated the MDD from the above table and decided the target dry density. In this case, from the above table Mixture No.1 + cement 6% because its additive percentage of MDD, OMC and PI are preferable to achieve MDD.

Hence, target dry density for subbase, **MDD*95%= 1.86g/cm^3**, (refer: Table 5.1.2.) Target moisture content is 11.00%.

5.2 Determine the stabilizer additive content

We considered the nearest cement additive percent by using above data, (Table 5.1.1). We used in the actual construction site work after calculation with some factors, shown in Table 5.2.1 and Graph5.2.1. These data are tested by RRL before New Year Festival.

The compaction condition of this UCS results are follows;

- UCS Mould φ10.00cm-hH-20.00cm
- 2.50 kg rammer

3layers, 25 blows/per layer

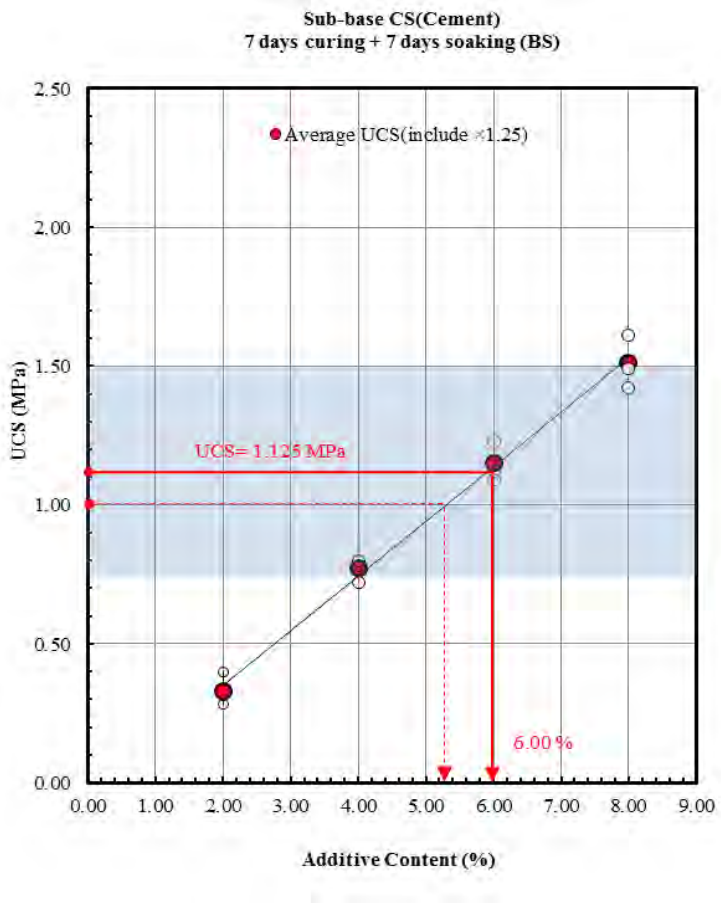
We used this data for the site construction.

Table 5.2.1 Materials mixed ratio and UCS result

Additive content				2%	4%	6%	8%	Remarks
Stabilized sub base (CS)	Cement	Dry density(g/cm^3)		1.78	1.94	1.96	2.00	BS
		Moisture content (%)		15.50	15.00	14.75	13.05	
		UCS (MPa)	7day+7day	0.26	0.62	0.92	1.21	
		*1.25	7day+7day	0.33	0.77	1.15	1.51	

Note: ×1.25* Correction Factor accordance with specimen type (ORN-31, page 29)

In the cement additive percent 2% to 8%, the strength is gradually increased. It was shown in Graph 5.2.1.



Graph 5.2.1 relationship for UCS test and stabilizer additive content

UCS=1.125MPa in Graph 5.2.1 (we used medium value of UCS 0.75 ~ UCS 1.50)

Rate of Premium α =Function (agitation·compaction degree, soil property in situ, etc.)

Design additive content = (1+α) ×Laboratory additive content

Design Additive content =1.15×6.00% = 6.90% (Table 5.2.2)

Table 5.2.2 Rate of premium for stabilized materials

Depth Stabilized Layer D(cm)	Soil Type	Premium Rate α	*Remarks
D < 50cm	Sandy Clay Cohesive Soil	15 ～ 20%	consider Soil Plant

(Source: Japanese manual) (Reference from PP1- The report on stabilized Material test at RRL)

*Remarks in Table 5.2.2

Soil plant required dry soil and dry sand to install subbase. In the construction work, we have not enough dry soil and dry sand. Therefore, we need to consider cement additive content.

$$\alpha' = \frac{\alpha}{1+\frac{\omega_n}{100}}$$

α (%) : Additive mixing ratio defined at dry density

α' (%) **:** The corrected input value = Input to touch panel (soil plant)

ω_n (%) : Moisture content of soil and sand mixed

*** By using this formula, we can adjust the cement additive ratio because moisture are containing in soil and sand. We need to examine the moisture content and loose density of soil and sand every day. This formula completely used after mixed (soil and sand) moisture content.**

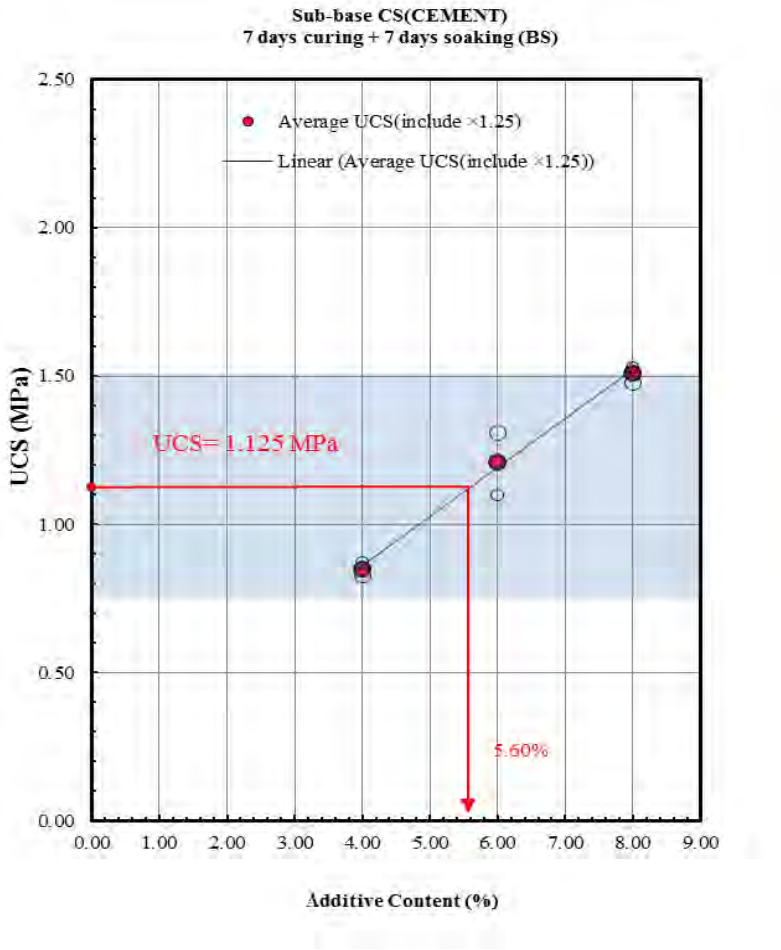
5.3 Determine the stabilizer additive content (after New Year Festival)

RRL tested by changing the compaction energy. Therefore, we encountered that the properties of materials are very loose. The properties of materials are described in Table 5.3.1. These data are received after New Year Festival from RRL.

Table 5.3.1 Materials mixed ratio and UCS result

Additive content				4%	6%	8%	Remarks
Stabilized sub base (CS)	Cement	Dry density(g/cm^3)		1.94	1.96	2.00	BS
		Moisture content (%)		15.00	14.75	13.05	
		UCS (MPa)	7day+7day	0.68	0.97	1.21	
		*1.25	7day+7day	0.85	1.21	1.51	

The relationship of UCS and cement additive percent was shown in Graph 5.3.1. This graph is derived from the Table 5.3.1.



Graph 5.3.1. Relationship of UCS test and stabilizer additive content

The calculation for rate of premium for stabilized materials and materials mixed ratio results are referred Table 5.2.2

UCS=1.125MPa in Graph 5.3.1 (we used medium value of UCS 0.75 ~ UCS 1.50)

Rate of Premium α =Function (agitation･compaction degree, soil property in situ, etc.)

Design additive content = (1+α) ×Laboratory additive content

Design Additive content =1.15×5.60% = 6.40% (refer Table 5.2.2)

The compaction condition of this UCS results are follows;

- UCS Mould φ10.00cm-hH-20.00cm
- 2.50 kg rammer
- **5layers, 25 blows/per layer**

6 EVALUATION FOR BASE COURSE

Stabilized Materials

We shall examine the materials ratio base on the UCS value, PI.

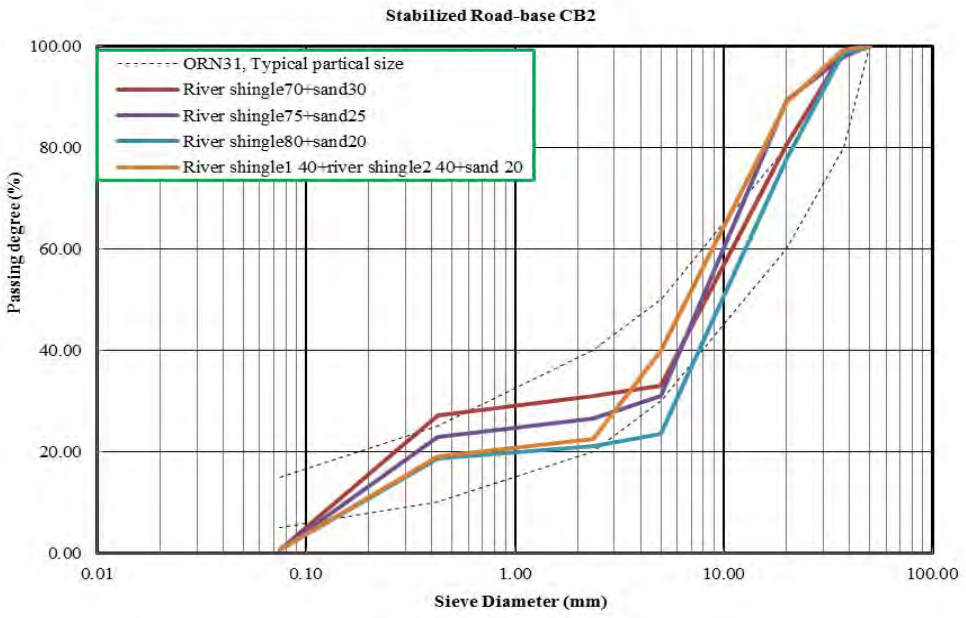
- Allowable requirement of UCS value for stabilized base course is 1.50~3.00, ORN-31, Page27. (Reference, PP1- stabilized Materials report)
- Allowable requirement of PI for stabilized base course is < 10, ORN-31, Page 28. (Reference, PP1- stabilized Materials report)

The procedure for evaluation of base course:

- Grain size distribution test
- Compaction test and UCS test with cement additive percent
- Determine the stabilizer additive content by using premium rate

6.1 Grain size distribution test

In this time, we shall use the river shingle for stabilized base course. Therefore, we performed the grain size test for materials with various mixing ratio. The results are shown in graph 6.1.1.



Graph 6.1.1. Grain size distribution graph for mixing ratio

In this time, the cement additive percent used from the river shingle1 (large size) 40%+ river shingle2 (small size) 40%+ sand 20% generally. For that reason is that according to the grain size distribution of materials ratio, are nearly the same.

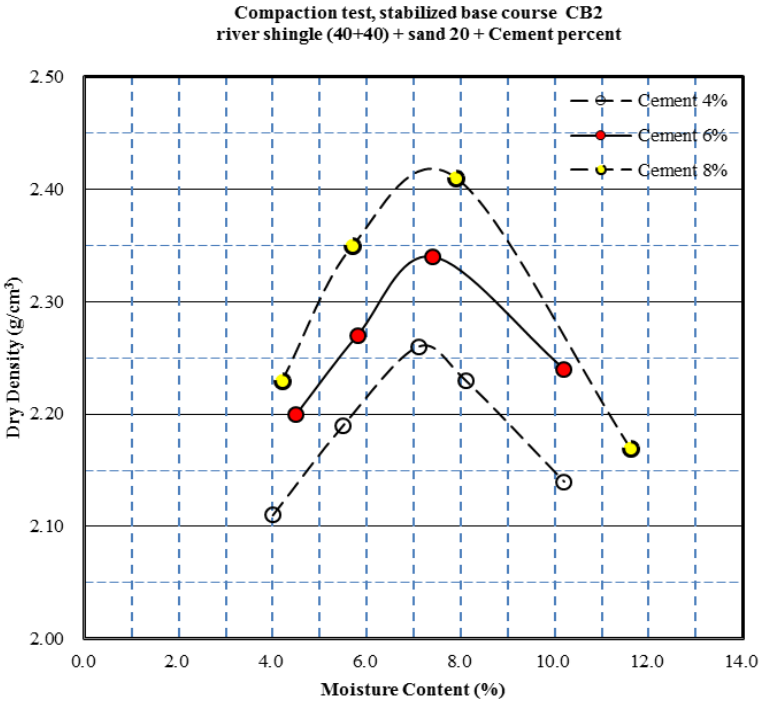
6.2 Compaction test and UCS test with cement additive percent

After grain size distribution test, we conducted the compaction test for maximum dry density and UCS test for compressive strength. The testing are based on the weight basis in laboratory test and varied the addition of cement from 4% to 8% in each case (BS).

Table 6.2.1, Materials mixed ratio, compaction test and UCS result for base course

No	Material	LL (%)	PI	OMC (%)	MDD (g/cm^3)	River shingle1 (g)	River shingle2 (g)	Cement (g)	Sand (g)	Water (ml)	UCS Value (MPa)
1	River shingle40%+40% + cement 4%	-	-	7.10	2.25	1444.00	1444.00	144.00	722.00	267.00	2.97
2	River shingle40%+40% +cement 6%	-	-	7.20	2.30	1496.00	1496.00	224.00	748.00	285.00	3.70
3	River shingle40%+40% +cement 8%	-	-	7.30	2.40	1547.00	1547.00	309.00	773.00	305.00	4.50

The relationship of dry density and moisture content are descried in Graph 6.2.1.



Graph 6.2.1. Comparison of cement stabilized materials for stabilized base course.

According to the testing results (Table 6.2.1), all of the cement additive ratios are exceed the target value that having the lowest additive content of UCS strength. (ORN-31, Page, 27). Therefore, we selected the cement additive content 4% because base on the economic consideration. In this case, we decided by using UCS value only, we have no PI value because river shingle and sand have no plastic limit.

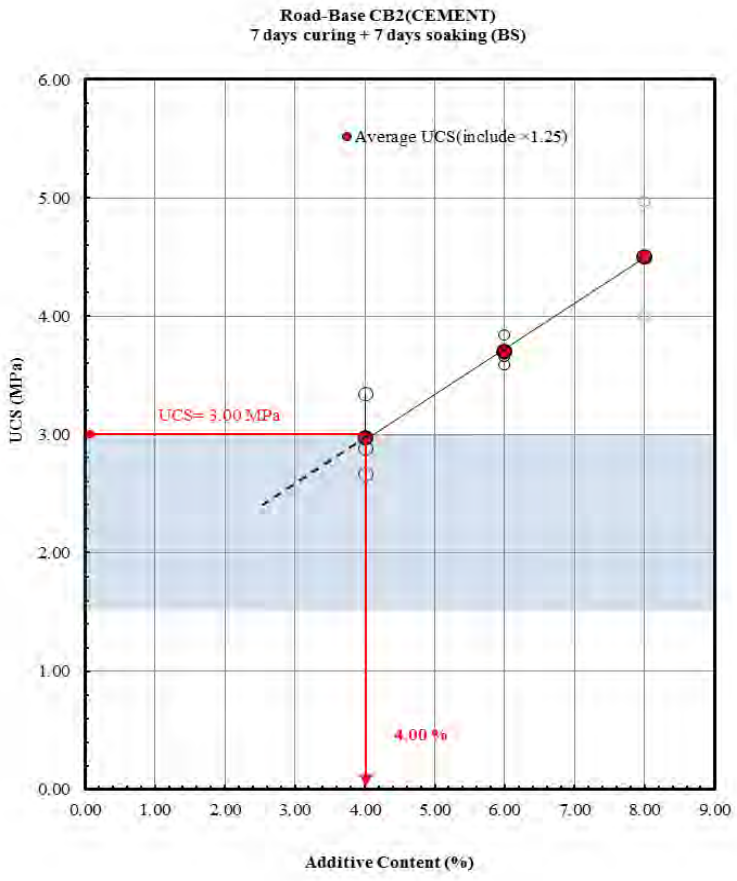
6.3 Determine the stabilizer additive content

In the compaction test, RRL used light compaction energy. (3layers, 25blows/ layer).
According to the compaction test and UCS test, we described with the Table 6.3.1. And we decided the cement additive percentage by using the relationship of UCS and cement additive percent graph. It was shown in Graph 6.3.1.

Table. 6.3.1 Mixing test result for cement stabilized sub-base

No	Mix Ratio By Weight			Compaction		Average UCS (MPa)	Average UCS ×1.25 (MPa)
	River Shingle (%)	Sand (%)	Cement (%)	OMC (%)	MDD (g/cm^3)		
1	40+40	20	4	7.10	2.25	2.38	2.97
2	40+40	20	6	7.20	2.30	2.96	3.70
3	40+40	20	8	7.30	2.40	3.60	4.50

Regarding with this graph we based on cement 4%, above Table 6.3.1. For that reason is that we need UCS value between 1.50~ 3.00. Therefore, we selected the cement additive percent is 4%.



Graph 6.3.1. Relationship for UCS test and stabilizer additive content (river shingle 40%+40%+sand 20%)

Rate of Premium α =Function (agitation compaction degree, soil property in situ, etc.)

Design additive content = (1+α)×Laboratory additive content

Design Additive content =1.15×4.00% = 4.60% (Table 6.3.2)

Table 6.3.2 Rate of premium for stabilized materials

Depth Stabilized Layer D(cm)	Soil Type	Premium Rate α	*Remarks
50cm	Sandy Clay Cohesive Soil	15 ～ 20%	consider Soil Plant

*Remarks in Table 6.3.2

Soil plant required dry sand and dry river shingle to install base course. Therefore, we need to prepare especially dry sand. Sand is easy to dry. If in the construction site, have no dry sand, we strongly prefer to make dry first. Because in the base course, we cannot reduce cement additive content. Because there have very small PI, when cement additive percent reduce, base course cannot consolidate well.

The compaction condition of this UCS results are follows;

・UCS Mould φ10.00cm-hH-20.00cm

・2.50 kg rammer

3layers, 25 blows/per layer

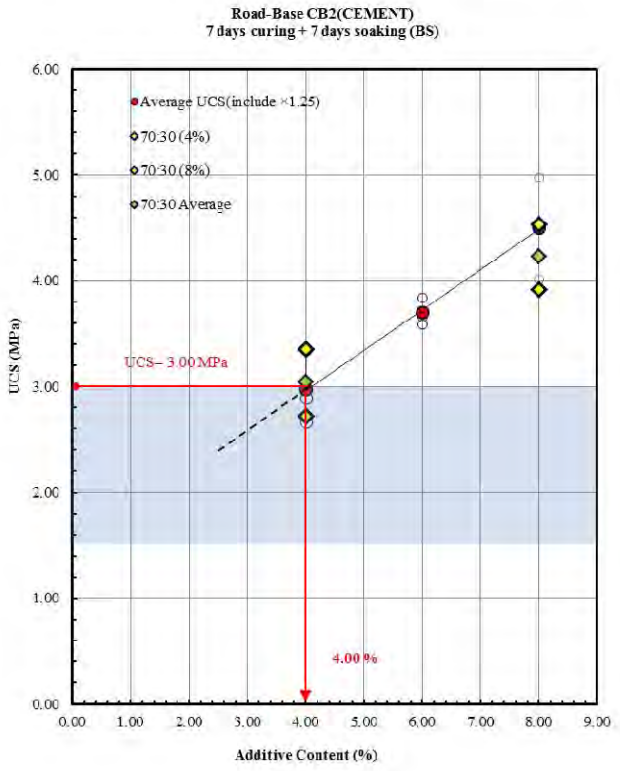
6.4 Determine the stabilizer additive content (after New Year Festival)

RRL tested by changing the compaction energy. The properties of materials are described in Table 6.4.1. These data are received after New Year Festival from RRL.

Table 6.4.1 Materials mixed ratio and UCS result

No	Mix Ratio By Weight			Compaction		Average UCS (MPa)	Average UCS ×1.25 (MPa)
	River Shingle (%)	Sand (%)	Cement (%)	OMC (%)	MDD (g/cm^3)		
1	70	30	4	6.50	2.24	2.40	3.00
2	70	30	6	8.50	2.30	3.36	4.20

Regarding with this graph we used cement 4%, for that reason is that we need UCS value between 1.50~ 3.00. Therefore, we selected the cement additive percent is 4%.



Graph 6.4.1. Relationship for UCS test and stabilizer additive content (river shingle 70%+sand 30%)

Rate of Premium α =Function (agitation compaction degree, soil property in situ, etc.)

Design additive content = (1+α) ×Laboratory additive content

Design Additive content =1.15×4.00% = 4.60% (Refer Table 6.3.2)

The compaction condition of this UCS results are follows;

- UCS Mould φ10.00cm-hH-20.00cm
- 2.50 kg rammer
- **5layers, 25 blows/per layer**

Regarding the material ratio for base course, we proposed:

1. Grain size distribution test
    - According the grain size graph, the river shingle 70% + sand 30%, upper grain size curve, within typical size of ORN-31 range.
    - River shingle 40%+40%+sand 20%, lower grain size curve, within typical size of ORN-31 range.

    This means that, grain size distribution of river shingle aggregates are almost same even changed river single ratio and sand. (Refer: Graph 6.1.1)

2. UCS test

   - The cement additive percent (after used premium rate) of river shingle 40%+40%+sand 20% is **4.60 %** (refer: Graph 6.3.1)

   - The cement additive percent (after used premium rate) of river shingle 70% + sand 30% is **4.60 %** (refer: Graph 6.4.1)

Both of these ratios are exceed the target value. Among them, UCS value for river shingle 70%+ sand 30% is 3.00 MPa (refer: Table 6.4.1) (UCS value for stabilized base course is 1.50~3.00 MPa, ORN-31, Page27)

Hence,

JICA and PW discussed that to use the same cement additive percent that based on river shingle 70%+sand 30%. In addition, the dry density and UCS value also based on river shingle 70% + sand 30%. Because river shingle mixing ratios are almost same range in the grain size graph. Its means that the river shingle specifications are not many different, also considered in the construction work condition.

Therefore, we considered that to use mixing ratio **river shingle 75% + sand 25%** instead of river shingle 70% + sand 30%. It is situated the medium range of river shingle 70%+ sand 30% grain size curve and river shingle1 (40)% + river shingle2 (40)% + sand 20%.(Refer: Graph 6.1.1)

In accordance with the testing of MDD and UCS for cement 4% of 2 material ratios, the results are not many different (refer: Table 6.3.1 and Table 6.4.1).

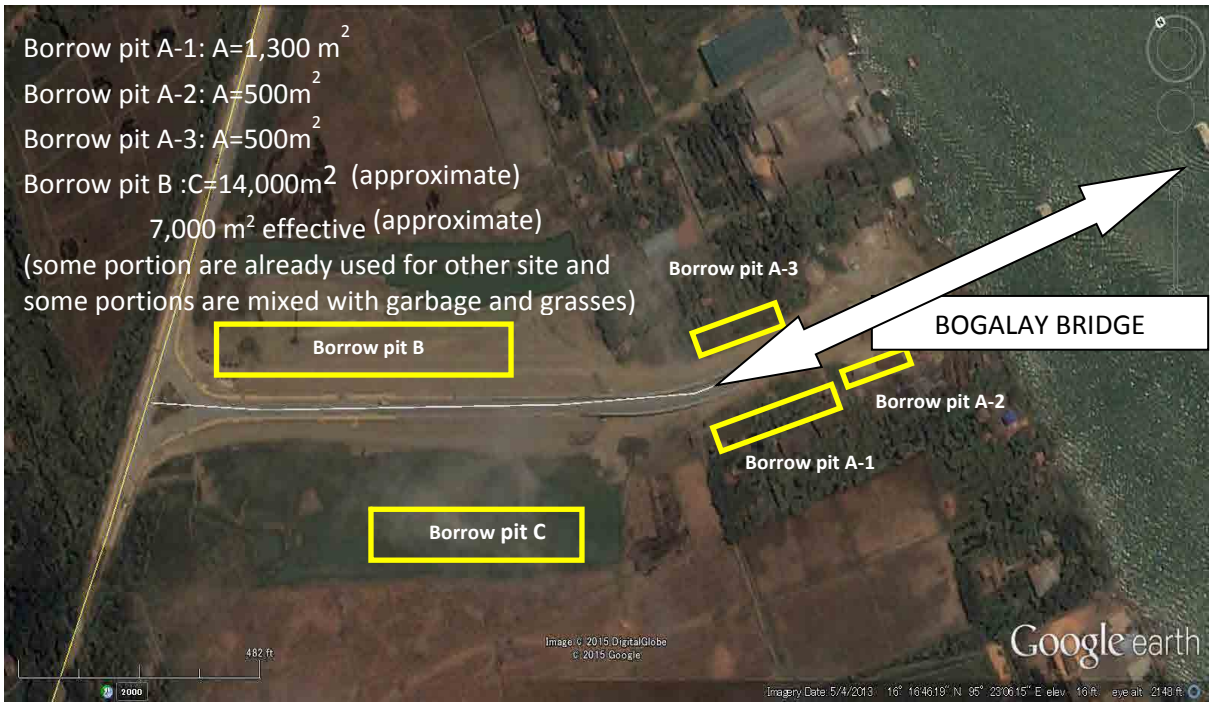
Regarding the target dry density for base course, in the construction work, we used light compaction energy. Therefore, we decided the degree of compaction for stabilized base course is 100%.

Therefore, the target dry density for base course is that **MDD*100%=2.24 g/cm^3** (refer: Table 6.4.1) (ORN-31, Page 15) target moisture content is 6.50%.

In the construction work, we used mixed river shingle without separately that river shingle1 and river shingle2.

7 ATTACH PHOTOS

Location of borrow pit

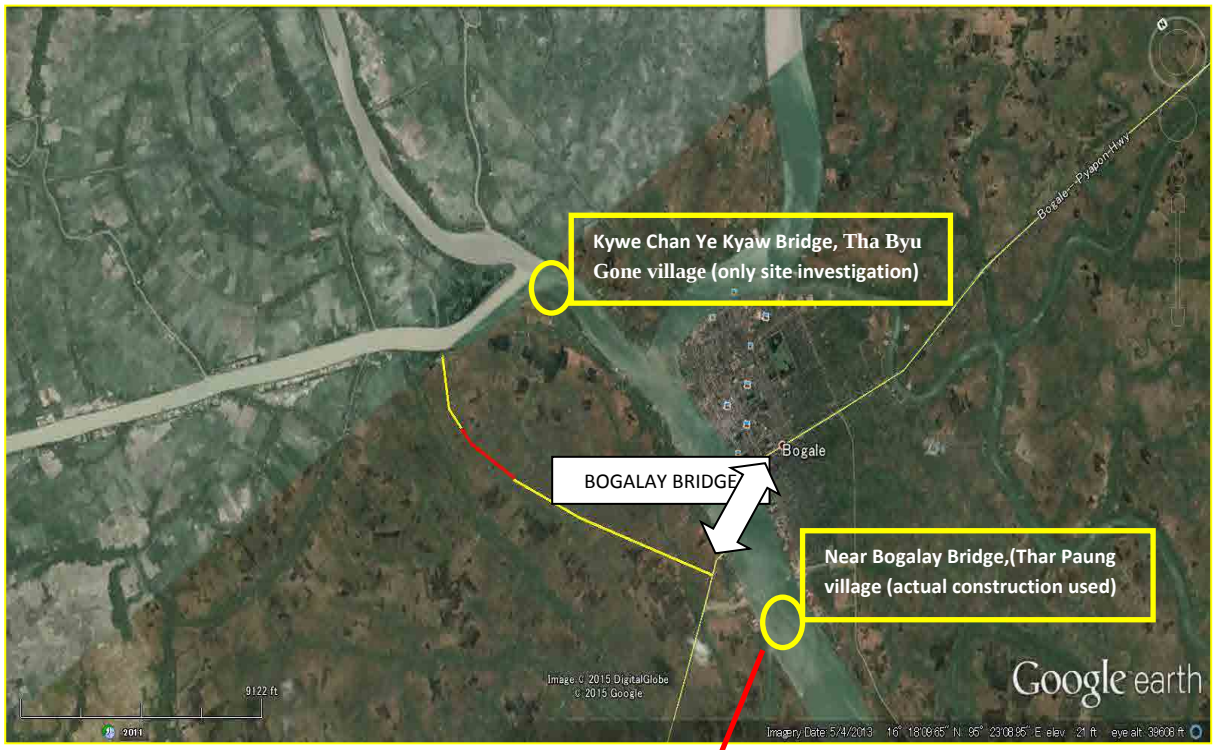


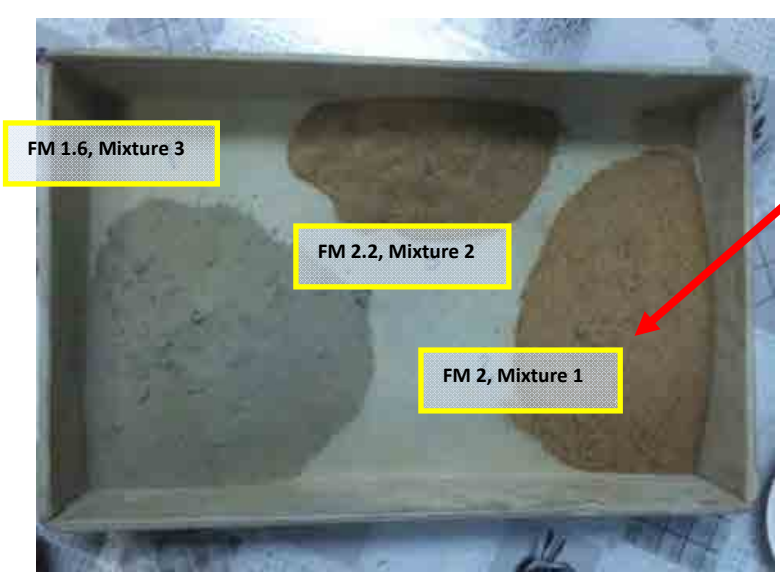
Borrow Pit A

Borrow Pit B

Borrow Pit C

Location of sand (near Bogalay Bridge)





Project site used material

Soil

Sand

River Shingle (1)

River Shingle (2)

Project site field test photo

UCS Test sample

DCP Test

Total Work Quantities in PP-2

I. Construction **Total length =** **800** **m (1/4 - 2/0)**

Category	Work item	Code (ORN)	Specification	Quantity	Unit
1. Earthwork					
1.1 Scarifying & re-compaction			t=Ave. 1ft	3,274.4	cu.m
1.2 Embankment	(1) Lower		Local soil	2,490.1	cu.m
	(2) road side		Local soil	582.6	cu.m
1.3 Subgrade			t=Ave.2ft, Soil : Sand = 50% : 50% (weight basis)	6,884.2	cu.m
1.4 Slope trimming				7,372.3	sq.m
2. Pavement					
2.1 Wearing course		BC	Penetration macadam, t=3in, w=18ft	4,389.1	sq.m
2.2 Hard shoulder			Graded crush stone, t=3in, w=8ft	1,950.7	sq.m
2.3 Base course		GB	Crush stone, CBR=100, t=6in, w=28ft	1,040.5	cu.m
2.4 Subbase course		CS	Cement stabilized, UCS=1.125MPa, t=6in, w=30ft, Soil : Sand = 50% : 50%, Cement = 5.3%	1,114.8	cu.m
3. Drainage layer	(1) Install crush stone		Crush stone, L = 1.2m, t=0.15m, w=0.5m	540	No.
				48.6	cu.m

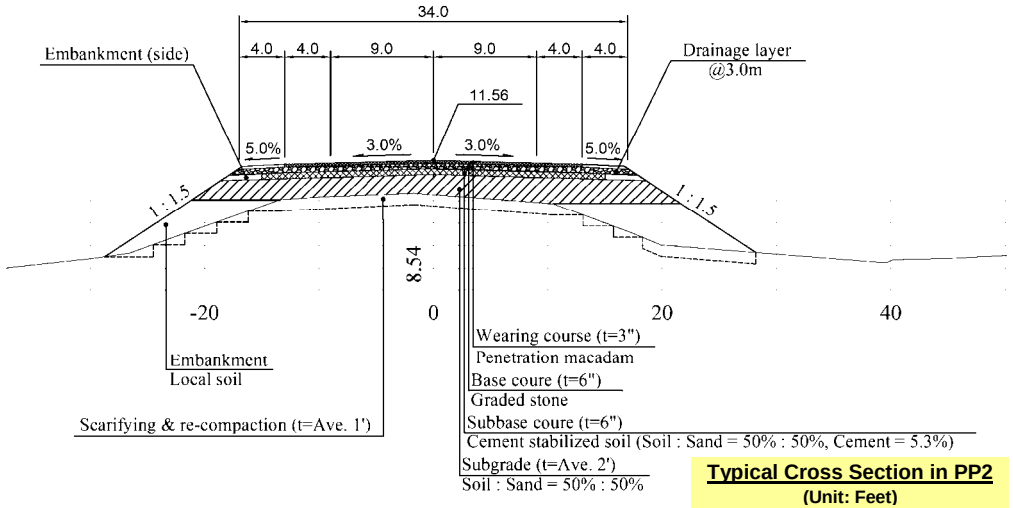
II. Off-site work

Category	Work item	Code	Specification	Unit	Unit
1. Temporary yard	(1) Site opening		Bush cut, grading, removal of surface soil (t=0.3m)	20,000.0	sq.m
	(2) Site clearance		Grading	20,000.0	sq.m
2. Diversion road			Filling & grading of local soil, L = 800m, W = 4m	3,200.0	sq.m

III. Import materials

Item	Work item	Code	Specification	Quantity	Unit
1. Cement	Subbase course		Soil=1.8t/cu.m, **Cement=5.3%**, Loss=10%	120.0	ton
2. Sand	(1) Subbase course		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	1,110.0	ton
	(2) Subgrade		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	6,820.0	ton
	(3) Embankment (roadbed)		Soil=1.8t/cu.m, **Sand=50%**, Loss=10%	2,470.0	ton
			Total	**10,400.0**	**ton**
3. Crush stone	(1) Base course		Weight=2.0t/cu.m, Loss=10%	2,290.0	ton
	(2) Hard shoulder		Weight=2.0t/cu.m, Loss=10%	330.0	ton
	(2) P-macadam		Weight=2.0t/cu.m, Loss=10%	730.0	ton
	(3) Drainage		Weight=2.0t/cu.m, Loss=10%	110.0	ton
			Total	**3,460.0**	**ton**
4. Straight asphalt (80/100)	(1) Prime coat		1 - 1.5ltr/sq.m, Loss=10%	6,100.0	ltr
	(2) P-macadam		0.7 - 2.3ltr/sq.m (2layers), Loss=10%	14,500.0	ltr
			Total	**20,600.0**	**ltr**
5. Fuel	Operation of equipment		Diesel		ltr

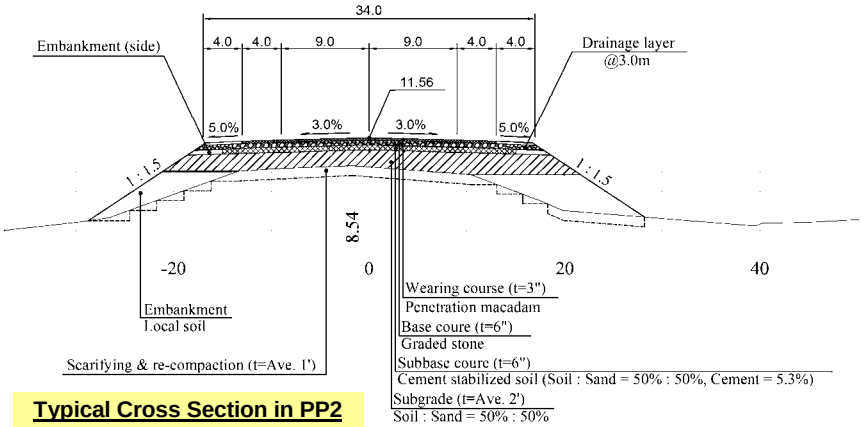
1. Earthwork



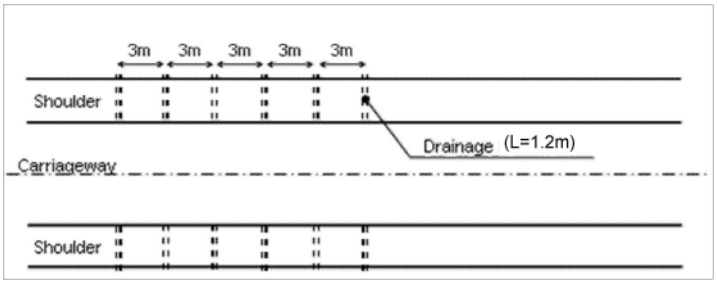
Typical Cross Section in PP2
(Unit: Feet)

Station	Distance	1.1 Scarifying & re-compaction				1.2 (1) Embankment (local soil)				1.2 (2) Embankment (road side)				1.3 Subgrade				1.4 Slope trimming			
	(ft)	Sq.Ft	Ave.Sq.Ft	Ave.sq.m	Cu.m	Sq.Ft	Ave.Sq.Ft	Ave.sq.m	Cu.m	Sq.Ft	Ave.Sq.Ft	Ave.sq.m	Cu.m	Sq.Ft	Ave.Sq.Ft	Ave.sq.m	Cu.m	L (Ft)	Ave.L (Ft)	Ave.L (m)	sq.m
79.0	100.0	47.50			0.00	44.94			0.00	7.62			0.00	64.74			0.00	16.70			0.00
80.0	100.0	44.55	46.03	4.28	130.33	59.35	52.15	4.84	147.66	7.62	7.62	0.71	21.58	75.10	69.92	6.50	197.99	27.60	22.15	6.75	268.19
81.0	100.0	42.49	43.52	4.04	123.23	9.94	34.65	3.22	98.10	7.62	7.62	0.71	21.58	91.53	83.32	7.74	235.92	18.70	23.15	7.06	265.04
82.0	100.0	40.97	41.73	3.88	118.17	38.63	24.29	2.26	68.77	7.62	7.62	0.71	21.58	97.29	94.41	8.77	267.34	27.50	23.10	7.04	253.59
83.0	100.0	39.95	40.46	3.76	114.57	51.15	44.89	4.17	127.11	7.62	7.62	0.71	21.58	68.60	82.95	7.71	234.87	23.20	25.35	7.73	269.82
84.0	100.0	37.02	38.49	3.58	108.98	35.84	43.50	4.04	123.16	7.62	7.62	0.71	21.58	80.66	74.63	6.93	211.33	25.80	24.50	7.47	248.05
85.0	100.0	39.71	38.37	3.56	108.64	18.28	27.06	2.51	76.63	7.62	7.62	0.71	21.58	66.12	73.39	6.82	207.82	20.20	23.00	7.01	232.13
86.0	100.0	43.11	41.41	3.85	117.26	26.30	22.29	2.07	63.12	7.62	7.62	0.71	21.58	54.21	60.17	5.59	170.37	24.40	22.30	6.80	242.93
87.0	100.0	46.87	44.99	4.18	127.40	46.35	36.33	3.37	102.86	7.62	7.62	0.71	21.58	72.74	63.48	5.90	179.74	23.80	24.10	7.35	285.24
88.0	100.0	46.02	46.45	4.31	131.52	54.87	50.61	4.70	143.31	7.62	7.62	0.71	21.58	97.50	85.12	7.91	241.03	25.20	24.50	7.47	299.35
89.0	100.0	46.83	46.43	4.31	131.46	22.34	38.61	3.59	109.32	7.62	7.62	0.71	21.58	81.86	89.68	8.33	253.95	23.60	24.40	7.44	298.00
90.0	100.0	44.42	45.63	4.24	129.20	19.51	20.93	1.94	59.25	7.62	7.62	0.71	21.58	115.25	98.56	9.16	279.08	25.90	24.75	7.54	297.07
91.0	100.0	45.20	44.81	4.16	126.89	41.85	30.68	2.85	86.88	7.62	7.62	0.71	21.58	94.26	104.76	9.73	296.63	25.80	25.85	7.88	304.73
92.0	100.0	42.48	43.84	4.07	124.14	36.76	39.31	3.65	111.30	7.62	7.62	0.71	21.58	94.93	94.60	8.79	267.86	24.40	25.10	7.65	289.48
93.0	100.0	45.00	43.74	4.06	123.86	19.78	28.27	2.63	80.05	7.62	7.62	0.71	21.58	101.45	98.19	9.12	278.04	22.10	23.25	7.09	267.53
94.0	100.0	38.51	41.76	3.88	118.24	54.92	37.35	3.47	105.76	7.62	7.62	0.71	21.58	94.96	98.21	9.12	278.09	28.60	25.35	7.73	278.46
95.0	100.0	37.87	38.19	3.55	108.14	46.82	50.87	4.73	144.05	7.62	7.62	0.71	21.58	73.46	84.21	7.82	238.46	24.50	26.55	8.09	266.74
96.0	100.0	41.90	39.89	3.71	112.94	21.40	34.11	3.17	96.59	7.62	7.62	0.71	21.58	87.59	80.53	7.48	228.02	23.20	23.85	7.27	250.25
97.0	100.0	47.43	44.67	4.15	126.48	34.97	28.19	2.62	79.81	7.62	7.62	0.71	21.58	106.24	96.92	9.00	274.43	23.30	23.25	7.09	273.19
98.0	100.0	42.20	44.82	4.16	126.90	31.16	33.07	3.07	93.63	7.62	7.62	0.71	21.58	104.00	105.12	9.77	297.67	24.90	24.10	7.35	284.13
99.0	100.0	42.31	42.26	3.93	119.65	16.58	23.87	2.22	67.59	7.62	7.62	0.71	21.58	98.40	101.20	9.40	286.57	22.40	23.65	7.21	262.90
100.0	100.0	44.11	43.21	4.01	122.36	14.25	15.42	1.43	43.65	7.62	7.62	0.71	21.58	103.21	100.81	9.37	285.45	22.90	22.65	6.90	257.47
101.0	100.0	43.93	44.02	4.09	124.65	24.22	19.24	1.79	54.47	7.62	7.62	0.71	21.58	100.24	101.73	9.45	288.05	27.30	25.10	7.65	290.67
102.0	100.0	47.68	45.81	4.26	129.71	21.26	22.74	2.11	64.39	7.62	7.62	0.71	21.58	106.66	103.45	9.61	292.94	22.70	25.00	7.62	301.25
103.0	100.0	41.79	44.74	4.16	126.68	20.47	20.87	1.94	59.08	7.62	7.62	0.71	21.58	97.01	101.84	9.46	288.36	24.70	23.70	7.22	278.91
104.0	100.0	44.50	43.15	4.01	122.17	40.22	30.35	2.82	85.93	7.62	7.62	0.71	21.58	91.77	94.39	8.77	267.28	22.90	23.80	7.25	270.14
105.0	100.0	34.44	39.47	3.67	111.77	32.07	36.15	3.36	102.35	7.62	7.62	0.71	21.58	106.85	99.31	9.23	281.21	29.10	26.00	7.92	269.97
106.0	100.0	42.63	38.54	3.58	109.12	35.19	33.63	3.12	95.23	7.62	7.62	0.71	21.58	73.77	90.31	8.39	255.73	23.60	26.35	8.03	267.12
Total	**2,800.00**	**1.1 Scarifying & re-compaction**			**3,274.43**	**1.2 (1) Embankment (local soil)**			**2,490.06**	**1.2 (2) Embankment (road side)**			**582.59**	**1.3 Subgrade**			**6,884.24**	**1.5 Slope trimming**			**7,372.35**

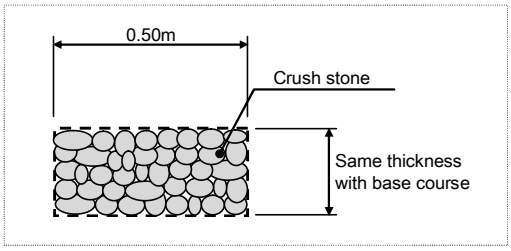
3. Drainage layer



Typical Cross Section in PP2
(Unit: Feet)



Layout of Drainage Layer (out of scale)



Dimension of Drainage Layer (out of scale)

Locations

Station																			
79 + 0	82 + 0	85 + 0	88 + 0	91 + 0	94 + 0	97 + 0	100 + 0	103 + 0
79 + 10	82 + 10	85 + 10	88 + 10	91 + 10	94 + 10	97 + 10	100 + 10	103 + 10
79 + 20	82 + 20	85 + 20	88 + 20	91 + 20	94 + 20	97 + 20	100 + 20	103 + 20
79 + 30	82 + 30	85 + 30	88 + 30	91 + 30	94 + 30	97 + 30	100 + 30	103 + 30
79 + 40	82 + 40	85 + 40	88 + 40	91 + 40	94 + 40	97 + 40	100 + 40	103 + 40
79 + 50	82 + 50	85 + 50	88 + 50	91 + 50	94 + 50	97 + 50	100 + 50	103 + 50
79 + 60	82 + 60	85 + 60	88 + 60	91 + 60	94 + 60	97 + 60	100 + 60	103 + 60
79 + 70	82 + 70	85 + 70	88 + 70	91 + 70	94 + 70	97 + 70	100 + 70	103 + 70
79 + 80	82 + 80	85 + 80	88 + 80	91 + 80	94 + 80	97 + 80	100 + 80	103 + 80
79 + 90	82 + 90	85 + 90	88 + 90	91 + 90	94 + 90	97 + 90	100 + 90	103 + 90
80 + 0	83 + 0	86 + 0	89 + 0	92 + 0	95 + 0	98 + 0	101 + 0	104 + 0
80 + 10	83 + 10	86 + 10	89 + 10	92 + 10	95 + 10	98 + 10	101 + 10	104 + 10
80 + 20	83 + 20	86 + 20	89 + 20	92 + 20	95 + 20	98 + 20	101 + 20	104 + 20
80 + 30	83 + 30	86 + 30	89 + 30	92 + 30	95 + 30	98 + 30	101 + 30	104 + 30
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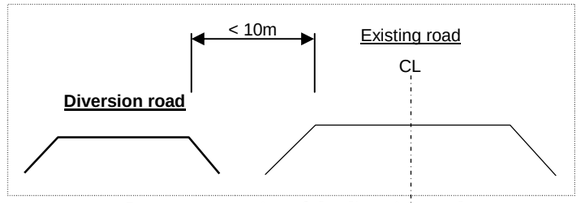
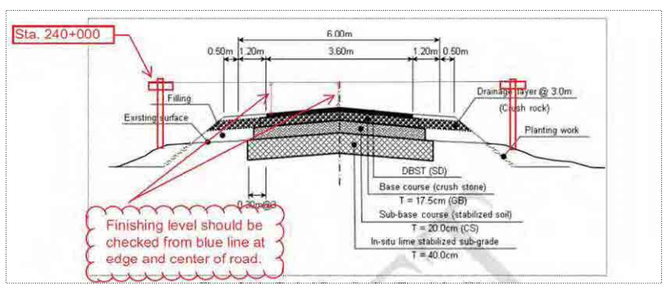
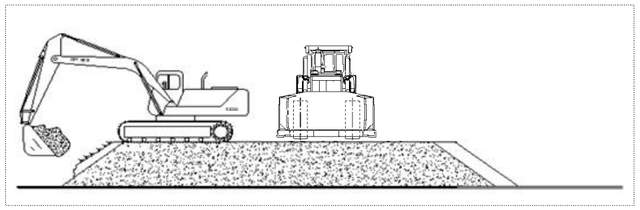
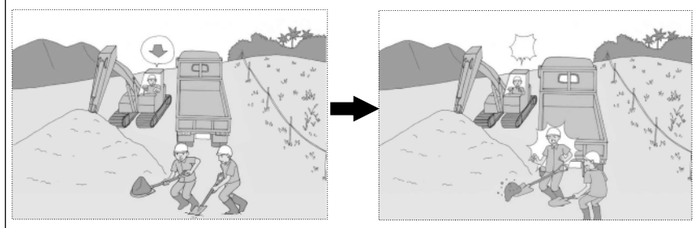
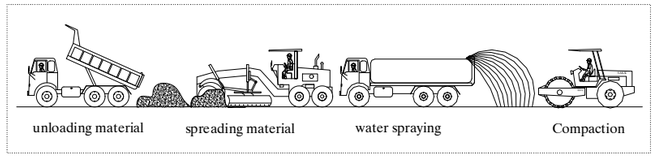
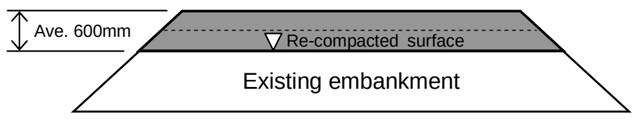
80 + 90	83 + 90	86 + 90	89 + 90	92 + 90	95 + 90	98 + 90	101 + 90	104 + 90
81 + 0	84 + 0	87 + 0	90 + 0	93 + 0	96 + 0	99 + 0	102 + 0	105 + 0
81 + 10	84 + 10	87 + 10	90 + 10	93 + 10	96 + 10	99 + 10	102 + 10	105 + 10
81 + 20	84 + 20	87 + 20	90 + 20	93 + 20	96 + 20	99 + 20	102 + 20	105 + 20
81 + 30	84 + 30	87 + 30	90 + 30	93 + 30	96 + 30	99 + 30	102 + 30	105 + 30
81 + 40	84 + 40	87 + 40	90 + 40	93 + 40	96 + 40	99 + 40	102 + 40	105 + 40
81 + 50	84 + 50	87 + 50	90 + 50	93 + 50	96 + 50	99 + 50	102 + 50	105 + 50
81 + 60	84 + 60	87 + 60	90 + 60	93 + 60	96 + 60	99 + 60	102 + 60	105 + 60
81 + 70	84 + 70	87 + 70	90 + 70	93 + 70	96 + 70	99 + 70	102 + 70	105 + 70
81 + 80	84 + 80	87 + 80	90 + 80	93 + 80	96 + 80	99 + 80	102 + 80	105 + 80
81 + 90	84 + 90	87 + 90	90 + 90	93 + 90	96 + 90	99 + 90	102 + 90	105 + 90
Nos. 30	Nos. 30	Nos. 30	Nos. 30	Nos. 30	Nos. 30	Nos. 30	Nos. 30	Nos. 30

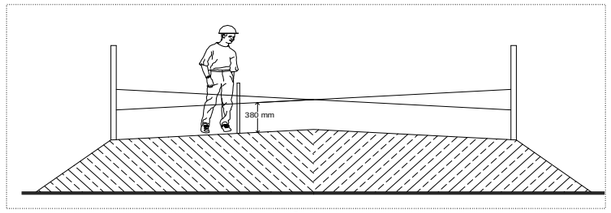
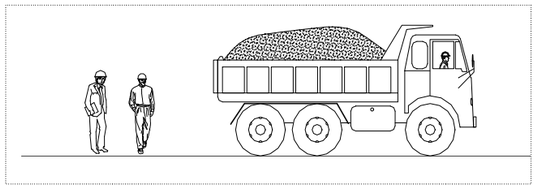
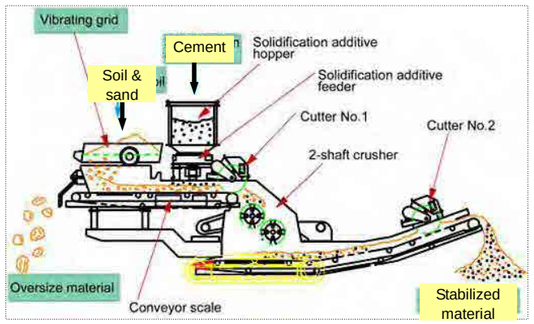
Unit L (m)	1.20
Unit W (m)	0.50
Unit D (m)	0.15
Unit V (cu.m)	0.09
Total Nos.	**540**
Total V (cu.m)	**48.60**

DIAGRAM OF WORK PROCEDURES IN THE PP-2

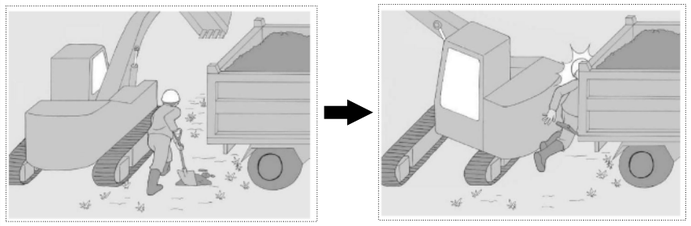
Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
1. Preparation work	1.1 Open temporary yard	- Removing top soil on the surface - Grading and compaction work - Layout should be set up by each function (e.g. stock yard, garage & workshop, staff's accommodation, material mixing lot, etc.)  **Removing top soil**  **Completed yard**	- Bulldozer with ripper - Agricultural tractor - Motor grader - Steel wheel roller			- Install traffic sign board on the access road(s) to the yard - No entry in heavy machinery working range	- Record work description and progress in daily report	- Confirm the report and submitted by the inspector
	1.2 Construction of traffic diversion road	- Location will be less than 10m from the existing road shoulder. - Local soil beside the existing road will be mounted up, graded and compacted.  **Image cross section of the diversion road**  **Grading work**  **Traffic sign board**	- Bulldozer - Motor grader - Steel wheel roller - Backhoe - Damp truck(s)			- Install traffic sign board at the both ends of the road - No entry of passenger vehicle, and/or motorcycle while the machinery is in operation	- Record work description and progress in daily report	- Confirm the report submitted by the inspector
	1.3 Engineering survey	- Install wooden stakes at each station (per 30m interval with interim pegs per 15m interval) to check the elevation of existing road and set out the finishing level of each pavement layer.  **Image of elevation check of finishing level**	- Transit level - Wooden stakes - Tape - Leveling string	- Interval: every 30m			- Measure the elevation by stake and string - Record the result in the inspection sheet(s)	- Examine the sheet submitted by the inspector

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
1. Preparation work (Cont'd)	1.3 Engineering survey (Cont'd)	 **Work view (transit level)**  **Wooden stake**						
2. Earthworks	2.1 Scarifying & re-compaction	(1) Scarifying & re-compaction - Top soil stripping (depth = 300mm) includes road shoulder and extension areas by backhoe & bulldozer with ripper. - Ensure removing grass/tree roots completely. - Grading by the grader. - Compact the surface by bulldozer and/or roller. - Spraying water depending on the material condition.  **Work image**  **Scarifying work**  **Grading work**	- Bulldozer with ripper - Backhoe - Motor grader - Steel wheel roller - Dump truck(s) - Water bowser truck			- Ensure that tool box meeting is done prior to start work. - Check workability on shoulder before the work starting - No entry in heavy machinery working range	- Check stripped surface after work completion - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Field density test (FDT) - Execute the FDT by sand replacement method after the compaction work.  **FDT work**	- FDT tool		- Target dry density = 1.58g/cm3 (provisional) - Target moisture content = 16.5% - 3 locations per 200m (both ends & interim point)		- Record the result in the test sheet	- Examine the test sheet

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
2. Earthworks (Cont'd)	2.2 Embankment work for subgrade (Ave. thickness = 600mm)	(1) Material mixing work in the yard - Mix materials by backhoe.  **Mixing work**  **Safety caution**	- Backhoe - Wheel loader - Dump truck		- Mixing ratio = soil : sand = 50% : 50%	- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Confirm mixing ratio - Check quantities in stockpile - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Subgrade construction work - Transport and spread the material on the top of re-compacted surface. - Grading and compaction work. Compacted thickness of each layer will not exceed 300mm. - Spraying water to assist compaction work.  **Image of Work sequences**  **Image cross section of subgrade work**	- Bulldozer - Motor grader - Steel wheel roller - Water bowser - Dump truck(s)			- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Check the surface condition before work starting - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(3) Field density test (FDT) - Execute the FDT by sand replacement method after the compaction work.	- FDT tool		- Target dry density = 1.95g/cm3 (provisional) - Target moisture content = 10.0% - 3 locations per 200m (both ends & interim point)		- Record the result in the test sheet	- Examine the test sheet

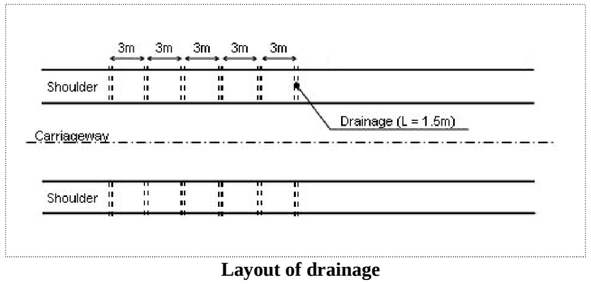
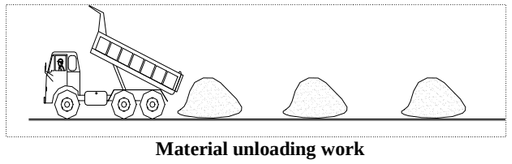
Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
2. Earthworks (Cont'd)	2.2 Embankment work for subgrade (Cont'd)	(4) Check finishing level - Check elevation and cross-fall of the finishing level whether these conform to the design  **Work image**	- Transit level - Wooden stakes - Tape - Leveling string	- Interval & point: 3points (i.e. center & both sides) every 30m - Tolerance Elevation: ±5cm Width: －10cm			- Measure the elevation by stake and string - Record the result in the inspection sheet	- Examine the inspection sheet
		(5) Proof rolling - Execute proof rolling work to observe whether depression point exists  **Work image**	- Soil mounted dump truck				- Visual inspection - Record the result in the inspection sheet	- Examine the inspection sheet - Determine the areas those need additional filling and compaction
3. Pavement work	3.1 Subbase installation work (Cement stabilization)	(2) Material production work in the yard 1) Material drying work - Ground soil will be dried by the agricultural tractor. - Leave 2 to 3days in advance to the application - load the material to dump truck by backhoe  **Drying work**	- Agricultural tractor - Backhoe - Dump truck				- Check moisture contents of the soil - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		2) Material mixing work by the plant - Throw dried soil and coarse sand into the vibration grid by the backhoe - Add cement into the hopper by manpower. - Load the mixed material on dump truck by backhoe  **Image of plant operation**	- Plant - Backhoe(s)		- Mix ratio = soil : sand = 50% : 50% - % of cement = 5.3% (provisional)	- Ensure that tool box meeting is done prior to start work. - No entry within heavy machinery working range	- Confirm mixing ratio - Check quantities in stockpile - Record work description and progress in daily report	- Confirm the report submitted by the inspector

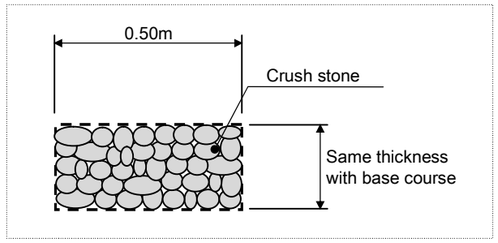
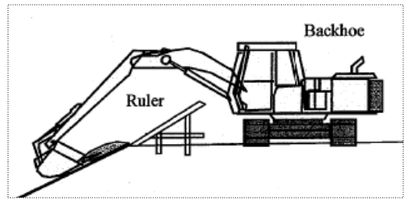
Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
3. Pavement work (Cont'd)	3.1 Subbase installation work (Cont'd)	 **Material loading work**				-		
		(3) Subbase installation work - Transport and spread the material on the top of subgrade - Grading and spreading work by grader and manpower - Initial compaction by tyre roller - Spraying water to assist compaction work and secure OMC, if necessary - Check interim elevation - Final compaction by steel wheel roller - Complete whole work cycle from mixing to compaction with in 2hours due to hardening time of cement  **Material loading**  **Spreading work**  **Initial compaction**  **Interim elevation check**  **Final Compaction**	- Dump truck - Motor grader - Tyre roller - Steel wheel roller - Water bowser (For interim elevation check) - Tape - Leveling string			- Ensure that tool box meeting is done prior to start work. - No entry within heavy machinery working range	- Check the surface condition before work starting - Observe moisture contents of the material - Record work description and progress in daily report	- Confirm the report submitted by the inspector

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
3. Pavement work (Cont'd)	3.1 Subbase installation work (Cont'd)	 **Safety caution**						
		(3) Field density test (FDT) - Execute the FDT by sand replacement method after the compaction work.	- FDT tool		- Target dry density = 1.95g/cm3 (provisional) - Target moisture content = - 3 locations per 200m (both ends & interim point)		- Record the result in the test sheet	- Examine the test sheet
		(4) Check finishing level - Check elevation and cross-fall of the finishing level whether these conform to the design  **Check finishing level**	- Transit level - Wooden stake - Tape - Leveling string	- Interval & point 3points (i.e. center & both sides) every 30m - Tolerance Elevation: ±4cm Thickness: －4.5cm Width: －5cm			- Measure the elevation by stake and string - Record the result in the inspection sheet	- Examine the inspection sheet
		(6) Proof rolling - Execute proof rolling work to observe whether depression point exists  **Proof rolling work**	- Soil mounted dump truck				- Visual inspection - Record the result in the inspection sheet	- Examine the inspection sheet - Determine the areas those need additional filling and compaction

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
3. Pavement work (Cont'd)	3.1 Subbase installation work (Cont'd)	(7) Curing work - Spaying water for the curing. The work will be executed twice per day (morning and afternoon). - Continue the work 4days or until installing upper layer.  **Curing work**	- Water bowser				- Observe moisture condition on surface - Record work description and progress in daily report	- Confirm the report submitted by the inspector
	3.2 Base course installation work (Graded crush stone)	(1) Material mixing work in the yard - Mix materials by backhoe.	- Backhoe - Wheel loader - Dump truck		- Mixing ratio = 1"x1" : 1/2"x3/4" : 3/8" : sand = 20% : 23% : 45% : 12%	- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Confirm mixing ratio - Check quantities in stockpile - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Surface cleaning work - Execute cleaning work on surface of the subbase course by air compressor  **Surface cleaning work**	- Air compressor				- Observe whether any debris exists on the surface - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(3) Base course installation work - Transport and spread the material on the top of subbase course - Grading and spreading work by grader - Compaction by tyre roller and steel wheel roller  **Grading work**  **Compaction work**	- Dump truck - Motor grader - Tyre roller - Steel wheel roller			- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Record work description and progress in daily report	- Confirm the report submitted by the inspector

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
3. Pavement work (Cont'd)	3.2 Base course installation work (Cont'd)	(4) Field density test (FDT) - Execute the FDT by sand replacement method after the compaction work.	- FDT tool		- Target dry density = - Target moisture content = - 3 locations per 200m (both ends & interim point)		- Record the result in the test sheet	- Examine the test sheet
		(5) Check finishing level - Check elevation and cross-fall of the finishing level whether these conform to the design	- Transit level - Wooden stake - Tape - Leveling string	- Interval & point 3points (i.e. center & both sides) every 30m - Tolerance Thickness: －3cm Width: －5cm			- Measure the elevation by stake and string - Record the result in the inspection sheet	- Examine the inspection sheet
	3.3 Wearing course (Penetration macadam)	(1) Surface cleaning work - Execute cleaning work on surface of the subbase course by air compressor	- Air compressor				- Observe whether any debris exists on the surface - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Spraying prime coat - Spraying bitumen material (MC70 or its equivalent) by bitumen sprayer on the surface of base course - Leave 48hours for the evaporation  **Checking surface before the work**  **Spraying bitumen**	- Bitumen sprayer		- Temperature: 57 to 71 degree Celsius - Quantity : 1.0 to 1.5 ltr per m2	- Ensure that tool box meeting is done prior to start work. - Install signboard and barricade to prevent vehicle's running	- Ensure whether nozzle of the sprayer is functioning properly before work starting - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(3) Applying 1st layer (stone basis) - Manually place base stones (size: 1" x 1") on surface of the base course - Mannualy spread binder stones (size: 1/2" x 3/4") to fill gaps between the base stones - Compact by the tyre roller.  **Placing stones**	- Tyre roller			- Ensure that tool box meeting is done prior to start work.	- Record work description and progress in daily report	- Confirm the report submitted by the inspector

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
3. Pavement work (Cont'd)	3.3 Wearing course (Cont'd)	(4) Applyng 2nd layer (Stone and bitumen) - Spray uniformly bitumen (straight asphalt: 80/100) by the sprayer on surface of 1st layer. - Spread finishing stones (size: 3/8") - Spray the bitumen to cover the stones. - Compact by the tyre roller. - Leave 48hours for curing purpose  **Spraying on 1st layer**  **Compaction work on 2nd layer**	- Tyre roller - Bitumen sprayer			- Ensure that tool box meeting is done prior to start work. - Install signboard and barricade to prevent vehicle's running	- Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(5) Check finishing level - Check elevation and cross-fall of the finishing level whether these conform to the design	- Transit level - Wooden stake - Tape - Leveling string	- Interval & point 3points (i.e. center & both sides) every 30m - Tolerance Thickness: －1.5cm			- Measure the elevation by stake and string - Record the result in the inspection sheet	- Examine the inspection sheet
4. Apparatus work	4.1 Drainage layer	(1) Material mixing work in the yard - Mix materials (equivalent to base course) by backhoe	- Backhoe - Wheel loader - Dump truck		- Mixing ratio = 1"x1" : 1/2"x3/4" : 3/8" : sand = 20% : 23% : 45% : 12%	- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Confirm mixing ratio - Check quantities in stockpile - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Excavation work on road shoulders - Manually excavate ditches on road shoulders with 3m of intervals  **Layout of drainage**	- Hand tools for earthwork				- Check interval lengths - Ensure gradient of drainage - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(3) Drainage layer installation work - Transport and unload the material on site - Manually fill the stones into the ditches - Manually Backfill and compact up to road surface by rammer  **Material unloading work**	- Dump truck - Hand tools for earthwork - Rammer				- Ensure uniformity of the material density - Record work description and progress in daily report	- Confirm the report submitted by the inspector

Work category	Work item	Work description	Equipment/Tool	Measurement	Quality control	Safety measure	Action by site foreman/inspector	Action by engineer
4. Apparatus work (Cont'd)	4.1 Drainage layer (Cont'd)	 **Dimension of drainage layer**						
	4.2 Slope sodding work	(1) Slope treatment - Cut extra soil on the slope by backhoe  **Work image**	- Backhoe - Timber for ruler (1:1.5)			- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Check slope ratio - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(2) Covering top soil - Cover top soil by wheel loader and/or bull dozer - Spread by manpower (thickness 5 – 10cm) **Work image**	- Wheel loader - Bulldozer - Dump truck			- Ensure that tool box meeting is done prior to start work. - No entry in heavy machinery working range	- Check thickness - Record work description and progress in daily report	- Confirm the report submitted by the inspector
		(3) Sodding work - Planting natural grass on the edge of slope (upper side) by manpower. - Sprinkling water if weather seems too dry.					- Check moisture condition - Record work description and progress in daily report	- Confirm the report submitted by the inspector

Inspection Sheet for Road Works (Subgrade)

Location: Road No.6, Bogale Township, Ayeyarwady Region

Section: 1/4 – 2/0 (L=800m)

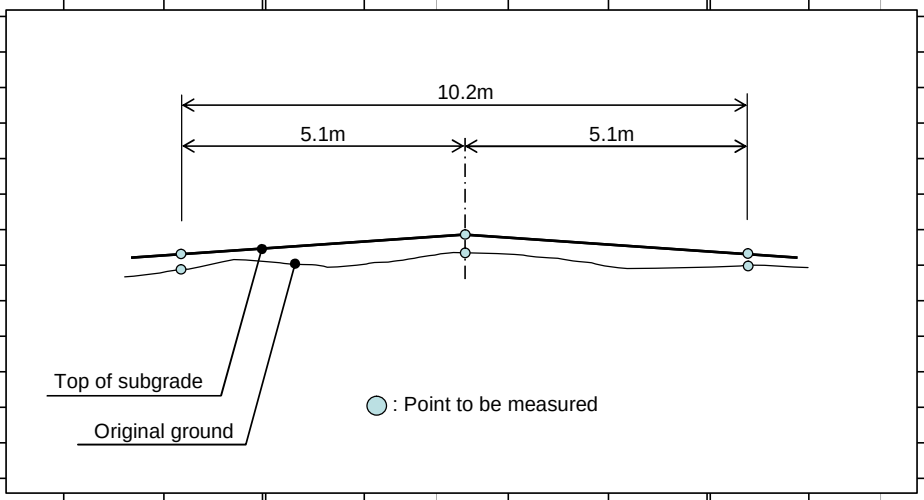
Elevation tolerance: ±0.05m

Inspection Date:

Measured by:

Checked by:

Station	Elevation Level Data														
	Left side 5.1m Offset					Center line					Right side 5.1m Offset				
	Original ground	Design		Measurement	Difference	Original ground	Design		Measurement	Difference	Original ground	Design		Measurement	Difference
	m	Ft	m	m	m	m	Ft	m	m	m	m	Ft	m	m	m
	(a)		(b)	(c)	(b) – (c)	(a)		(b)	(c)	(b) – (c)	(a)		(b)	(c)	(b) – (c)
79		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
80		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
81		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
82		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
83		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
84		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
85		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
86		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
87		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
88		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
89		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
90		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
91		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
92		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
93		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
94		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
95		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
96		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
97		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
98		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
99		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
100		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
101		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
102		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
103		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
104		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
105		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		
106		10.13	**3.09**				10.31	**3.14**				10.13	**3.09**		



Inspection Sheet for Road Works (Subbase course)

Location: Road No.6, Bogale Township, Ayeyarwady Region

Section: 1/4 – 2/0 (L=800m)

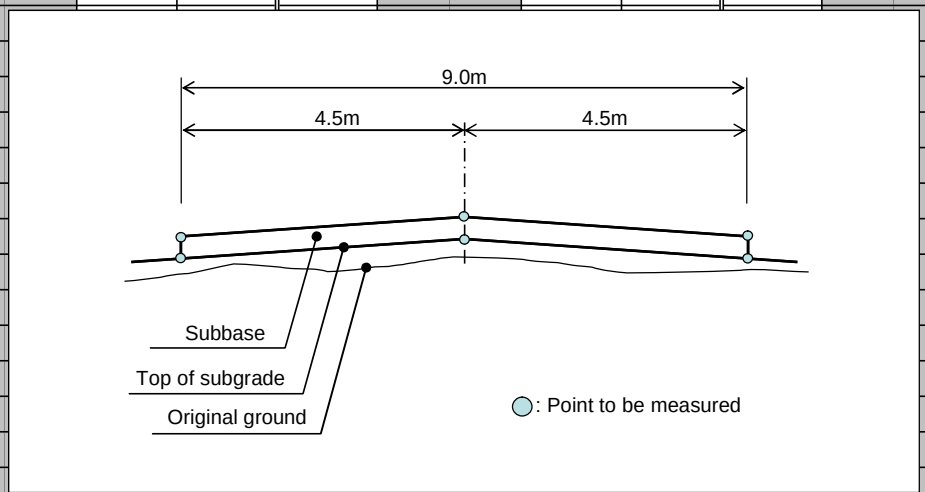
Thickness tolerance: −0.045m

Inspection Date:

Measured by:

Checked by:

Station	Elevation Level Data														
	Left side 4.5m Offset					Center line					Right side 4.5m Offset				
	Top of subgrade	Design		Measurement	Thickness	Top of subgrade	Design		Measurement	Thickness	Top of subgrade	Design		Measurement	Thickness
	m	Ft	m	m	m	m	Ft	m	m	m	m	Ft	m	m	m
	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)
79		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
80		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
81		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
82		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
83		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
84		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
85		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
86		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
87		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
88		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
89		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
90		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
91		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
92		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
93		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
94		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
95		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
96		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
97		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
98		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
99		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
100		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
101		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
102		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
103		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
104		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
105		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		
106		10.32	**3.15**				10.81	**3.29**				10.32	**3.15**		

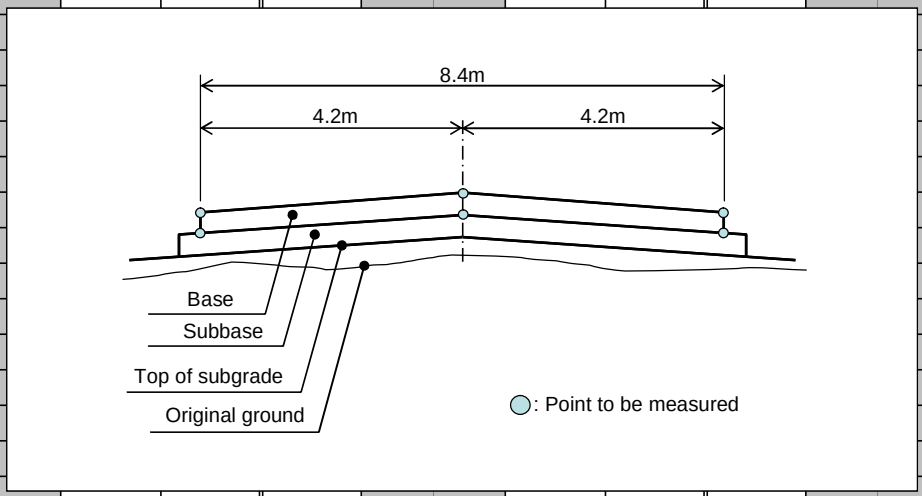


Inspection Sheet for Road Works (Base course)

Location: Road No.6, Bogale Township, Ayeyarwady Region
Section: 1/4 – 2/0 (L=800m)
Thickness tolerance: −0.03m

Inspection Date:
Measured by:
Checked by:

Station	Elevation Level Data														
	Left side 4.2m Offset					Center line					Right side 4.2m Offset				
	Top of subbase	Design		Measurement	Thickness	Top of subbase	Design		Measurement	Thickness	Top of subbase	Design		Measurement	Thickness
	m	Ft	m	m	m	m	Ft	m	m	m	m	Ft	m	m	m
	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)
79		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
80		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
81		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
82		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
83		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
84		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
85		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
86		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
87		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
88		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
89		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
90		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
91		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
92		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
93		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
94		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
95		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
96		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
97		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
98		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
99		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
100		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
101		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
102		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
103		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
104		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
105		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		
106		10.87	**3.31**				11.31	**3.45**				10.87	**3.31**		

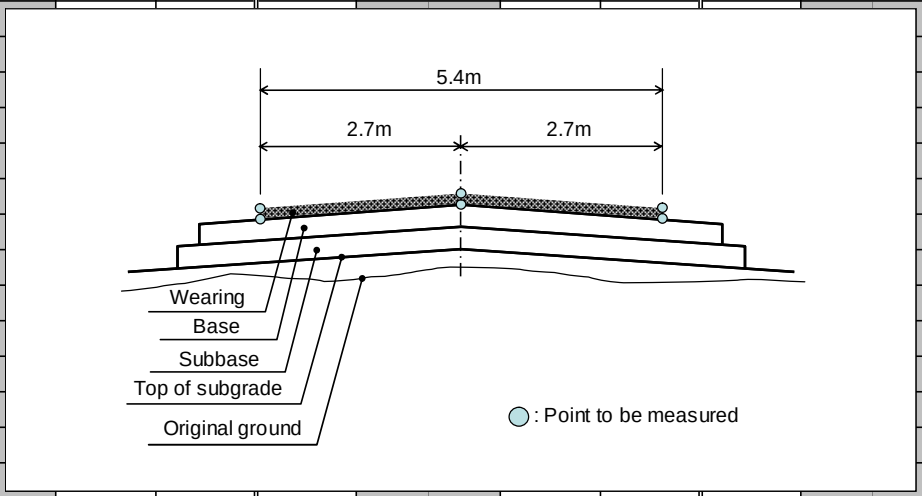


Inspection Sheet for Road Works (Wearing course)

Location: Road No.6, Bogale Township, Ayeyarwady Region
Section: 1/4 – 2/0 (L=800m)
Thickness tolerance: −0.015m

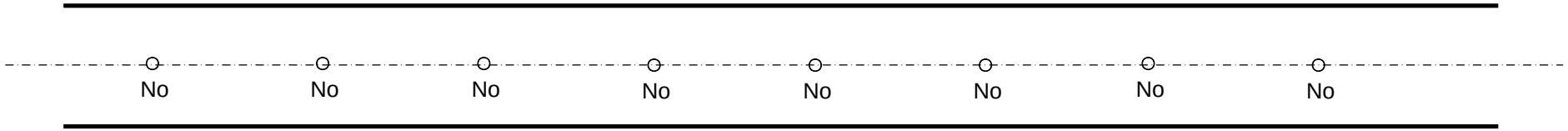
Inspection Date:
Measured by:
Checked by:

Station	Elevation Level Data														
	Left side 2.7m Offset					Center line					Right side 2.7m Offset				
	Top of base	Design		Measurement	Thickness	Top of base	Design		Measurement	Thickness	Top of base	Design		Measurement	Thickness
	m	Ft	m	m	m	m	Ft	m	m	m	m	Ft	m	m	m
	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)	(a)		(b)	(c)	(c) – (a)
79		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
80		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
81		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
82		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
83		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
84		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
85		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
86		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
87		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
88		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
89		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
90		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
91		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
92		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
93		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
94		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
95		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
96		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
97		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
98		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
99		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
100		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
101		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
102		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
103		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
104		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
105		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		
106		11.29	**3.44**				11.56	**3.52**				11.29	**3.44**		



Existing Subgrade Density Test

Project Title			
Parson in charge			
Type of Base	Subgrade	Subbase	Roadbase
Additve			

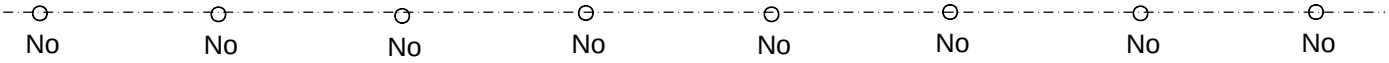


Date													
Station													
Site Test	Testing Method												
	Wet Debsity γ_t (g/cm3)												
	Dry Density γ_d (g/cm3)												
	Moisture Content Wn (%)												
	(other test)												
Compaction degeree	Max Dry density(g/cm^3)												
	Compaction degree (%)												

Date													
Station													
Site Test	Testing Method												
	Wet Debsity γ_t (g/cm3)												
	Dry Density γ_d (g/cm3)												
	Moisture Content Wn (%)												
	(other test)												
Compaction degerre	Max Dry density(g/cm^3)												
	Compaction degree (%)												

Sub grade Stabilization

Project Title	
Date	
Parson in charge	
Wearher / Temperature	
Additve	
Testing Method	



1. Dry Density and Moisture Content before scarify

Station						
0mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
135mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
270mm	Wet Debsity γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

2. Moisture content before rolling (scarified mixing soil)

Date					
Station					
Moisture Content Wn (%)					

3. Dry Density and Moisture Content after Rolling

Station						
0mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
135mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
270mm	Wet Debsity γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

4. Extra

Station						
0mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
135mm	Wet Debsity γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
270mm	Wet Density γ_t (g/cm3)					
	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

Test Sheet (Subbase Course)

Project Title	
Date	
Parson in charge	
Wearher / Temperature	
Additve	
Testing Method	

No No No No No No No No

1. Moisture content at borrow pit

(1) Soil

Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

(2) Sand

Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

2. Moisture content before rolling

Station					
Wet Density γt (g/cm3					
Dry Density γd (g/cm3)					
Moisture Content Wn (%)					

3. Dry Density and Moisture Content after Rolling

Station						
Wet Density γ_t (g/cm3)						
Dry Density γ_d (g/cm3)						
Moisture Content Wn (%)						
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

4. Extra

Station						
Wet Density γ_t (g/cm3)						
Dry Density γ_d (g/cm3)						
Moisture Content Wn (%)						
Average	Dry Density γ_d (g/cm3)					
	Moisture Content Wn (%)					

Test Report

No. : CE/2014/B2406 Date : 2014/11/24 Page : 1 of 4

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
12-1, HONMACHI 3-CHOME, SHIBUYA-KU, TOKYO, 151-0071, JAPAN

CE/2014/B2406

The following sample(s) was/were submitted and identified by/on behalf of the applicant as :

Sample Description	:	PORTLAND CEMENT
Style/Item No.	:	TIS15-PART1-2555
Sample Receiving Date	:	2014/11/17
Testing Period	:	2014/11/17 TO 2014/11/24

==========

Test Requested	:	As specified by client, with reference to RoHS Directive 2011/65/EU Annex II to determine Cr(VI) content in the submitted sample.
Test Method	:	Please refer to next pages.
Test Result(s)	:	Please refer to next page(s).
Conclusion	:	Based on the performed tests on submitted samples, the test result of Cr(VI) comply with the limit as set by RoHS Directive 2011/65/EU Annex II; recasting 2002/95/EC.

SGS TAIWAN LTD
SGS
TAIWAN

Troy Chang/ Manager– Tech
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory – Taipei

Test Report

No. : CE/2014/B2406 Date : 2014/11/24 Page : 2 of 4

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
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CE/2014/B2406

Test Result(s)

PART NAME No.1 : GRAY POWDER

Test Item(s)	Unit	Method	MDL	Result	Limit
				No.1	
Hexavalent Chromium Cr(VI)	mg/kg	With reference to IEC 62321: 2008 and performed by UV-VIS.	2	15	1000

Note：

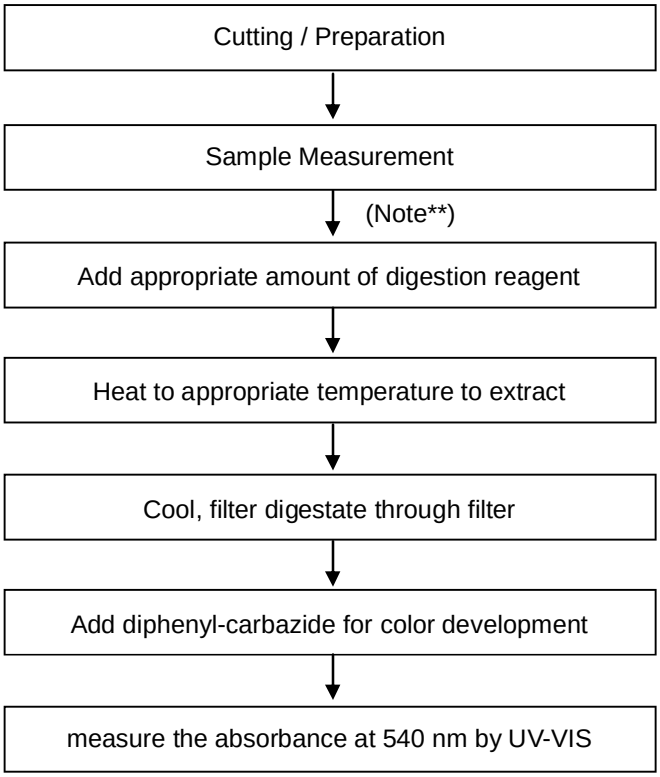
1. mg/kg = ppm；0.1wt% = 1000ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
12-1, HONMACHI 3-CHOME, SHIBUYA-KU, TOKYO, 151-0071, JAPAN

CE/2014/B2406

Hexavalent Chromium Cr(VI) Analytical flow chart

1) Name of the person who made measurement: Climbgreat Yang
2) Name of the person in charge of measurement: Troy Chang



Note** (For IEC 62321)

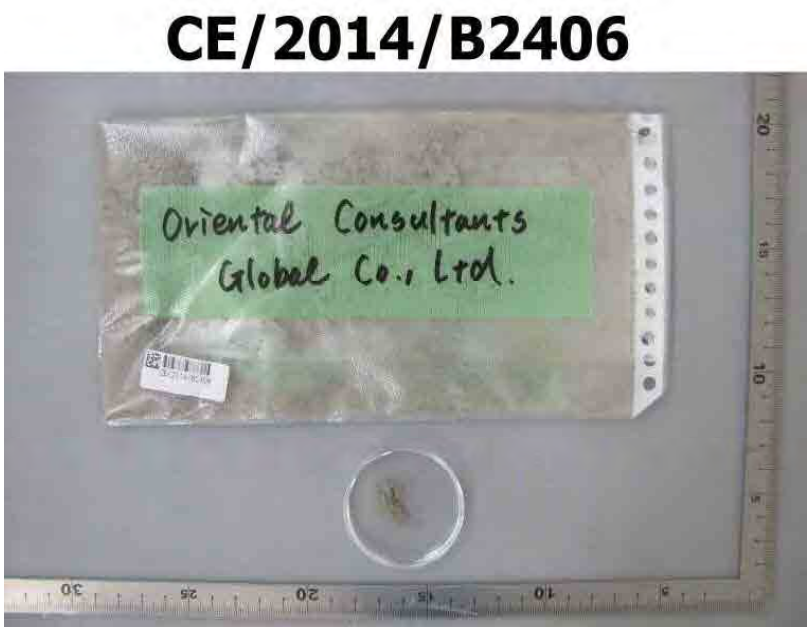
(1) For non-metallic material, add alkaline digestion reagent and heat to 90~95℃.
(2) For metallic material, add pure water and heat to boiling.

Test Report

No. : CE/2014/B2406 Date : 2014/11/24 Page : 4 of 4

ORIENTAL CONSULTANTS GLOBAL CO., LTD. *CE/2014/B2406*
12-1, HONMACHI 3-CHOME, SHIBUYA-KU, TOKYO, 151-0071, JAPAN

*The tested sample / part is marked by an arrow if it's shown on the photo. *



** End of Report **

Weekly Work Schedule in the PP-2

Schedule16-22Mar

I. Road Works

Category	Work item	March 16 Mon	17 Tue	18 Wed	19 Thu	20 Fri	21 Sat	22 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule23-29Mar

I. Road Works

Category	Work item	March 23 Mon	24 Tue	25 Wed	26 Thu	27 Fri	28 Sat	29 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule30Mar-5Apr

I. Road Works

Category	Work item	March 30 Mon	March 31 Tue	April 1 Wed	April 2 Thu	April 3 Fri	April 4 Sat	April 5 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule6-12Apr

I. Road Works

Category	Work item	April 6 Mon	7 Tue	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule13-19Apr

I. Road Works

Category	Work item	April 13 Mon	14 Tue	15 Wed	16 Thu	17 Fri	18 Sat	19 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule20-26Apr

I. Road Works

Category	Work item	April 20 Mon	21 Tue	22 Wed	23 Thu	24 Fri	25 Sat	26 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule27Apr-3May

I. Road Works

Category	Work item	April 27 Mon	28 Tue	29 Wed	30 Thu	May 1 Fri	2 Sat	3 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule4-10May

I. Road Works

Category	Work item	May 4 Mon	5 Tue	6 Wed	7 Thu	8 Fri	9 Sat	10 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule11-17May

I. Road Works

Category	Work item	May 11 Mon	12 Tue	13 Wed	14 Thu	15 Fri	16 Sat	17 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule18-24May

I. Road Works

Category	Work item	May 18 Mon	19 Tue	20 Wed	21 Thu	22 Fri	23 Sat	24 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Schedule in the PP-2

Schedule25-31May

I. Road Works

Category	Work item	May 25 Mon	26 Tue	27 Wed	28 Thu	29 Fri	30 Sat	31 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress9-15Mar

I. Road Works

Category	Work item	March 9 Mon	10 Tue	11 Wed	12 Thu	13 Fri	14 Sat	15 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress16-22Mar

I. Road Works

Category	Work item	March 16 Mon	17 Tue	18 Wed	19 Thu	20 Fri	21 Sat	22 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress23-29Mar

I. Road Works

Category	Work item	March 23 Mon	24 Tue	25 Wed	26 Thu	27 Fri	28 Sat	29 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress30Mar-5Apr

I. Road Works

Category	Work item	March 30 Mon	March 31 Tue	April 1 Wed	April 2 Thu	April 3 Fri	April 4 Sat	April 5 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress6-12Apr

I. Road Works

Category	Work item	April 6 Mon	7 Tue	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress13-19Apr

I. Road Works

Category	Work item	April 13 Mon	14 Tue	15 Wed	16 Thu	17 Fri	18 Sat	19 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress20-26Apr

I. Road Works

Category	Work item	April 20 Mon	21 Tue	22 Wed	23 Thu	24 Fri	25 Sat	26 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress27Apr-3May

I. Road Works

Category	Work item	April 27 Mon	28 Tue	29 Wed	30 Thu	May 1 Fri	2 Sat	3 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Total	(%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress4-10May

I. Road Works

Category	Work item	May 4 Mon	5 Tue	6 Wed	7 Thu	8 Fri	9 Sat	10 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress11-17May

I. Road Works

Category	Work item	May 11 Mon	12 Tue	13 Wed	14 Thu	15 Fri	16 Sat	17 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress18-24May

I. Road Works

Category	Work item	May 18 Mon	19 Tue	20 Wed	21 Thu	22 Fri	23 Sat	24 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

Weekly Work Progress in the PP-2

Progress25-31May

I. Road Works

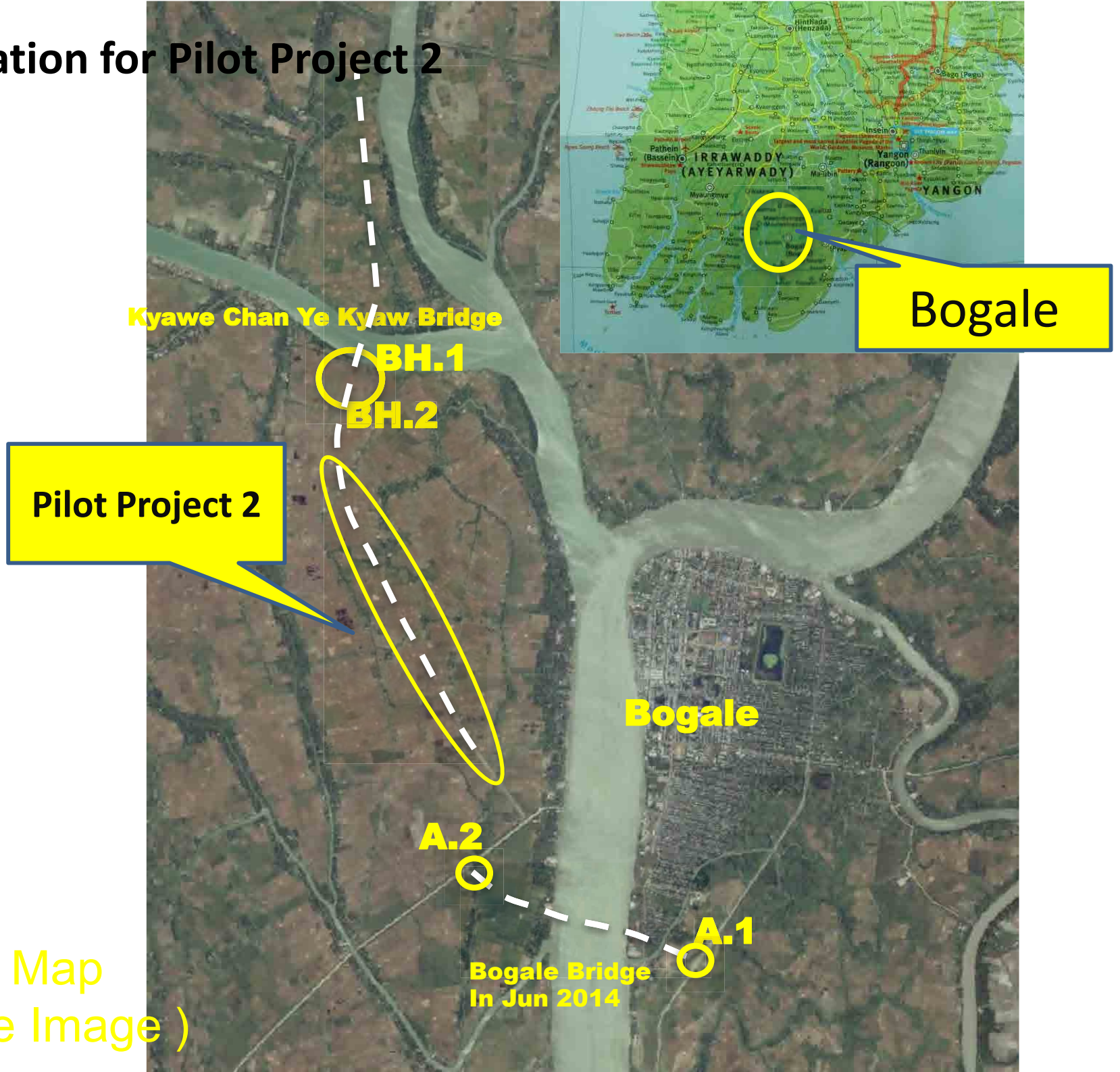
Category	Work item	May 25 Mon	26 Tue	27 Wed	28 Thu	29 Fri	30 Sat	31 Sun	Actual work description	Total quantity	Unit	Progress Weekly	Progress Total	Progress (%)	Issues & remarks	*Discussion agenda (if any)
1. Earthwork																
1.1 Scarifying & re-compaction										600	m		0	0.0%		
1.2 Embankment	(1) Lower									600	m		0	0.0%		
	(2) Road side									600	m		0	0.0%		
1.3 Subgrade										600	m		0	0.0%		
1.4 Slope trimming										600	m		0	0.0%		
2. Pavement																
2.1 Wearing course	(1) P-macadam									300	m		0	0.0%		
	(2) DBST									300	m		0	0.0%		
2.2 Hard shoulder										600	m		0	0.0%		
2.3 Base course	(1) Graded stone									300	m		0	0.0%		
	(2) Stabilized material									300	m		0	0.0%		
2.4 Subbase course										600	m		0	0.0%		
3. Drainage layer										300	m		0	0.0%		
II. Works in Yard																
1. Temporary yard	(1) Site opening									20,000	sq.m		0	0.0%		
	(2) Site clearance									20,000	sq.m		0	0.0%		
2. Diversion road										600	m		0	0.0%		
3. Material production	(1) Subgrade									9,000	cu.m		0	0.0%		
	(2) Subbase									1,500	cu.m		0	0.0%		
	(3) Base (stone)									700	cu.m		0	0.0%		
	(4) Base (stabilized)									700	cu.m		0	0.0%		
	(5) Hard shoulder (stone)									200	cu.m		0	0.0%		
	(6) P-macadam									250	cu.m		0	0.0%		
	(7) DBST									250	cu.m		0	0.0%		
III. Other works (if any)																
1.																
2.																

KYAW CHAN YE KYAW BRIDGE

(APPROACH ROAD)

LABORATORY TEST DATA

Site Information for Pilot Project 2



Location Map
(Satellite Image)

Site Investigation

The proposed site is located n the vast deltaic region of the Ayeyawady River. The surface soils are essentially alluvial deposits. At the proposed site, the embankment is filled with Silty fine Sand (from local paddy field) means soil type is CL (muddy soils). In the present state, the embankment's length is over 2 miles. From 0 feet to 2 miles is filled macadam and over 2 miles is mostly earth embankment. In the rainy season, water level is may be high 3 feet from the original level. The embankment's plasticity index is 23% and CBR value is only 3% maximum.

In this site, D.C.P test performed two places for embankment subgrade and location for soil batching plant. The D.C.P test results are obtained from the PW RRL. On the embankment, D.C.P test is performed from 1/4 mile to 2 miles.

Job and Location: Pilot Project 2, Road No. 10 (M 1/4 to M 2/0)

Test Point No.	Location	D.C.P		Remarks
		Depth (mm)	Value mm/blow	
1	M 1/4	120-400 400-500 500-850	56.0 100.0 350.0	
2	M 1/4 + 300'	40-210 210-330 330-700	170.0 120.0 370.0	
3	M 1/5	50-320 320-450 450-800	270.0 130.0 350.0	
4	M 1/5+ 300'	50-480 480-820	430.0 340.0	
5	M 1/6	40-250 250-370 370-730	210.0 120.0 360.0	
6	M 1/6+ 300'	50-170 170-460 460-690	120.0 290.0 230.0	
7	M 1/7	50-180 180-340 340-780	130.0 160.0 440.0	
8	M 1/7+ 300'	40-450 450-610 610-770	410.0 160.0 160.0	
9	M 2/0	70-550 550-820	430.0 340.0	

Table1. Results of D.C.P test on Subgrade.

Job and Location: Plant

Test Point No.	Location	D.C.P		Remarks
		Depth (mm)	Value mm/blow	
1		5-270 270-380 380-410 410-610 610-740	220.0 110.0 30.0 200.0 130.0	
2		50-240 240-650 650-870	220.0 110.0 30.0	
3		40-600 600-880	560.0 280.0	
4		40-140 140-260 260-475 475-550 550-685 685-790	100.0 120.0 215.0 75.0 135.0 105.0	

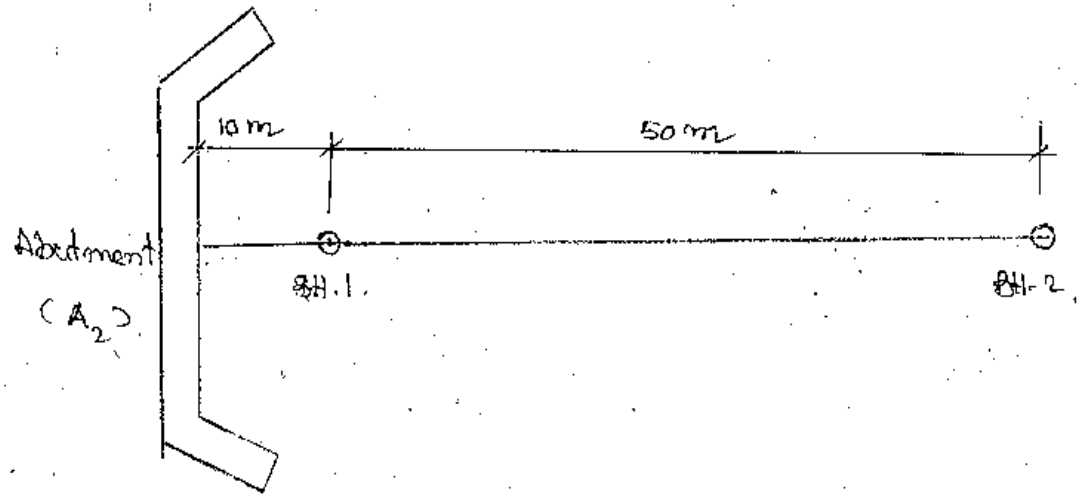
Table2. Results of D.C.P test for plant location on Subgrade.

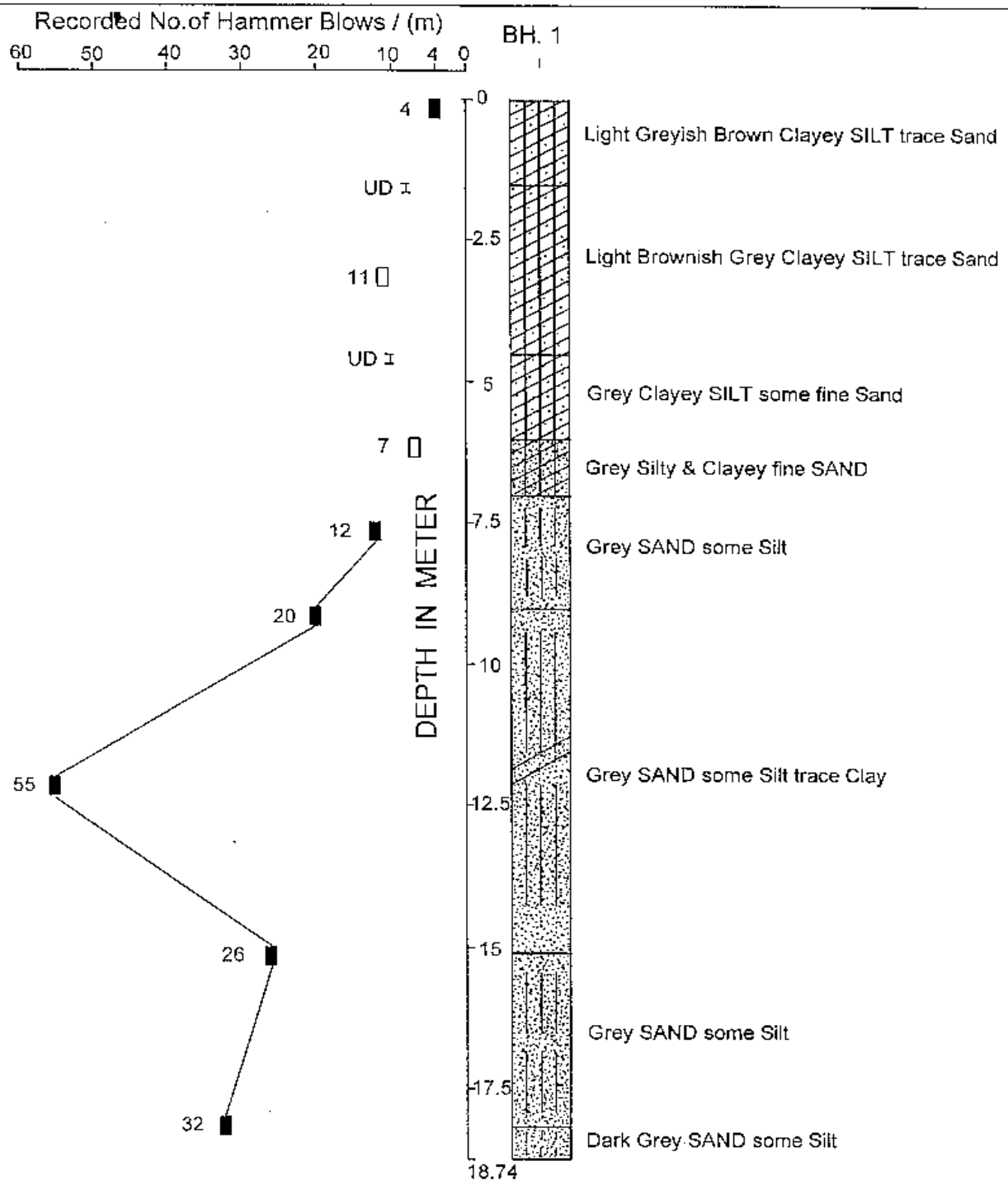
Boring Testing

The proposed site (pilot project 2) is located between Bogale Bridge and Kyaw chan ye kyaw approach road. The soil types, physical properties, resistance and other testing results are not many different, according the Bogale bridge borehole data results and Kyaw chan ye kyaw approach road data results. These data obtained from the road research laboratory (RRL) report. Therefore, boring testing for pilot project 2 will be going on with the correlation data.

APPROACH ROAD (KYWE CHAN YE KYAN BRIDGE)

BORE HOLE LOCATION PLAN.





Based on TERZAGHI Standard for S.P.T

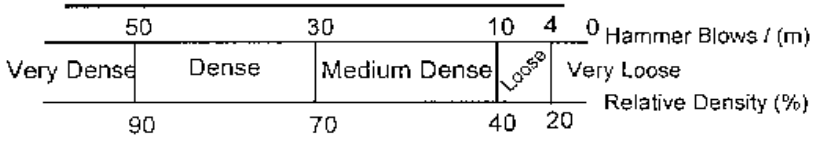


FIG. NO. 2.1 PROFILE OF BORE HOLE

KYWE CHAN YE KYAW (APPROACH ROAD)

Drilled by U Kyaw Soe Aung

Visually Classification by U Sonny (T.G.I)

Checked by U Aung Kyi (A.E)

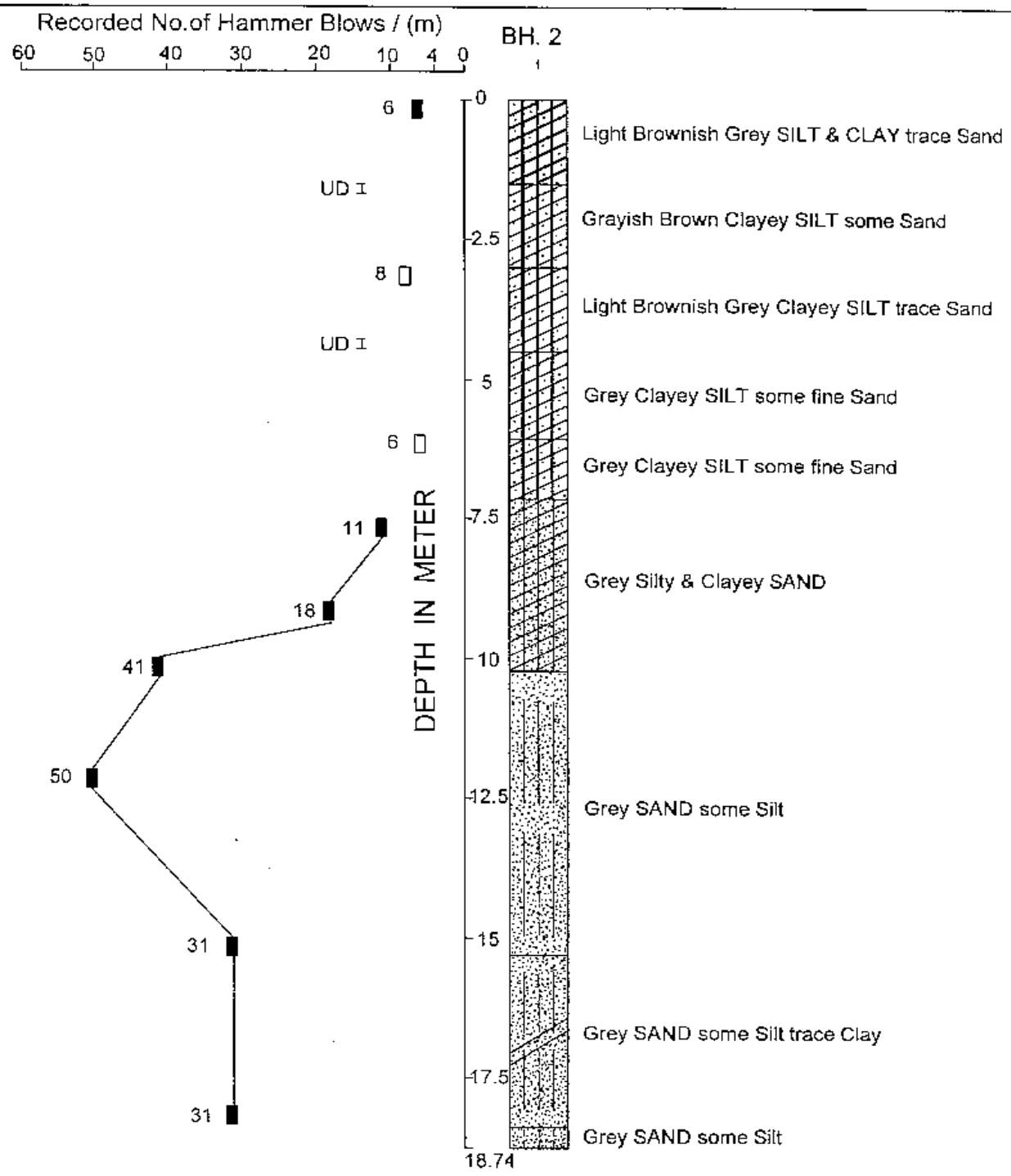
March, 2014. Scale 1" - 2.5 m

LEGEND FOR SAMPLING

□ Standard Shelby Sampler Driven with 140 lbs Hammer, Drop 30".

■ Standard Split - Spoon Sampler Driven with 140 lbs Hammer, Drop 30".

Soil Testing & Research Laboratory
PUBLIC WORKS



Based on TERZAGHI Standard for S.P.T

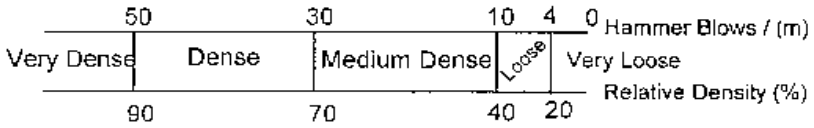


FIG. NO. 2.2 PROFILE OF BORE HOLE

KYWE CHAN YE KYAW (APPROACH ROAD)

Drilled by U Kyaw Soe Aung

Visually Classification by U Sonny (T.G.I)

Checked by U Aung Kyi (A.E)

March, 2014. Scale 1" - 2.5 m

LEGEND FOR SAMPLING

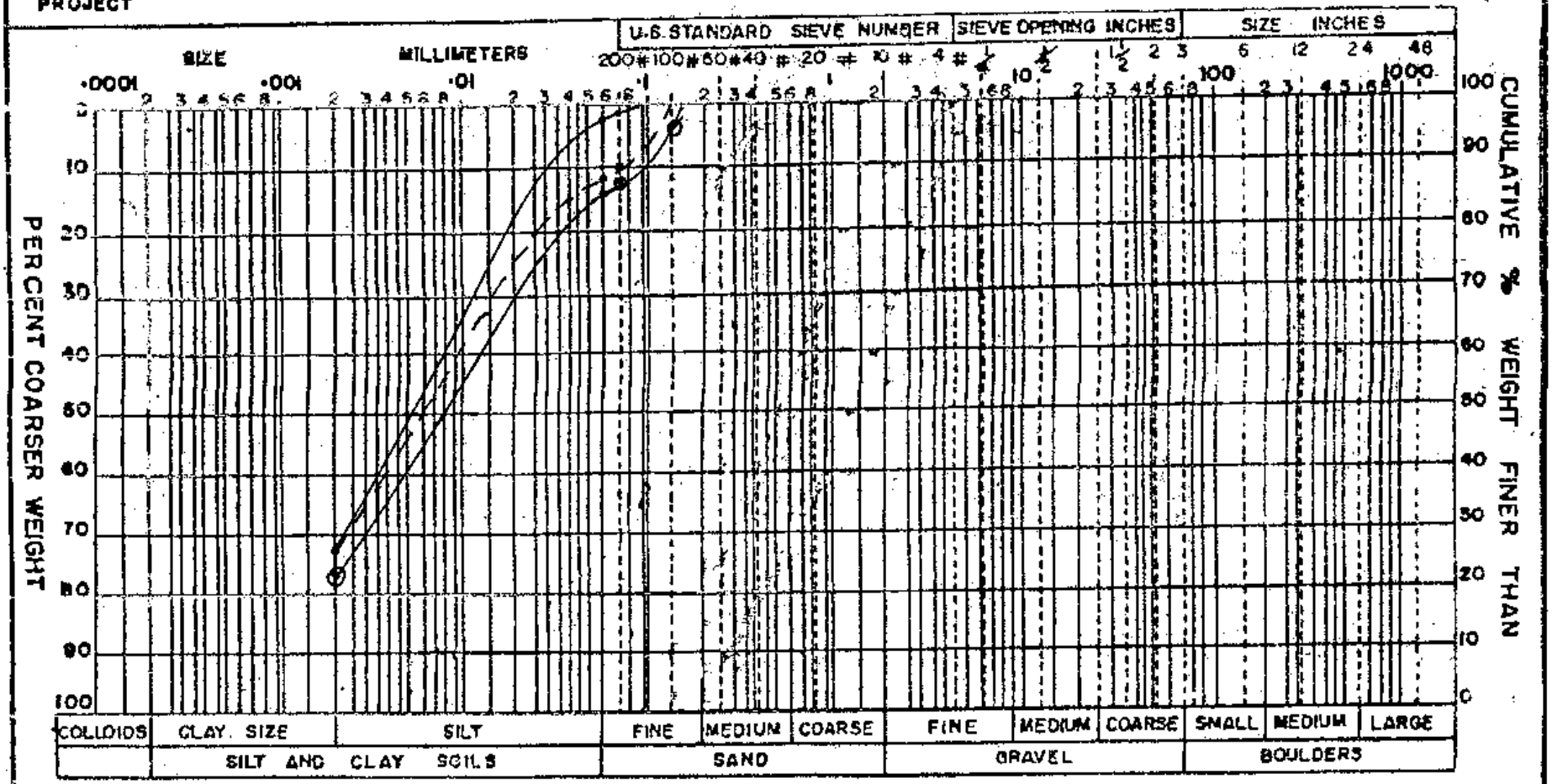
□ Standard Shelby Sampler Driven with 140 lbs Hammer, Drop 30".

■ Standard Split - Spoon Sampler Driven with 140 lbs Hammer, Drop 30".

Soil Testing & Research Laboratory
PUBLIC WORKS

Fig 3. (a) GRAIN SIZE DISTRIBUTION

PROJECT Kyaw Chan Ye - Kyaw Bridge (Approach Road) BORE HOLE NO.BH- 1



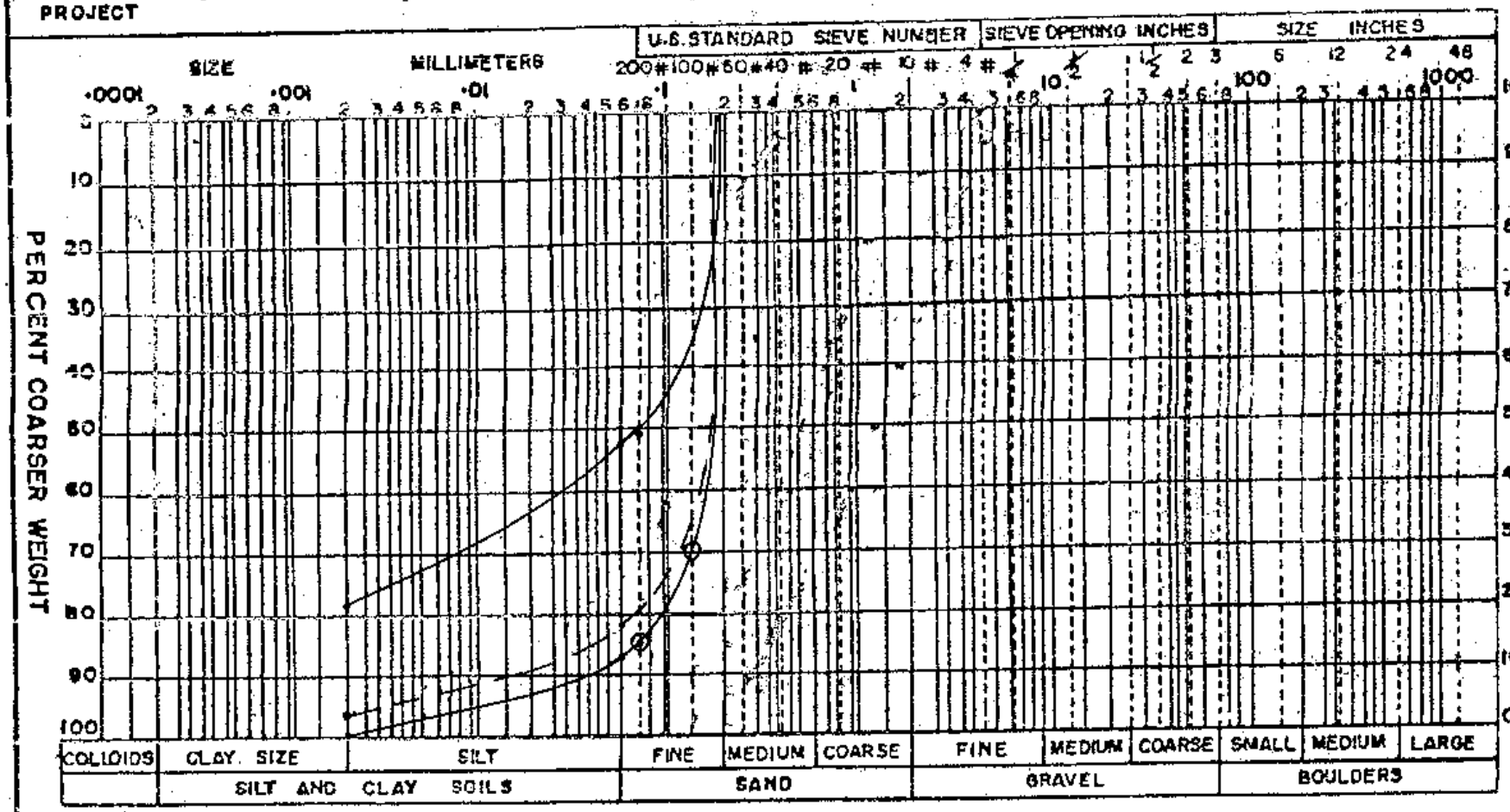
DEPTH (m) 0 – 0.65 Split – 1

DEPTH (m) 1.5 – 1.95 UD – 1

DEPTH (m) 4.5 – 4.8 UD – 2

Fig 3.1(b)GRAIN SIZE DISTRIBUTION

PROJECT Kyaw Chan Ye Kyaw Bridge (Approach Road) BORE HOLE NO.BH- 1



DEPTH (m) 6.1 – 6.7 Shelby – 2
DEPTH (m) 9.15 – 9.6 Split – 3
DEPTH (m) 15.24 – 15.69 Split – 5

Fig 3.2(a) GRAIN SIZE DISTRIBUTION

PROJECT Kyeve Chan Ye Kyaw Bridge (Approach Road)

BORE HOLE NO. BH-2

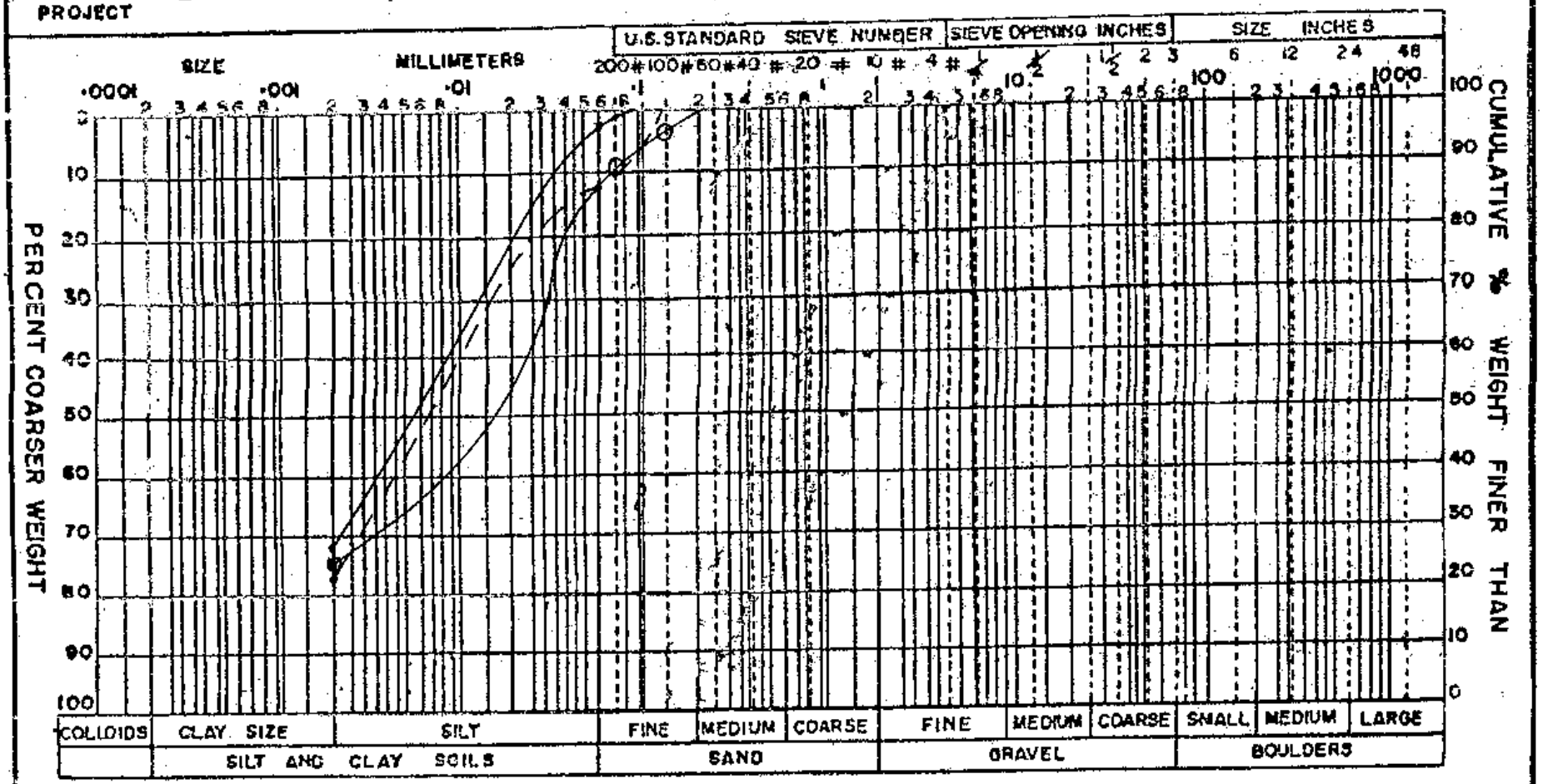
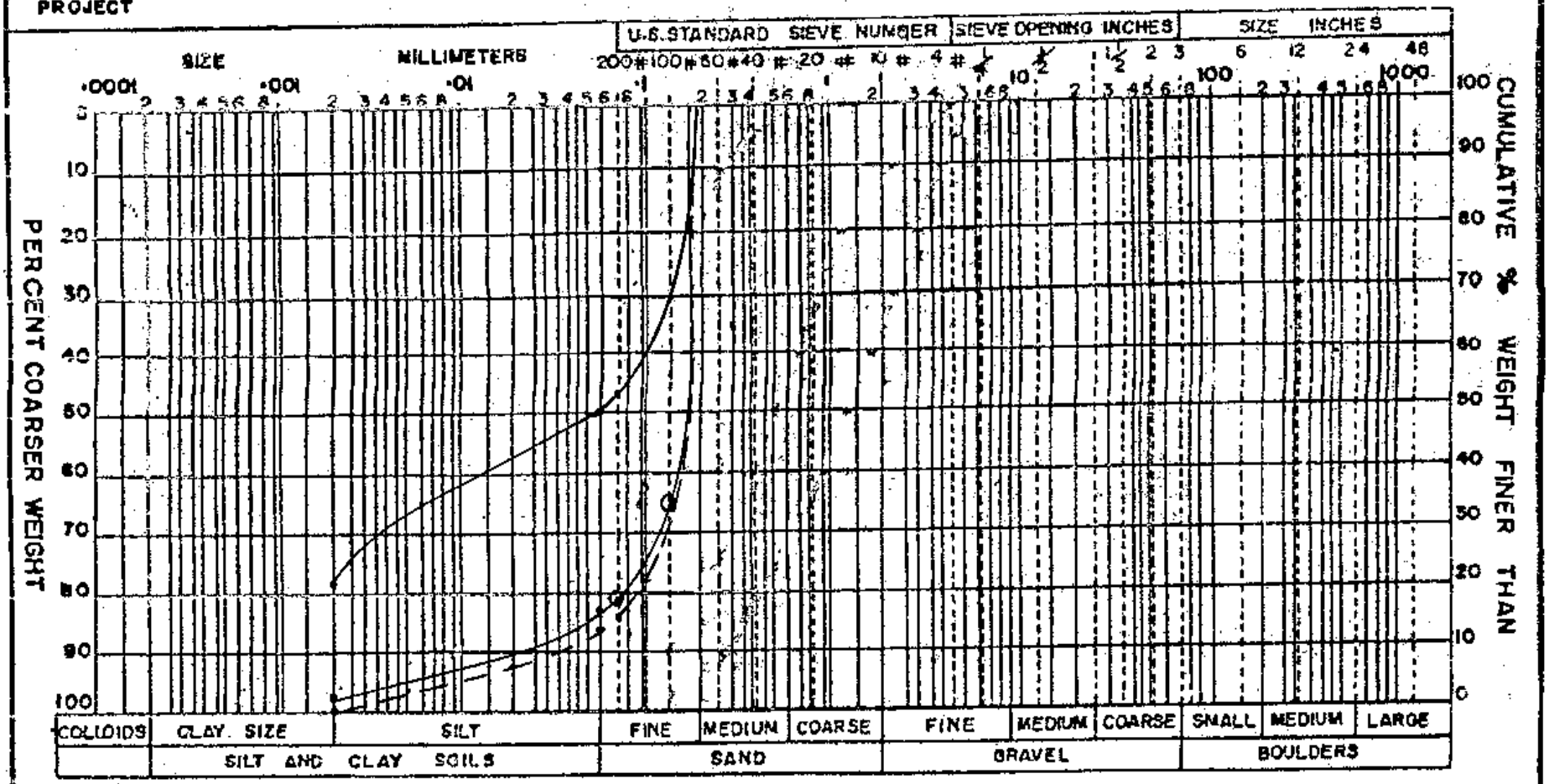


Fig 3.2(b) GRAIN SIZE DISTRIBUTION

JOB NO Kyeue Chan Ye Kyaw Bridge (Approach Road) BORE HOLE NO.BH- 2

PROJECT



DEPTH (m) 7·6 – 8·1 Split – 2

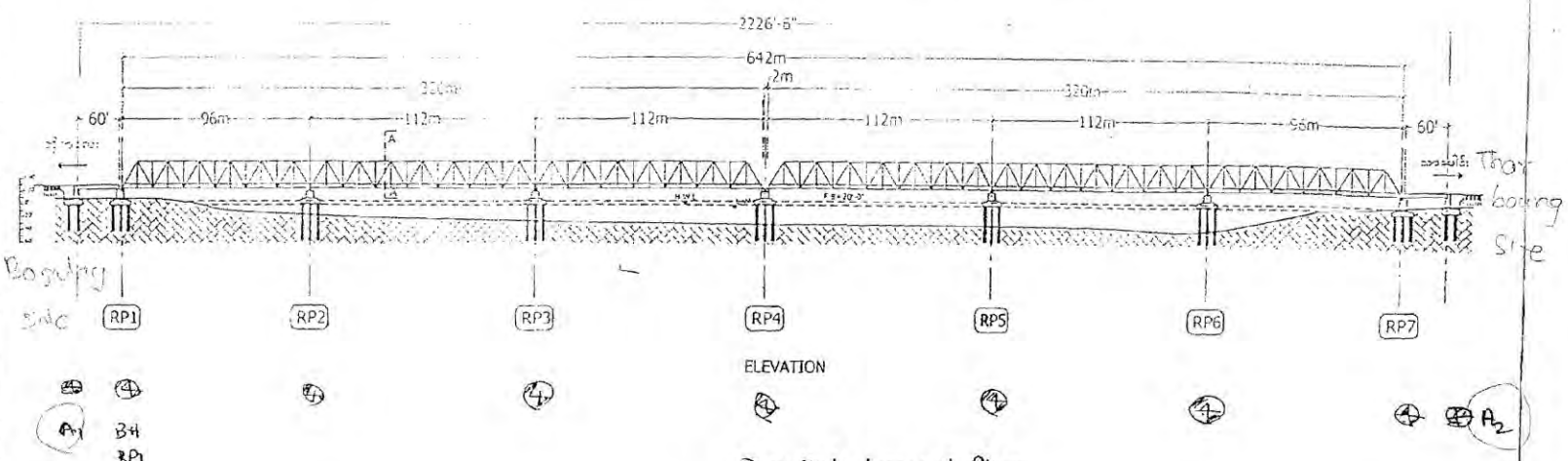
DEPTH (m) 10·67 – 11·12 Split – 4

DEPTH (m) 15.24 – 15.69 Split – 6

BOGALE BRIDGE

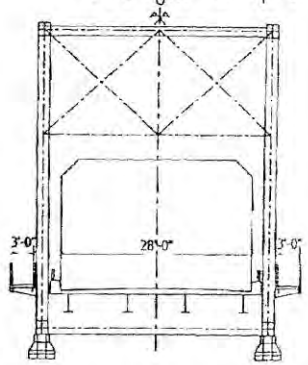
LABORATORY TEST DATA

Bogale Bridge

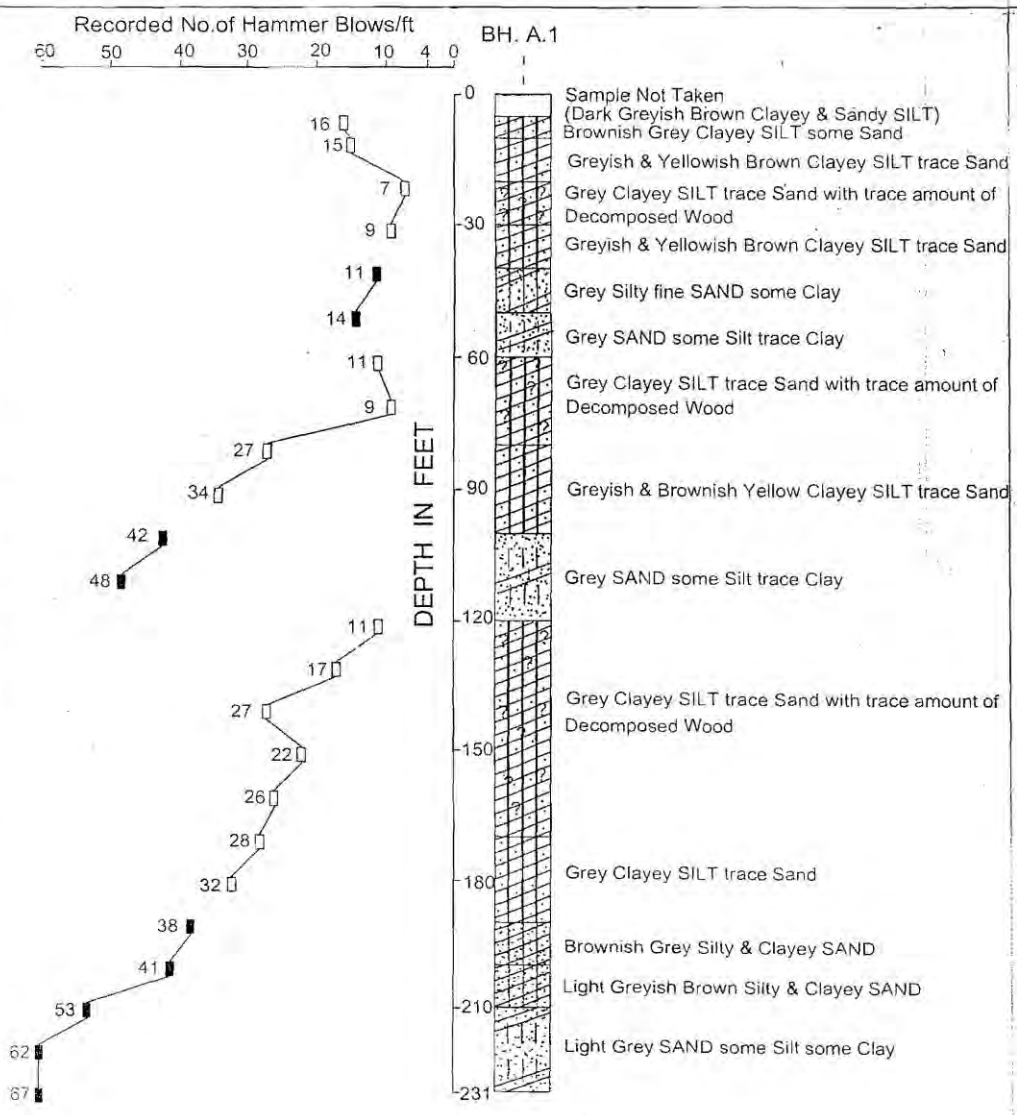


ELEVATION

Bore Hole Layout Plan



STEEL TRUSS CROSS-SECTION (A-A)



Based on TERZAGHI Standard for S.P.T

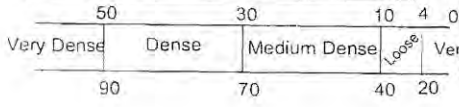


FIG. NO. 2.1 PROFILE OF BORE HOLE (BH.A.1)

BOKALAY RIVER BRIDGE

Drilled by U Saw Yan Paing

Visually Classification by U Sonny (T.G.I)

Checked by U Aung Kyi (A.E)

May, 2010. Scale 1"-30'

LEGEND FOR SAMPLING

▯ Standard Shelby Sampler Driven with 140 lbs Hammer, Drop 30".

▮ Standard Split - Spoon Sampler Driven with 140 lbs Hammer, Drop 30".

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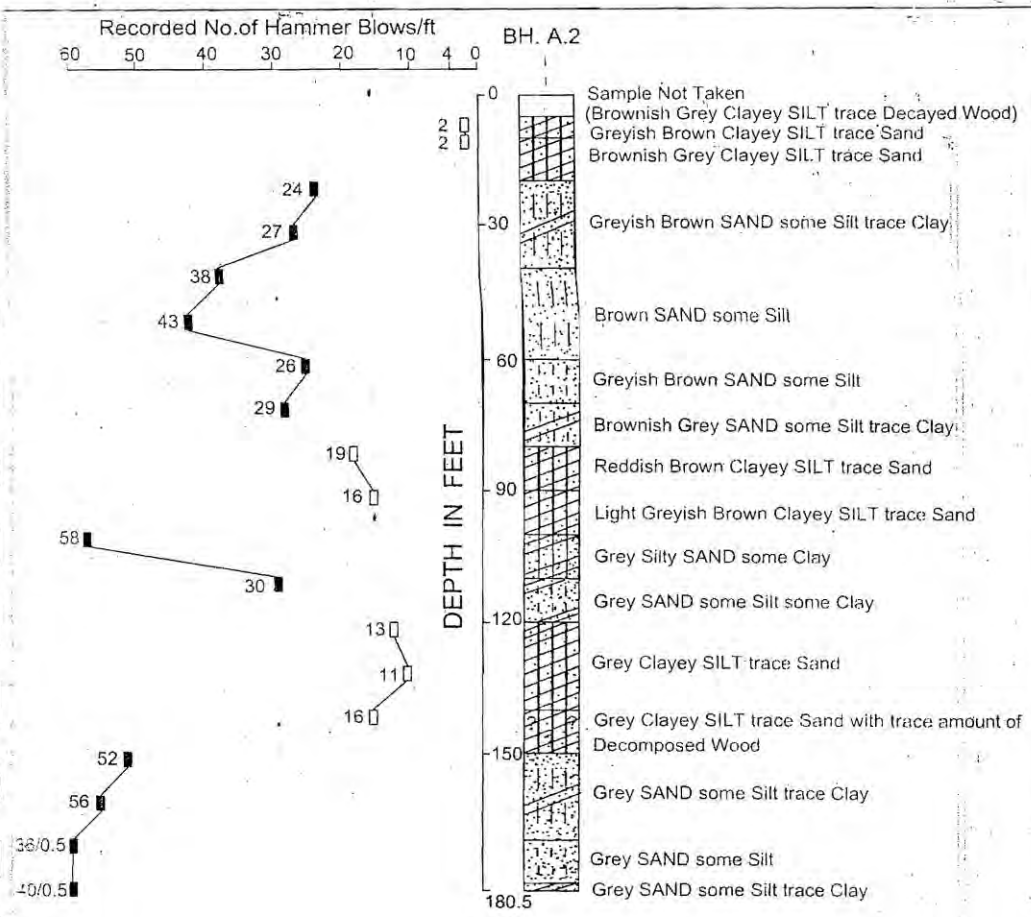

Based on TERZAGHI Standard for S.P.T

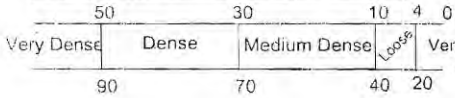

FIG. NO. 2.9 PROFILE OF BORE HOLE (BH.A.2)

BOKALAY RIVER BRIDGE

Drilled by U Saw Yan Paing

Visually Classification by U Sonny (T.G.I)

Checked by U Aung Kyi (A.E)

May, 2010. Scale 1"=30'

LEGEND FOR SAMPLING

□ Standard Shelby Sampler Driven with 140 lbs Hammer, Drop 30".

■ Standard Split - Spoon Sampler Driven with 140 lbs Hammer, Drop 30".

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TABLE NO. 2

GRAIN SIZE DISTRIBUTION & ATTERBERG'S LIMITS TEST RESULTS

JOB & LOCATION : BOKALAY RIVER BRIDGE.

BORE HOLE NO. A.1

BORE HOLE	SAMPLES			SOIL DESCRIPTION	MECHANICAL ANALYSIS TEST RESULTS										ATTERBERG'S LIMITS			
					GRAVEL			SAND			SILT	CLAY	FINE					
	SHELBY	SPLIT	DEPTH		Coarse 76.2 to 25.4 mm	Medium 25.4 to 9 mm	Fine 9 to 2 mm	Coarse 2 to 0.6 mm	Medium 0.6 to 0.2 mm	Fine 0.2 to 0.06 mm	0.06 to 0.002 mm	Less than 0.002 mm	Minus No. 200 Sieve	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT
														L.L	P.L	P.I	S.L
No.	No.	No	ft.		%	%	%	%	%	%	%	%	%	%	%	%	%
A.1		1	40 41.5	Silty SAND some Clay						59	28	13	47	N.L	N.P	N.P	
	5		60 62	Clayey SILT trace Sand						2	73	25	99	42	23	19	
	7		80 82	Clayey SILT trace Sand						4	68	28	68	46	21	25	
		3	100 101.5	SAND some Silt trace Clay						83	14	3	22	N.L	N.P	N.P	
	14		170 172	Clayey SILT trace Sand						2	78	20	99	47	21	26	
		6	190 191.5	Silty & Clayey SAND						50	27	23	57	37	24	13	
		7	210 211.5	SAND some Silt some Clay						71	17	12	56	N.L	N.P	N.P	

Tested by
(U Sonny T G I)

Supervised by
(U Sonny T G I)

Checked by
(Daw Phyu Phyu A T)

TABLE NO. 2

GRAIN SIZE DISTRIBUTION & ATTERBERG'S LIMITS TEST RESULTS

JOB & LOCATION : BOKALAY RIVER BRIDGE.

BORE HOLE NO. A.2

BORE HOLE	SAMPLES			SOIL DESCRIPTION	MECHANICAL ANALYSIS TEST RESULTS									ATTERBERG'S LIMITS			
					GRAVEL			SAND			SILT	CLAY	FINE				
	SHELBY	SPLIT	DEPTH		Coarse 76.2 to 25.4 mm	Medium 25.4 to 9 mm	Fine 9 to 2 mm	Coarse 2 to 0.6 mm	Medium 0.6 to 0.2 mm	Fine 0.2 to 0.06 mm	0.06 to 0.002 mm	Less than 0.002 mm	Minus No. 200 Sieve	LIQUID LIMIT L.L	PLASTIC LIMIT P.L	PLASTICITY INDEX P.I	SHRINKAGE LIMIT S.L
No.	No.	No.	ft.		%	%	%	%	%	%	%	%	%	%	%	%	%
A.2		3	40-41.5	SAND some Silt						87	13	-	20	N.L	N.P	N.P	
	3		80-82	Clayey SILT trace Sand						2	69	29	99	48	21	27	
		7	100-101.5	Silty SAND some Clay						62	25	13	45	N.L	N.P	N.P	
	5		120-122	Clayey SILT trace Sand						2	71	27	99	46	22	24	
		9	150-151.5	SAND some Silt trace Clay						81	14	5	27	N.L	N.P	N.P	

Tested by
(U Sonny T G I)

Supervised by
(U Sonny T G I)

Checked by
(Daw Phyu Phyu A T)