Republic of the Union of Myanmar
Ministry of Construction, PW

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

Project Completion Report

July 2015

Japan International Cooperation Agency
（JICA）

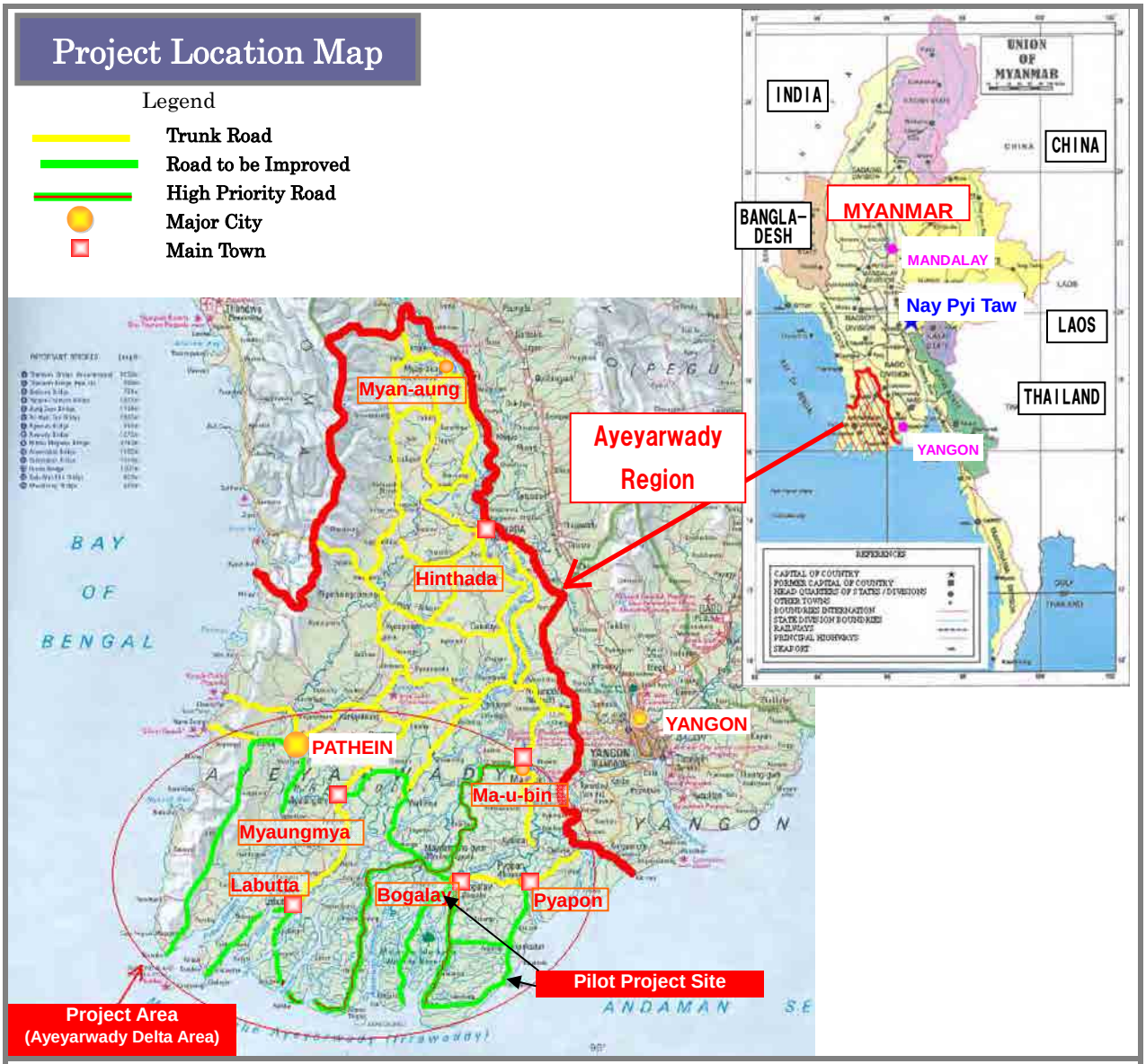
Pegasus Engineering Corporation
Oriental Consultants Global Co., Ltd.

EI
JR
15-151

Project Location Map

Legend

- Trunk Road
- Road to be Improved
- High Priority Road
- Major City
- Main Town



Outline of Republic of the Union of Myanmar & Ayeyarwady region

Basic Data of Myanmar	Myanmar	Ayeyarwady region
■ Area	680 thousand km^2	35 thousand km^2
■ Population	62.4 million (2011, IMF)	6.18 million (2014)
■ Capital	Nay Pyi Taw	Pathein
■ Ethnic	Burma (70 %)	
■ Language	Myanmar	
■ Religion	Buddhist (90%), Christian, Muslim	
■ Currency	Kyat (1 $ = 818 Kyat, April 2012)	
■ Major economic Sector	Agriculture	
■ GNP per capita	702 $ (200~1400 by CIA)	9 $ (2011)
■ Economic Growth	5.5 %	10.2 % (2011)
■ Inflation ratio	7.3 %	

Abbreviations

AASHTO	American Association of State Highways and Transport Officials
AE	Assistant Engineer
AH	Asian Highway
ASAL	Average Standard Axle Load
BIMETEC	Bay of Bengal Initiative for Multi-Sect oral Technical & Economic Cooperation
BOT	Built, Operation & Transfer
BP	Beginning Point
CE	Chief Engineer
CTC	Central Training Center
DD	Deputy Director
DDA	Department of Development Affairs of MOBA
DMD	Deputy Managing Director
DSE	Deputy Superintending Engineer
EE	Executive Engineer
EP	Ending Point
Furlong	1/8 mile
GMS	Greater Mekong Sub- region
GOM	the Government of the Republic of the Union of Myanmar
GRP	Grass Root Project
JCC	Joint Coordinating Committee
JPSC	JICA Project Supporting Committee
LBT	Labor Based Technique
MOBA	Ministry of Boarder Affairs (Myanmar)
MOC	Ministry of Construction (Myanmar)
MES	Myanmar Engineering Society
MLIT	Ministry of Land, Infrastructure and Transportation (Japan)
MM	Minutes of Meeting
MTC	Mechanical Training Center (Myanmar)
ORN	Oversea Road Notes
PD	Project Director
PM	Project Manager
PP	Pilot Project
PW	Public Works, (this vanished since Apr 2015, and became department of MOC)
RCSU	Regional Construction Special Unit
RD	Record of Discussion
RRL	Road Research Laboratory
SRL	Soil Research Laboratory
TCP	Technical Cooperation Project
VMD	Vice Managing Director
WP	Work Plan
YTU	Yangon Technical University

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Chapter 1 Project Outline

1.1 Background of the Project

Ayeyarwady Region is one of 7 regions and 7 states of the Republic of the Union of Myanmar. The region municipality is managed by the local government headed by the Chief Minister.

The area of Ayeyarwady Region is 35,140 km^2 with six districts, Pathein, Hinthada, Myaungmya, Maubin, Pyapon and Labutta. The total population is 6,175,123 according to the 2014 census.

Almost of half of the southern region of Ayeyarwady region is composed of soft ground area from the Ayeyarwady River Delta, which will be affected by tidal movement. The tidal range will reach to a few meters at the maximum.

The soft ground delta area of the Ayeyarwady River had almost no habitants until the middle of the 19th century. Currently, the area has been developed as a huge rice field that produces 6 million tons of rice annually, half of Myanmar's total production. In addition, the population is increasing rapidly. Recently the fish farm was extended switching from rice fields, and 40-ton fish transport trucks are the heaviest vehicles using the road. This is one of the issues to be considered as a future vital element for pavement design.

The rainy season starts in May and continues around six months until November. Total precipitation is more than 3,000 mm in half a year. The rate of rainfall can be 30 mm/hour or more. During this rainy season, almost all road construction is stopped except repair work and the maintenance work is to secure the construction materials for the dry season.

There is almost no rain during the other half of the year. The road subgrade of the Ayeyarwady area becomes very hard during the dry season, almost like a soil-cement base-course. Macadam pavement with a thickness of around 10 cm has been constructed on that hard base. (Since the subgrade is so hard, the so-called base course or subbase course is sometimes omitted.) However, the road is muddy and mired during the half-year rainy season. Ordinary traffic becomes impossible, and the repairs of damaged potholes or pits in the roads must be repeated every year. Another big issue is the difficulty of securing aggregate for the execution of road construction. Good quality materials are hauled by ships from the Mandalay area (around a few hundred km length). This transportation cost is expensive. The savings of the construction cost is one of the important reasons the PW had an insufficient budget.

The Ayeyarwady River Delta is the area affected by monsoon season. In addition, the Ayeyarwady area has been affected by terrible disasters such as the huge cyclone "Nargis" in 2008. More than 138,000 people died and the total fiscal loss reached 13 trillion Kyat. Inadequate road conditions caused a delay for relief operations and recovery work. Considering future countermeasures, the GOM has been implementing a 5 years road development plan since 2009 to construct 11 new roads[1] and more than 50 long bridges over the many branches of the Ayeyarwady River for emergency roads in a disaster.

The Japanese Government has been assisting the GOM on recovery projects with other international assistant agencies, and this Technical Cooperation Project is executed based on an agreement with the JICA[2] as one of its international cooperation projects.

[1] 888 km in total length as shown in Table 5.2 in Annex 5 of this Report

[2] Minutes of Meeting (MM) signed in Feb. 2012 and Record of Discussion signed on Jul. 2012. Project duration is 3 years from Jul. 2012

1.2 Objectives of the Project

The Purpose of this Project and Outputs are composed of two categories as shown in Table 1.1. Pilot Projects were executed as shown in Table 1.2 in order to achieve Output 2. (Hereinafter the first one is called as PP-1 and second one is called as PP-2.)

Table 1.1 Project purpose and Outputs target.0.0

	Target Purpose	Indicators in PDM (Ver. 1.0)	New indicators in Ver. 2.0
Overall Goal	Roads in the delta areas of Ayeyarwady Region are improved.	The length (km) of road construction under the control of the PW is increased in the delta areas.	Quantitative target：The road improved by the stabilization technique is more than 10 km.
		Reduced driving hour or traveling time.	Qualitative target：Driving hour or travelling time is reduced 10% comparing before execution of project.
	reason of revision of indicator：	Project overall goal is assessed 3 years after the completion of Project. A clear indicator is desirable. However, the current indicators will not show the influence results of the project clearly.	
Project Purpose	The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.	1. Road length constructed by the technology introduced from Pilot project	Quantitative target： By the end of the project, road length constructed by the technology introduced from the Pilot Project is extended longer than 2.6 km.
		2. Improved road conditions in delta area	Qualitative target：The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff.
	reason of revision of indicator：	There is no quantitative indicator in Ver. 1.0. It is better to show the improvement degree of road engineer's capacity enhancement.	
Output1	Road technology standards and manuals for designing and construction works are improved.	1-1. The number of the road technology standards and manuals developed by the PW is increased.	Quantitative target：New soft soil treatment manual is discussed and accepted by the PW.
			Qualitative target：More than 10 engineers are executing the work by using the manual.
	reason of revision of indicator：	The expression by acceptance is more appropriate than preparation of standards or manuals.	
Output2	The practical skills and knowledge of the road technical staff are enhanced.	2-1. Number of trained engineers (Seminar WS OJT).	Quantitative target：Total number of trained staff of P.W is more than 300 numbers.
			Qualitative target：50% of participants evaluate training/seminars favorably.
	reason of revision of indicator：	It is more appropriate to show the final target number of the project. The number of participants to Seminar・Workshop・OJT during the project is shown in right table.	

	Participants
Seminar	68
Workshop	171
OJT	56
Training in Japan	23

Table 1.2 Outline of the Pilot Project

	Period	Purpose	Place
PP-1	End of 2013 ～Apr 2014	Enhancement of road development ability focused on stabilization methods of subgrade and base course	At Road No.7 among the 11 new road in Ayeyarwady Delta area
PP-2	End of 2014 ～Apr 2015	On reflecting the results of PP-1, enhancement of road development ability focused on stabilization was conducted by changing the site and methods	At the Road No.10 （connecting to Road No.1 through Kyew Chan Ye Kyaw bridge）
		Enhancement of road development ability focused on stability and settlement of high embankment at the approach road to bridge through their behavior observation survey and analysis.	Approach road to Kyew Chan Ye Kyaw Bridge on Road No.10

1.4 Organization for the implementation

a) The JICA Expert Team is composed of a Long Term Expert Team and a Short Term Expert Team, as shown in Table 1.3.

Table 1.3 JICA Expert Team Member List

Specialty	Name	Mobilization	Demobilization	Remarks
Chief Adviser	Fujimoto	2013/02	2013/07	Chief Adviser was obliged to go back to Japan in the middle of 2013 due to sickness
Road Technical Standard	Miyake	2013/07	2015/06	
Project Coordinator	Ishida	2013/04	2015/06	

Short Term Expert Team

Assignment	Name	PP-1	PP-2	Remarks
Chief・Road Planning・Appraisal	Kaneda	O	O	3.5 MM increased in Aug 2014
Sub-Chief・Road Design Construction Planning	Kobayashi	O	O	5.0 MM increased in Aug 2014
Supervision	Fujikuma	O	-	
New staff	Akmar	O	O	3.5 MM increased in Aug 2014
Survey/Soft Ground Countermeasure	Yoneyama	O	-	7.0 MM decreased in Aug 2014
Ditto New staff	Nishijima	-	O	Member changed & 5.0 MM increased in Aug 2014
Quality Control	Miyamoto	O	O	
Mechanical Management	Kohsaka	O	-	
Preparation of Soft Ground Treatment Manual	Yokoo Suzuki	-	O	6.0 MM increased in Aug 2014 2.4 MM increased in Aug 2014
Coordinator・Training in Japan	Suzuki	O	O	

b) Counterpart team

Counterpart organization is the PW (Public Works) under the MOC.

Counterpart members are dispatched for each of PP-1 and PP-2 as shown in Table 1.4.

In addition, different counterpart members were assigned to 3 kinds category’s activities for PP-2.

Table 1.4 PW Counterparts

	Name	**Title** MD: Managing Director DMD: Deputy MD CE: Chief Engineer DCE: Deputy CE SE: Superintending Engineer DSE: Deputy SE EE: Executive engineer AE: Assistant Engineer JE: Junior Engineer TE: Township Engineer	**Function** PM: Project Management IP: Implementation Program QC: Quality Control QS: Quantity Survey TS: Topo Survey SI: Soil Investigation CS: Construction Supervision	PP -1	PP-2		
				Pilot Project of Stabilization		High embankment Observation & Analysis	Committee for Soft soil treatment manual
1	Mr. Kyaw Linn	Managing Director	Chairman of JCC	O	O	O	O
2	Mr. Win Tint	D M D (Work), PW					O
3	Mr. Khin Maung Kyaw	C E (Road), PW					O
4	Mr. Kyaw Shein	D C E, Planning	Project Director	O			
5	Mr. Aung Myint Oo	D C E, Planning	Project Director		O	O	O
6	Mr. Aung Myint	In-house Consultant, RRL	Adviser	O		O	O
7	Ms. Hla Hla Thwe	S E, Road	Project Manager	O		O	O
8	Mr. Myint Kyi	S E, Ayeyarwady Division					O
9	Ms. Mya Mya Win	D S E, RRL	Design	O	O	O	O
10	Mr. Aung Myo Oo	D S E, Airfield 2	IP & PM	O		O	O
11	Mr. Khin Zaw	D S E, Special Unit (4)					O
12	Mr. Zaw Naing	D S E, Special Unit (2)					O
13	Mr. Kyi Twin Oo	D S E, Special Unit (15)					O
14	Mr. Thet Zaw Win	E E, Phyapon District	IP & PM		O		O
15	Ms. Htar Zin Thin Zaw	E E, RRL/Yangon	Material QC		O	O	O
16	Ms. Zin Zin Htike	E E, ADB project, PW	QS		O		
17	Mr. Nyi Nyi Zaw	E E,	Ditto		O		
18	Ms. Aye Aye Thwin	E E, Road Design /NPT-HQ	TS & drawing		O	O	
19	Mr. Kyaw Tun Lin	E E, Maubin District					O
20	Mr. Thet Zaw Win	E E, Pyapon District					O
21	Mr. Than Htoo Aung	E E, Latputta District					O
22	Mr. Toe Toe	E E, Myaung Mya District					O
23	Mr. Yan Naing Zaw	E E, Hintharda District					O
24	Mr. Tint Lwin	E E, Pathein District					O
25	Mr. Nay Lin Tun	AE (RRL)					O
26	Mr. Tint Lwin Oo	AE (RRL)					O
27	Mr. Nyi Nyi Kyaw	A E, RRL/Yangon	SI (material)	O	O	O	O
28	Mr. Aung Kyi	A E Airfield -2	Ditto			O	
29	Ms. Ei Ei Mon	A E, Road	Documentation	O			
30	Mr. Win Naing	A E, PW/Bogalay Township	Ditto		O		
31	Mr. Than Naing	A E, Airfield -2	Ditto	O		O	
32	Mr. Nyi Nyi Win	A E, PW/Mechanical Dept	Soil plant		O	O	
33	Mr. Tun Min Oo	A E, Design /NPT-HQ	Dimension control		O		
34	Ms. Su Mon Kyaw	T E, Pyapon	CS	O			
35	Ms. Khin Aye Myint	J E (1), Airfield -2	QS			O	
36	Mr. Hlaing Min Zaw	J E (2), PW/Mechanical Dept.	Machinery work		O	O	
37	Mr. Tun Tun Naing	J E (2) Phyapon District	Work progress control		O		
38	Mr. Win Khaing	J E (2), Airfield -2	Work progress control & Monitoring Work			O	
39	Mr. Tun Tun Naing	J E (2) PW/Phyapon District	Ditto		O		
40	Mr. Tin Ko		CS			O	
41	Mr. Aung So Oo		Observation survey			O	
42	Mr. Myo Min Aung		Computer analyze			O	
43		SRL					O
44		Yangon Technological University					O

1.5 Other Inputs by Public Works

Table 1.5 shows input items for the TCP by PW based on the agreement with the JICA.

Table 1.5 Provision of Offices and Facilities

Items	Executed Status
Office Space	The PW provided 2 office spaces in its own buildings, the Ex-MOC building and the Central Training Center (CTC) in Yangon City.
Data / Information	The PW provides data and information necessary for the TCP.
A part of expenses for Seminar and WS execution.	Preparation of the meeting place, and tea/snacks for attendees
Resources for Implementation of PP	The PW arranged resources required for implementation of the stabilization work of PP-1 and PP-2, such as a budget, labor, material and equipment. (The budget for the high-embankment at Kyew Chan Kyaw Bridge is prepared by the Ayeyarwady regional government.)

Chapter 2 Project Activities

Outline of Activities

Table 2.1 shows the main events executed during the TCP.

Table 2.1 Major Activities in Project

Feb 11, 2013	Kickoff Meeting, Project was approved officially after explanation of outline of Project	
May 27, 2013	The first Workshop (Review of PDM by PCM methods)	Almost works in 2013were preparatory work
June 13-14, 2013	The first Seminar	
Sep 5, 2013	The first JCC (Approval of Work Plan, Approval about Review of Geometric Design Standards and Translation of Japanese Soft Soil ground Treatment manual)	
	The first training in Japan	
Dec 14, 2013	The 2nd Workshop (Discussion about PP-1 work plan, Explanation of High embankment observation Plan)	
Feb 2014-	Preparation of PP-1 stabilization work Intensive training of operation work of the stabilizer (19/Feb) in PP-1 work site	Actual works for PP-1 stabilization work, High embankment behavior observation work, Soft ground Treatment manual
Mar 2014-	Starting of actual stabilization work[3] Intensive training of soil stabilization work (13 – 14/Mar) in Pyapon and PP-1 work site Starting of Kyew Chan Ye Kaw approach road embankment work, and starting of behavior observation work[4] after installing equipment (This earthwork suspended since middle of May due to entering rainy season.)	
May 28, 2014	Executed presentation meeting at NPT about Stabilization and High embankment behavior observation work	
June 2014	Starting WS about initial analysis related to High embankment behavior observation work	
July 2014	Starting translation & Editing of Soft ground Treatment manual	
Aug 2014	Reporting of the results of Mid-Term Evaluation of Project at NPT	
Sep 2014	Changing of PD (project Director) to Mr. Aung Mint Oo	
Oct 2014	Preparation of PP-2 work[5]	PP-2 stabilization work, High embankment behavior observation work, Soft ground Treatment manual
Nov 2014	Decision of policy of PP-2 and preparation of site work	
Dec 2014	Restarting of work of high Embankment (PP-2)	
Feb 2015	Stabilization work on Road No. 10 in Bogale was commenced on 15/Feb. Workshop was held at Bogaley for the explanation about high embankment observation methods and soil stabilization work by using soil mixing plant Team submitted the implementation program of PP-2 (soil stabilization work) to the MOC.	
Apr 2015	Soil mixing plant was set at site (Apr 4) and WS for Stabilization by using Soil Mixing Plant on Apr 29	
May 2015	Stabilization by using Soil Mixing Plant	
Jun 16 2015	Seminar for the summarization of Technical Cooperation Project	

[3] Pilot Project stabilization work (PP-1) started in Feb 2014. The details are described in the Pilot Project Report (PP-1) submitted in Aug 2014, and this progress report describes basic matters only.

[4] Countermeasure work for high-embankment work was one of the activities of this TCP. However, the PW side informed to TCP that countermeasure work could not be executed at approach road to Kyew Chan Ye Kyaw Bridge due to the shortage of construction term and budget. TCP team has changed the policy to carry out behavior observation work only without countermeasure work.

[5] Based on the discussion with new PD, the length and the site for the stabilization work at PP-2 is decided 4-furlong (800m) between 0/1 and 2/0 of Road Number 10 considering the convenience of access of materials and staff. However, the length was reduced finally to 600m due to budgetary reasons.

This Report will explain the activities shown in Table 2.2, which is described in Annex 1 “PDM”. Each activity progress result is explained on the next pages according to the New Workflow Chart (Annex 2-1). [6]

Table2.2 Activity Items of Short Term Experts

Activity	
0:	Conduct the baseline survey
1-5: Additional Activities By the revision on Aug 2014	Road technology standards and manuals for designing and construction works are prepared and improved based on the results of the Pilot Project.
	A part of this activity was revised as follows:
	[Geometric Design Standard] The PW and the TCP team made a mutual consensus for the implementation of the revision work about the Geometric Design Standard during the 1st JCC, in September 2013. However, after the 1st JCC, the PW commenced the revision work of their Geometric Design Standard under the cooperation with KOICA. Therefore, The TCP team proposed to avoid unnecessary similar work, and the PW accepted the following: * Site investigation for the target roads will be done on a vehicle basis (expressway and national highway) * The investigation focus on traffic safety for the geometric features and traffic safety facilities. * The team submitted Technical Notes on National Road & Expressway (Geometric Structure & Traffic Safety Facility) to the MOC as the work output on June 10, 2015.
	[Soft Ground Treatment manual] The Road Earth Work Soft ground Treatment Manual[7] was translated into English, and it was revised for Myanmar conditions. It proposed a specific ground and soil survey through the execution of the Pilot Project. The long-term experts and the assistance committee in Japan has advised on the preparation of a draft manual.
2-1:	Select the location of the Pilot Project
2-2:	Project Site Reconnaissance
2-3:	Planning of Selected the Pilot Project
2-4:	Assist the implementation of the Pilot Project
2-5:	OJT for technical transfer for Road and Mechanical Engineer
2-6:	Assessment of the Pilot Project
2-7:	Implementation of Workshop & Seminar to share the knowledge acquired through the Pilot Projects

[6] New Workflow Chart is prepared based on the review of Original Workflow Chart to execute the site work more efficiently.

[7] Issued in 2012 by the Japan Road Association

Activity No. 0 **Conduct the baseline Survey**

No	Sub-activity	Executed Item	Remarks
0.1	Establishing Implementation Plan	The Work Implementation Plan was submitted to the JICA in January 2013.	
0.2	Site Survey	Site reconnaissance was conducted prior to the start of the project to ensure the smooth progress of the project.	
	Baseline Survey	The TCP team implemented a base line survey to collect the data for confirmation of the status of the pre-project implementation stage. Baseline data are listed in Annex 5. [8]	The PW presented 12 existing road technical standards and manuals. [9]
0.3	Preparing the Work Plan and Discussion with the PW	Revised Work Plan based on the suggestions by the Japanese assistance committee was mutually agreed in the JCC on September 4, 2013. Issues on embankment work, such as settlement, sliding, and erosion, were recognized as the serious items. Solutions for these issues are deemed essential for the development of road technology in Myanmar. Behavior observation work is added as one of the activities in the Work Plan.	

Activity No.1-5 **Road technology standards and manuals for designing and construction works are prepared and improved based on the results of the Pilot Project**

No	Sub-activity	Executed Item	Remarks
1.5.1	Verification of existing standards and extraction of issues	<u>Road Geometric Design Standard</u> The team reviewed the existing standard to identify issues. As a result of the work, the team observed that a significant amount of primarily necessary description was missing.	Through review work, the team considered that it is necessary to describe more details. However, the team altered contents of the work outputs to Technical Note on National Highway & Expressway (Geometric Structure & Traffic Safety Facility) (TN) instead of revision of the standard due to the reason stated in Table 2.2.
		<u>Soft Ground Treatment Manual</u> The necessity of soft ground treatment manuals is confirmed to be a high priority in Myanmar at the JCC meeting in September 2013.	
1.5.2	Selection of target section/ Confirmation of important places	<u>Road Geometric Design Standard</u> (i) Yangon-Mandalay Expressway (Whole section) (ii) National Highway No.1 (NPT -YGN) (iii) National Highway No.4 (Heho-Taunggyi-Loilem-Takaw) in Shan State.	The team concentrated on mitigating the risk of traffic accidents on the road infrastructure in the aspect of road geometric structure and traffic safety facility.
		<u>Soft Ground Treatment Manual</u> It was decided that the main survey target area for a soft grounds survey is Ayeyarwady and the important area for execution of PP-2 is Pyapon and Bogaley.	
1.5.3	Site Investigation	<u>Road Geometric Design Standard</u> The team implemented a total of 8 site investigations on the above stated routes.	The site investigation was completed in December 2014

[8] Two of the 12 exiting road standard and manuals are in the Myanmar language between. RRL translated "Road Maintenance Manual" into English, but "Surface treatment Manual" was not.

[9] 11 English versions were handed over to the TCP team.

		Soft Ground Treatment Manual The TCP members surveyed the dry season conditions in Feb and March of 2014 and rainy season conditions in May and June.	
1.5.4	Preparation of Draft revision and submission	Road Geometric Design Standard The team compiled the output of the following works in the TN for submission. - Site investigation to identify issues on the national highway and the expressway - Analysis of the identified issue - Developing a proposal for solutions	The team submitted TN to the MOC on June 10, 2015. Media and quantity of the submission are as follows. - 30 hardcopy sets -1 CD-R containing the softcopy
		Soft Ground Treatment Manual (Draft) Translation of the Japanese soft ground treatment was conducted in Aug 2014. Many figures from the original were replaced to meet Myanmar conditions, and a 400 pages draft for Myanmar was prepared. Based on the discussion with PD in Nov 2014, 50 copies were printed and delivered to the PW side through the RRL. 23 members of the editing committee were nominated in Dec 2014 including additional members from SRL and YTU (Yangon Technology University).	Based on the committee discussion, a final draft was prepared and submitted to the PW side in Jun 2015. Simultaneously the main points were explained at the Seminar.

Activity No. 2.1 Selection of the Pilot Project Location

No	Sub-activity	Executed Item	Remarks
2.1.1	Confirmation of Current Development Plan of the PW	The PW presented the information about the PW project development plan to the JICA Expert Team between February and March 2013. The TCP team has studied the PW plan and the following facts were found: 1) The implementation plan will be discussed at the budgetary meeting, which will be held every six months. 2) There is no plan considering a multi-year timespan. 3) The implementation plan will be revised frequently based on the political decisions.	The presented Development Plan is for 2 years only, which is not enough to evaluate the achievement rate of the Overall Goal.
2.1.2	Site reconnaissance	The site reconnaissance survey of Ayeyarwady Delta Area was executed by subcontract with local consultants. It includes hearing results about the flood level from local people[10]. The location map of site reconnaissance work is shown in Figure 2.1. The site reconnaissance report was prepared by local consultants.	
2.1.3	Soil Sampling	In order to confirm the geotechnical feature of the Ayeyarwady River Delta area, the soil samples were collected on road No. 2, No. 3, No. 4, No. 5, No. 6, No. 7 and No. 10 in Figure 2.1.	
	PP-1	A material test for the stabilization work was implemented as described in Appendix-B of the completion report of PP-1.	
	PP-2	The PW and the TCP team decided Road No. 10. This section is adjacent with the approach road section of Kyaw Chan Ye Kyaw Bridge.	

[10] Annex 7 Table 7-2 in Progress Report 1 shows the hearing results about the flood level from the local people.

		Local soil and river sand gathered from the riverbed near the site were selected for stabilized subbase mixing soil. Material for the stabilized road-base were sand and river shingles gathered in Ayeyarwady in consideration of the cost reduction.	
		Bearing strength of the existing embankment on the road to KCYK bridge was confirmed by SPT test for the study about stability and consolidation settlement. The WS was conducted on how to determine the soil stratum and necessary basic numeric data for analysis work.	Composition of sub-surface ground in the project section was determined by analyzing existing boring data.

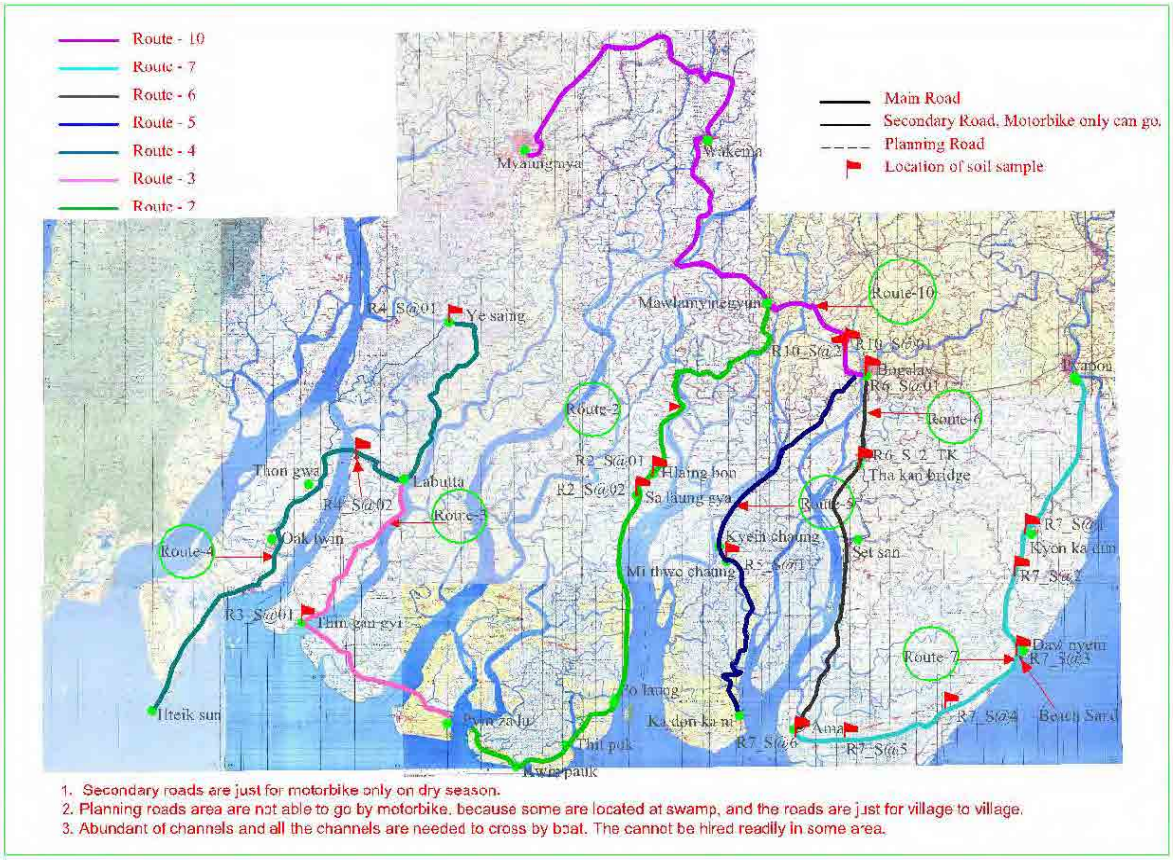


Figure 2.1. Location Map of Site Reconnaissance Work in Ayeyarwady Region

No	Sub-activity	Executed Item	Remarks
2.1.4	Soil property Test at the RRL	The soil test of soil sample from the site was done at the RRL. Detailed test results are shown in the Test Results Report of Soil Samples and Mixing Design.	
	PP-1	The CBR Test of Subgrade of Route No. 7 was conducted. Test results showed CBR of Subgrade is around 2%.	
	PP-2	CBR values of the field soils are as follows based on the laboratory test. Existing subgrade: CBR=2% Soil in borrow pit: CBR=3% Soil in borrow pit + sand (II): CBR=6% Soil in borrow pit + sand (III): CBR=4%	The material mixing test by adding cement and lime is reported in Appendix B.of PP-2 Road Stabilization Completion Report

Laboratory Test (weight measuring)

Curing of Test Pieces for CBR test

No	Sub-activity	Executed Item
2.1.5	Decision of Site for the Pilot Project PP-1	A section of Road No. 7 in the Pyapon district was decided as the site location for PP-1 after the comparison of candidate locations[11]. The section nearest to the Pyapon side (1.6 km) was selected as the first Pilot Project site of road stabilization taking the development plan into consideration[12].
	Decision of Site for stabilization work PP-2	The implementation location was decided by considering experience and knowledge obtained through PP-1. Principal concerned points are listed below. * Short distance between the accommodation and site * Adjacent to the urban area for convenience of transporting material and equipment * Fresh water is available * Not a malaria contaminated area The section of the stabilization work is BP: 1 mile, 4 furlongs, EP: 2 miles. (Total length = 800 m, but later this length is reduced to 600 m.)
	Selection of High embankment section PP-2	Countermeasure works for the high embankment were decided to complete at the Kyew Chan Ye Kyaw Bridge approach road of Road No. 10. It is forecasted that the stability factor is around 1.3 and total settlement is around 60 cm. Because of the small PW budget, 2 kinds of countermeasure works were decided: 1) Mixing 30% sand into fill materials to increase the internal friction angle and 2) Setting a slightly wider berm than normal. Behavior observation work was conducted in Mar 2014

Site for Pilot PP-1 (Myo Kone of Pyapon District)

Mixing and Stock Yard of Materials

[11] Results of the comparison of the 3 sites about the beneficial effect are shown in Annex 7 Table 7-3 of Project Progress Report 1.

[12] It is shown in Annex 7 Table 7-4 of Project Progress Report 1.

PP-2 implementation section (before works)

Temporary yard for PP-2 beside Bogaley Bridge

Kyew Chan Ye Kyaw Bridge (Bogaley side)

Water condition in Dec 2014 at Borrow pit

Ditto (after embankment)

Ditto on Apr 29 2015 (after embankment)

Activity No. 2.2 Pilot Project Site Reconnaissance

No	Sub-activity	Executed Item	
2.2.1	Site Reconnaissance for the selected place PP-1	The following items were discussed with the site Chief Engineer: ・Repairing methods for the slope erosion near the starting point of the site ・Securing the motor pool yard and mixing yard for stabilization ・Any issues related to local residents ・Any influence on the hospital near the end point ・Transportation method for 24 tons of stabilizer considering the 8 ton weight limit of the small bridges on the way to the site	The PW decided not to carry out slope protection. Drainage structure in the shoulder was changed from aggregate layer (original design) to installation of PVC pipe

	PP-2	Site investigation, material sampling, and the topographic survey for the stabilization work were completed in 2014.
2.2.2	Soil compaction test at Laboratory PP-1	Table 2.3 shows the summary of Mixing components test results.
	PP-2	The material mixing test for the stabilization work was completed in Apr 2015.

Table 2.3 Mixing Components test results

Object	Studied item	Target	Additives and its volume
PP-1 Slaked lime for Sub-grade stabilization		Modified CBR Target is 20%	Slaked lime 3.6% by outer ratio
PP-1 Cement for Base Course Stabilization		For Sub-base	Cement 6.3% by outer ratio
		For Road-base	Cement 6.8% by outer ratio
Material test for subgrade construction work in PP-2	Compaction test, CBR test (4day soaked and 7day soaked)	Target CBR = 5%	Soil: Sand = 50% : 50%
Material test for stabilized subbase course in PP-2	Trial mix test of soil and sand by considering grain size distribution Determination of the additive in accordance with soil property (PI)	UCS = 1.125 MPa for subbase course	Soil: Sand = 50% : 50% Cement 7.0% by outer ratio
	Utilizing river shingle for cost reduction approach	UCS =3.0MPa for base course	Sand:Rivershingle=70%:30% Cement 4.6% by outer ratio

No	Sub-activity	Executed Item
2.2.3	Selection of necessary equipment PP-1	Road improvement by stabilization in PP-1 was executed by two methods: 1) Mixing on-site 2) Carrying mixed materials from the off-site mixing yard The necessary equipment including PP-2 was studied as shown in Table 2.4 and 2.5
	PP-2	The team applied the soil mixing plant for the production of cement-stabilized soil. The team transported and installed the stabilized soil on the road section as used for the subbase course and base course. Design work for the foundation concrete (RC) of the plant was completed in Jan 2015, and constructed in March 2015.

The original procurement plan of necessary equipment in this TCP was revised to the equipment shown in Table 2.4 due to the changing of surrounding conditions as shown in Table 2.5.

Table 2.4 History of selection of equipment necessary for the TCP

	Equipment	Conclusion	Reason
Procurement from Japan	Self-traveling stabilizer	Cancelled	Similarly, functioning equipment was decided to procure through a Non-project Grant, and the TCP changed the policy to utilize it in PP-1.
	Soil Plant	New request	Macadam pavement is popular in the delta area, in which large crushed stone (around 10cm) is used. The stabilizing equipment has a capacity limit for mixing large-size stone. Thus, the decision was made to remove large stones in the existing macadam pavement before using the stabilizer. Before starting PP2, a countermeasure for cost savings was recommended to place the base course on the existing pavement using new mixed material from a soil mixing plant. The procurement of a soil plant in PP-2 was accepted.

	Equipment	Conclusion	Reason
Hand carry equipment	Bucket type mixer	Cancelled	This was proposed as alternative equipment for the possibility of delay of the procurement stabilizer. However, it was cancelled for the following reasons: 1) It costs 20 million kyat to attach a bucket type mixer to the PW's backhoe. 2) The guarantee on the trouble will not be given from the maker from that modification. 3) Utilization of a similar stabilizer becomes possible through the Non-project Grant.
	RI Density gauge	Cancelled	A similar electric density gauge was supplied by the Non-project Grant scheme.
	Site CBR Tester	Cancelled	The site CBR could be converted from the measured data by cone penetration tester. It is possible to measure the trafficability of PP-1 by plate type loading tester (K-value), which was supplied by the Non-project Grant scheme.
	Total station	New request	It is essential to measure the works of PP-1 and to check the embankment behavior observation. However, all the site offices near Pyapon have no such equipment. Therefore, the procurement by TCP was decided.
	Software	Ditto	Slope stability analysis was conducted through the Workshop using free software. The RRL requested the procurement of versatility analysis software applicable to multi-soft ground layers.

Table 2.5 Necessary equipment List

Category	Name	PP-1	PP-2	Purpose of use	Supply methods
(i) Road Stabilization & site measuring equipment	Road stabilizer (Photo1)	1		Stabilization work on-site	NPG
	Soil mixing plant (Photo2)		1	Production of chemically stabilized soil to be applied for the pavement work	○ by TCP
	Bulldozer	2	2	Earthwork, grading	NPG
	Excavator	1	2	Earthwork, loading	NPG
	Wheel loader		1	Loading	NPG
	Grader	1	1	Scarifying macadam layer, grading	NPG
	Tire roller	1	1	Compaction	NPG
	Steel wheel roller	1	1	Compaction	NPG
	Water distributor	1	1	Spraying water	NPG
	Dump truck	3	3	Transportation of soil & material	NPG
	Bitumen distributor	1	1	Pavement (wearing course)	NPG
	Cone penetrometer	1	1	Field CBR test	NPG
	Electric Density Gauge	1		Field density test	NPG
(ii) High Embankment behavior observation equipment	Boring machine		1	Drilling & sampling	○ by TCP
	Total Station (Photo3)		1	Measurement of ground behavior	○ by TCP
	Data Logger (Photo4)		1	Data acquisition/Recording	○ by TCP
	Settlement board (Photo5)		4	Measurement of settlement	○ by TCP
	Pore water pressure gauge with 50 m cable (Photo6)		3	Measurement of Pore Pressure	○ by TCP
	Inclination gauge with 50 m cable (Photo7)		1	Measurement of inclination	○ by TCP
	Water level gauge with 50 m cable (Photo8)		1	Underground water level	○ by TCP
	Plastic Survey stack 1.2m		16 box	Survey work	○ by TCP
	Slope Stability Analysis application		1	Analysis of slope stability	○ by TCP

Remarks : "○ by TCP" means to be supplied by this Technical Cooperation Project, "NPG" means be supplied by the Non-project Grant, "no mark" means to be supplied by PW.

Photo1: Road stabilizer

Photo2: Soil mixing plant

Photo3: Total Station

Photo4: Data Logger

Photo5: Settlement board

Photo6: Pore water pressure gauge

Photo7: Inclination gauge

Photo8: Water level gauge

No	Sub-activity	Executed Item	Remarks
2.2.4	Auger Boring Survey PP-1	Soil boring survey was conducted up to a depth of 30 meters by sub-contracting to study the settlement on the existing embankment.[13] Figures 2.2.a and 2.2.b show the soil-boring log with N-value (unit of depth is by meters). The thickness of the soft ground stratum is larger than forecasted. The team submited a soft copy of the final report to the JICA.	
	PP-2	Two boring surveys were conducted in Mar 2014 at a high embankment section near Kyew Chan Ye Kyaw bridge. A workshop was conducted for the analysis of the data.	The TCP considered that variation of the stratum was not significant according to the existing boring data. The TCP also assumed the settlement depth due to consolidation was not very deep in a section with such a low embankment. Therefore, the TCP cancelled additional boring survey work.

[13] Details are shown in Study Report prepared by the sub-Contractor.

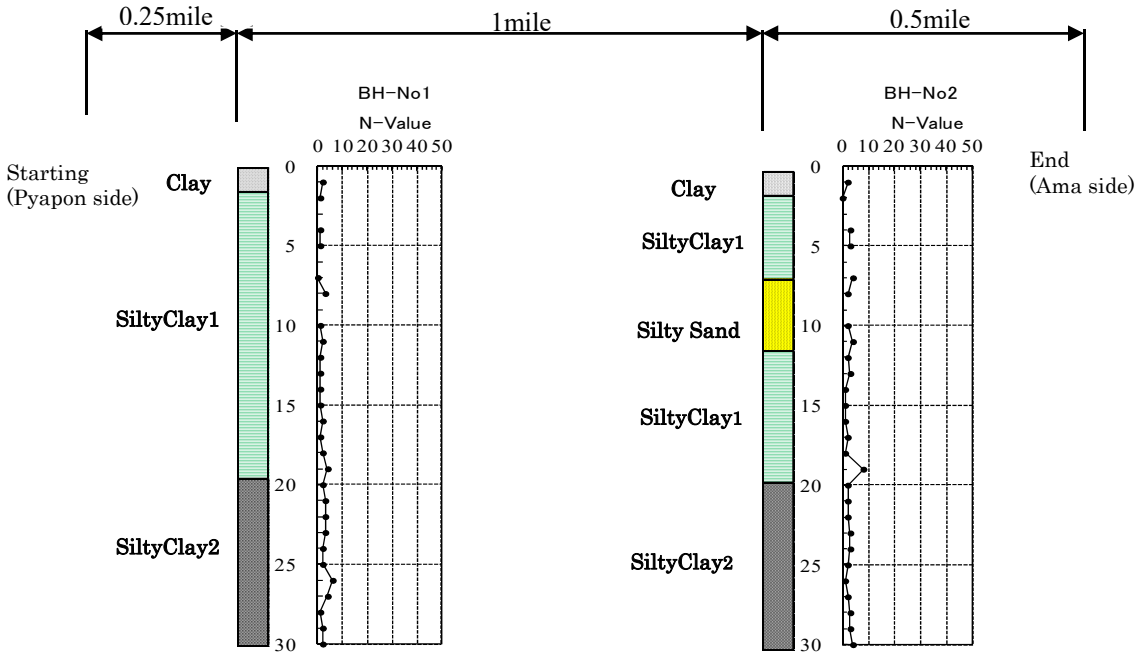


Figure 2.2.a Soil histogram with N-value at the Pilot Project 1 site

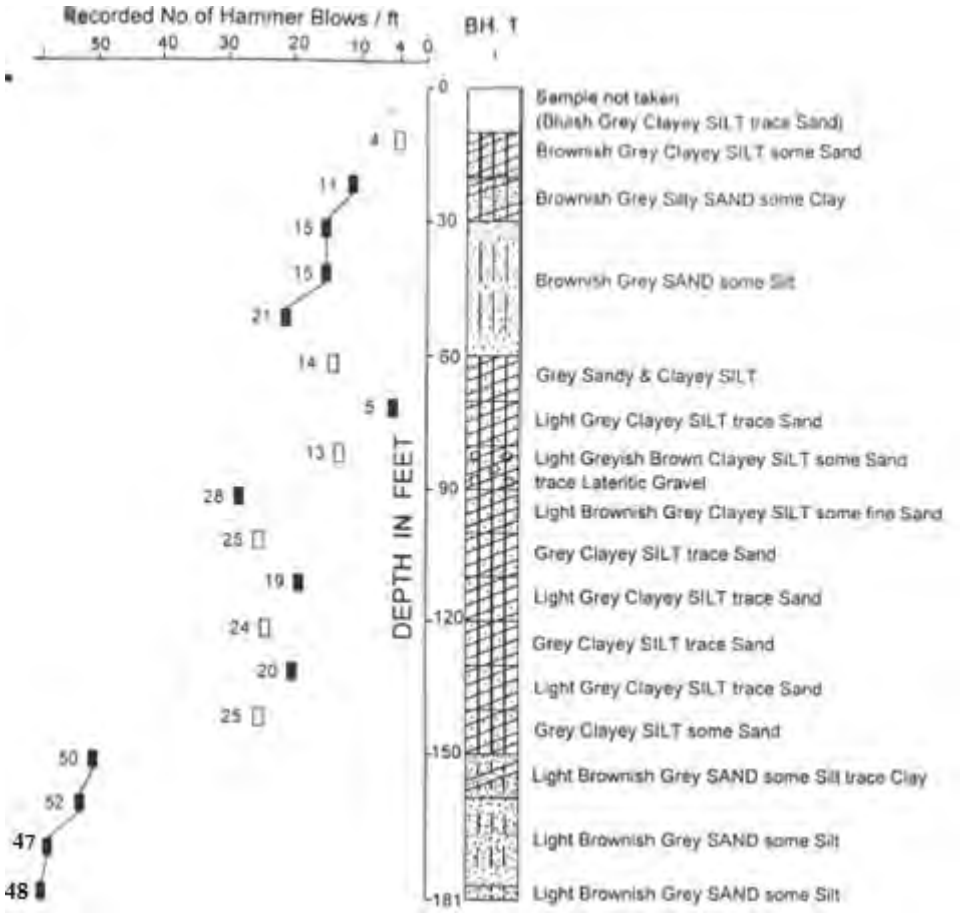


Figure 2.2.b Soil histogram of High embankment section at the Pilot Project 2 site

No	Sub-activity	Executed Item	Remarks
2.2.5	Monitoring of Embankment Behavior[14] PP-1	More than 50 new long bridges were constructed in the Delta-area based on the 5 years roads development plan. Almost all of the construction was rushed to finalize in 2014. Thus, the implementation of settlement countermeasure work was practically difficult due to the restriction of time and budget. Therefore, behavior observation work and the analysis of the embankment were recommended under the advice of Prof. Omine of Nagasaki University. Countermeasure work was decided on, in case the analysis results show any issues on safety.	The TCP proposed test embankment beside the existing road embankment in order to confirm the initial ground behavior after the construction. Proposed dimension of the embankment was 3-4m height and 100-200sq.m areas. However, the PW rejected the proposal due to following reasons. * Several years have been passed since the construction. Currently, the consolidation settlement seems stable because due to the time. * Embankment was constructed not by complying with the appropriate method due to emergency circumstance after the Cyclone Nargis. Therefore, reproduction of the behavior will be very difficult. Therefore, the PW and the TCP agreed to implement the monitoring work of ground behavior on the existing embankment immediately after completion of PP-1. However, accessibility to the site for the work became impossible during the rainy season by the severe deterioration of the access road to the site. Therefore, the work was not implemented.
	PP-2	Behavior observation of the high-embankment section was commenced in Mar 2014 at the start of the fill work. It was interrupted due to rainy season at a height of 0.9 m (3 layers), and restarted in the middle of Dec 2014. All of the embankment work was completed by the end of April 2015. The maximum settlement was 0.6 m in June 2015	Behavior observation (settlement volume, pore pressure, underground water level, underground earth movement, ground surface movement) is executed on a daily basis along the progress of the embankment work. As of June 2015, a 0.6 m settlement and 30 mm lateral movement in underground have occurred. Pore-pressure data are almost the same as the underground water level. However, the data of the ground surface movement varied and it is difficult to explain their trend by some theory. Their tendency shows that the movement to the inner side was detected in early stage and changed to the outside movement of 7-8 cm. The data for these observation results are shown in “Pilot Project Report Part 2-2”

[14] Followings are object for behavior observation survey

	Object	Issues detected
PP-1	Low embankment：a common road with around a 2 m-height embankment	Minor defects on the road surface and erosion on the slope were partially observed. However, large- scaled deformation and settlement on the embankment were not observed.
PP-2	Low embankment：common road with around a 2 m height embankment	No issue is occurred during the pre-construction stage.
	High embankment：approach road to bridge is around 10 m height	Big settlement of the embankment・Slope sliding

Activity No. 2.3 Assistance for Formulation of the Selected Pilot Project

No	Sub-activity	Executed Item	
2.3.1	Assist Preliminary Design of the Pilot Project PP-1	A longitudinal and cross-sectional topographic survey was executed, which is usually not implemented in the PW projects. The TCP team has assisted with the preparation of CAD drawings by using the survey results The PW implemented pavement design work by applying its own manual based on ORN31. The JICA Expert introduced another approaches such as the Japanese standard (TA method) and AASHTO (SN method). Finally, the RRL adopted their conventional method utilizing the following data: (i) Current traffic volume, (ii) Damage factor of heavy vehicles (iii) Traffic growth ratio (iv) Evaluation of subgrade strength indicated by CBR	
	PP-2	The MOC executed geometric survey work for the preparation of the drawings (i.e. plan, profile and cross section) to be applied for the design works. The MOC also implemented the pavement design work by applying the AASHTO method. Design output was compiled in the implementation program that was submitted to the MOC in February 2015. The implementation program PP-2 is submitted separately as a .reference report ”PP-2 Implementation Program”	The MOC and the Team attempted the thickness reduction by applying free software as called “GAME” which is based on a multi-layer analysis method. However, the result was not applied in the PP-2 because the MOC recognized that further examination and analysis would be required for a broad application of this approach.
2.3.2	Assist Mixing Component Test at Laboratory PP-1	Training for the tests was conducted mainly for assistant engineers about stabilizing the subgrade and subbase course (compaction testing and CBR testing were conducted according to BS standards) The results of the training are summarized in Table 2.6.	
	PP-2	The TCP supported the PW regarding its test implementation approach and analysis/ summarizing methods of the test results in the same way as PP- 1.	

Table 2.6 Summary of Technical Transfer of Mixing Test

Item	Contents of Initiatives
Understanding of test methods and purpose	・Discussion was implemented about the difference of the compaction method of BS and AASHTO taking into consideration routine test methods by the RRL.
Understanding of lime and cement stabilized courses	・Introduction of Japanese work methods ・Important points to consider in lime and cement stabilized course design a. Relationship between soil characteristics (PI) and stabilization materials b. Strength characteristics of stabilized materials ・Methods for using local materials for cost reduction
Mixing tests	・Preparation of a test plan and control of work progress based on schedule ・Control and guidance of test conditions ・Review of test results (discussion with senior engineers) at each stage
Organization of test results	・Organization of the test results using an Excel spreadsheet ・Comparison of test results using graphs and assessment of test results

(Continue to next page)

Quality control on-site	・Implementation of strength tests with varying degrees of compaction and plate loading tests for the field CBR test ・Examination of on-site test control methods ・Evaluation and improvement method of construction conditions based on field test results with the site engineer
Understanding design methods for stabilized subgrade	・Methods for evaluating average CBR of stabilized subgrades according to Japanese road paving design standards

Checking of Cone type penetration tester

Mixing of materials for stabilization work

Personnel guidance at site

Degree of confirmation test
(Sand replacement method)

Compaction test on mixing soil in situ

Field CBR test (Plate loading test)

No	Sub-activity	Executed Item	Remarks
2.3.3	Assist Construction Plan and Cost Estimate	PP-1 The PW has a cost estimation standards book, which includes the unit price of labor, materials and equipment. Each district office calculates its work cost by using the standard. They will be audited periodically. Soil stabilization work was newly introduced to Myanmar in PP-1. Therefore, the TCP recorded and summarized input quantities (labor, material and equipment) for implementation of the stabilization work. Such data will be applied in case that the PW develops "unit productivity data" of the stabilization work in the future. A summary of the input is shown in Annex C of PP-1 Completion Report Cost estimation samples are shown in Annex 6-2. PP-2 The team presented the work contents, including (i) work items, (ii) work quantities, and (iii) a tentative construction schedule to the MOC for the works of construction scheduling and cost estimates using their own approach.	The MOC and the team should have a common understanding regarding the detailed contents of PP-2 instead of the outline for the prompt action of the MOC.
	PP-1	The PP-1 construction time schedule was prepared and proposed to the PW side by showing first the critical pass work as well as other work schedules taking into consideration the work procedures, necessary equipment, and required time or days. Image of work sequences of in-situ subgrade stabilization work is illustrated in Figure 2.3.	
	PP-2	The plant was newly procured equipment in Myanmar. Therefore, the team prepared the work sequences with application of the plant as shown in Figure 2.4.	

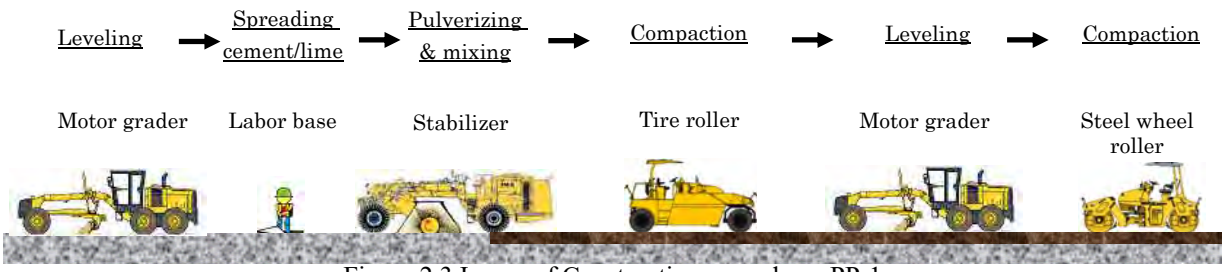


Figure 2.3 Image of Construction procedures PP-1

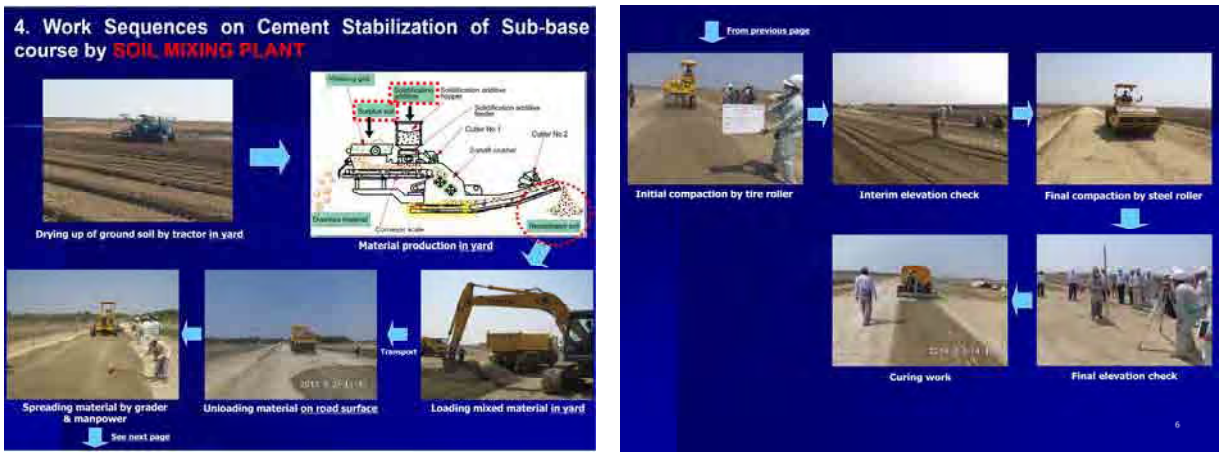


Figure 2.4 Image of Construction procedures PP-2

Cost analysis results are shown below with conventional aggregate layer methods. We can know that stabilization cost in PP-1 looks a little expensive, but normally it is a rather inexpensive method.

Table 2.7 Comparison of Unit Cost

	Conventional Road Base construction			Road Stabilization	
Subgrade	PW basic methods	ADB	Japan standard methods	PP1budget (modified)	Stabilization
		Soil & sand	Soil	Lime stabilization	Lime stabilization
Output area					180-250m2/day
Thickness (inches)		16	8	16	16
Total cost $			286	56035	
$/m3		18	14	27	17
$/m2		4.5	2.9	6.3	6.9

Subbase	PW basic methods	ADB	Japan standard	PP1 budget (stabilization)	Stabilization
	Laterite	Shingle / soil	Laterite/sand	Cement stabilization	
Output area					500-1400 m3/day
(Volume)	100sud				
Thickness (inches)	6”	8	8	8	8
Total cost $	9,048		574	60134	
$/m3	32	44	29	40	32
$/m2	4.8	9.0	5.7	8.0	6.5

Base course	PW basic methods	ADB	Japan standard	PP-1budget	Stabilization
	Aggregate	Crushed rock	Aggregate	Aggregate	
Output area					
(Volume)	100sud				
Thickness (inches)	6”	6	6	7	6”
Total cost $	14,653		1122	97323	
$/m3	52	102	75	80	64
$/m2	7.8	15.0	11.2	14.0	9.6

No	Sub-activity	Executed Item
2.3.4	Assist Quality Control Plan of Material & Finished Work	Discussion and training at the RRL laboratory was executed for quality control methods about materials. The outlines are shown in Table 2.8.

Table 2.8 Study of Quality Control

Item	Contents	Conditions
1. Quality evaluation of existing earth banking	(1) Existing embankment materials	・The RRL has experience with on-site density testing. However, the level of ability is variable according to staff expertise. ・Indoor training was done on the CBR test method corresponding to the degree of finished compaction on-site.
	(2) Embankment settlement characteristics	Ground strength testing and consolidation testing were conducted. WS for analyzing settlement calculation was done
2. Quality control; standards	(1) Quality control standards (general materials)	Confirm the RRL quality control standards. They stipulate the technical specifications, compaction level and on-site testing frequency of each paving material. Laboratory soil testing is implemented. Person in charge for Q/C on-site was decided.
	(2) Stabilized roadbed and course	1) Quality control of lime can be performed by the RRL engineers. 2) Although the RRL is using ORN 31, Japanese test methods were introduced for the comparison. 3) The testing method for easy chromium hexavalent is explained. Test samples have been simultaneously taken back to Japan to confirm its safety by conducting a dissolution test. 4) There are no manufacturing standards for lime.
3. Confirmation of Test apparatus	(1) Site measuring devices	1) There is a density tester based on the sand substitution method. 2) Two types of site testing for strength measurement were used, one was dynamic cone penetration test, and the other was a plate-loading test to measure in situ CBR.
	(2) Test records	There are site testing record sheets (paper-based) prepared by the RRL. The participants were trained on organizing storage methods of test results using electronic media, such as Excel spreadsheets.
4. Confirmed about Training on-site	(1) Training schedule	The RRL assistant engineers stayed at the site in accordance with the project schedule, and an assistant engineer visited regularly to discuss following up with the assistant engineer and the site engineer.
	(2) On-site survey contents	1) A plan for the necessary survey of on-site work for stabilized road courses was established (mixing materials, roller compaction time etc.). 2) Quality test contents have been discussed. (materials and compaction level, etc.)
	(3) Implementation process	1) Made clear the roles and the actual conditions of the site engineers and quality engineers (the RRL) on the direct management approach

No	Sub-activity	Executed Item
2.3.5	Assist Procurement plan of Equipment	In order to procure the equipment for stabilization (shown in Table 2.9), specification and cost estimation for bidding was prepared. Mobilization methods of the PW equipment and/or rental machines were studied The site engineer studied how to make a detailed time schedule especially for stabilized roads using the soil mixing plant.

Table 2.9 Studied Equipment

	Equipment	Study Results
(1)	Mixing bucket and its adaptation kit for the PW's excavator modification	Procurement of (1)-(3) by the TCP is cancelled because the road stabilizer was supplied by the Non-grant Project in November 2013.
(2)	New excavator with a mixing bucket	
(3)	Road stabilizer	
(4)	Boring machine for earth survey	Procured in Feb 2014.
(5)	Small soil mixing Plant	It was procured prior to the start of PP-2 as shown in Figure 2.5.

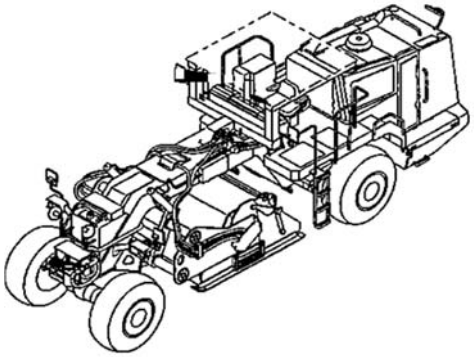


Photo 9 Road Stabilizer (Base Course Type)

Photo 10 Soil Mixing Plant (Fixed Type)

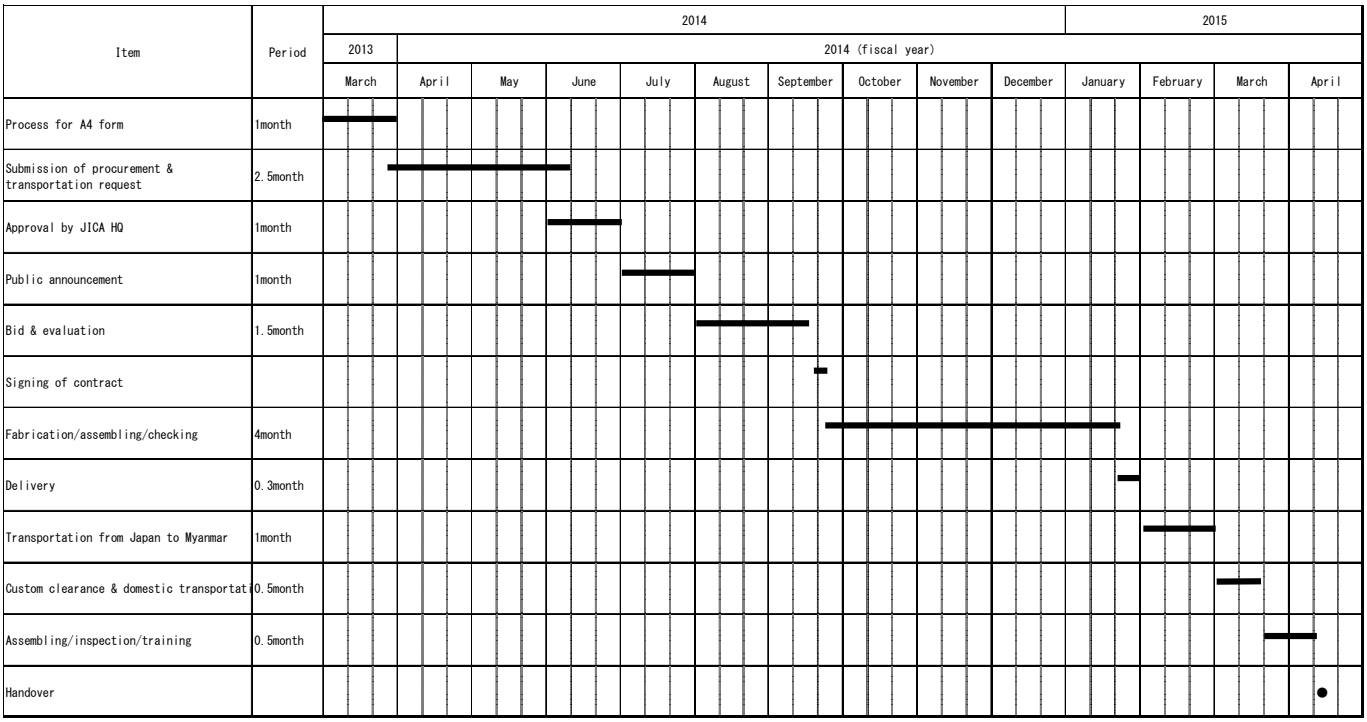


Figure 2.5 Procurement Process of Soil Mixing Plant

Figure 2.6 Soil Plant Installation places

No	Sub-activity	Executed Item	Remarks
2.3.6	Assist Management Plan about Mechanical Work	The TCP investigated a)-b) and considered c) as described below: a) Structure of the equipment management organization b) Equipment management forms used at the site c) Contents of capacity development training for stabilize's operators. OJT was conducted at the PP-1 site and PP-2 sites.	Training of assembly and initial operation of the plant was implemented between April 3 and April 10 in the PP-2 site.
2.3.7	Cooperation with "GRP"	Cooperation with the JIP is specified in the Contract. Cooperation methods were discussed several times between the TCP and the JIP, and agreed on as below: a) Information acquired through research and testing will be shared each other. b) The TCP will make suggestions to the JIP regarding the manual, if needed.	

Activity No. 2.4 Assist of the implementation of the Pilot Project

No	Sub-activity	Executed Item	Remarks
2.4.1	Assist Construction management	PP-1 began in early 2014, and was interrupted in the May when the rainy season began, leaving the remaining the work of roadside drainage and slope protection. The PW side restarted the works in November. A Reference Paper for Road Stabilization was prepared as a small manual. The Pilot Project budget is managed by the PW, but the amount changed from time to time, and it affected to the scale and contents of the Pilot Project.	In order to the delay the start of works the same as PP-1, the TCP requested a special arrangement of the budget for PP-2 over the fiscal year from PW.
2.4.2	Assist Quality Control management	A technical transfer was conducted mainly for the quality control on site. A similar supervisory team organization with PP-1 is proposed for PP-2	
2.4.3	Assist Construction equipment management	It is said that rental equipment from the PW equipment division needs the acceptance of the MD.	The supplier conducted initial soil plant operation training in Apr 2015.

		The Project Office should prepare the cost by themselves in case of equipment rental from a private company. A preparatory study was important for the selection of equipment.	

Activity No. 2.5 OJT for technical transfer for Road and Mechanical Engineer

No	Sub-activity	Executed Item	Remarks
2.5.1	Training about Road Design	Technical assistance was executed through the WS and OJT regarding designing the embankment, shoulder slope protection, surface water drainage etc. The PW and the TCP applied the existing manual (ORN 31 basis) for pavement design work. In addition, the TCP supported the PW in improving their understanding regarding the concepts and methodology of the GRP manual and AASHTO manual. The TCP proposed improving the road geometric design through site investigation on the expressway and the national highway.	Training programs for the design/ construction method in PP-2 was implemented through Workshop and OJT. (Feb-May 2015) Proposal improving the expressway and national highway was submitted in Jun 2015.
2.5.2	Training of Plan and Construction about Soft Ground Treatment	Necessary equipment was procured in Feb 2014 for the behavior observation work of the high-embankment on the approach road to the bridge. They were installed as OJT before starting the embankment work at the site of the Kyew Chan Ye Kyaw bridge. The TCP continuously conducted OJT more than 10 times as a practical WS about the estimating of stability and settlement by utilizing the boring survey results at the site.	
2.5.3	Training on Quality Control	The training plan was designed and executed to strengthen the capacity building of site engineers about the site management for executing work and quality control.	
2.5.4	Training of Operator and Mechanics	The TCP conducted an evaluation of the level of development of ability in PP-1. Details are described in the PP-1 Results Report. Operation training of the soil plant was executed at PP-2.	

Activity No. 2.6 Assessment of the Pilot Project

No	Sub-activity	Executed Item		Remarks
2.6.1	Technology Applicable for the Pilot Project	Workshops and actual observation works were conducted after installing survey equipment at site based on the discussion of policies with the PW and advice from Prof Omine about the behavior observation and analysis method.		The embankment was began in Dec 2014 (the beginning of the dry season), observation survey work restarted simultaneously. The survey work became more important beginning in Mar 2015 (when the height grew to more than 5 m) and the TCP team requested that the PW to continue the survey work over 1 year after the completion of the embankment work.
2.6.2	Issues on Capability of the PW	The observation survey is the first trial for the PW, and technical knowledge was transferred to young engineers by preparing textbooks.	Construction work by the PW is done principally by direct management without clear specification. The budget is not enough and QC at the site is not popular. Almost every weekend, the Minister or Deputy Minister visits the site to monitor it from political standpoint. However, the corroborative budget is not prepared immediately. The necessary budget have to be appropriated tentatively from another project in the district. It will affect to all district project.	
			The PW and the TCP implemented core sampling and laboratory tests of the stabilized materials in the PP-1 section to examine the deterioration level of the materials. The PW purchased the core samplers with its own budget.	

Activity No. 2.7 Implementation of Workshop & Seminar to share the knowledge acquired through the Pilot Projects

<table>
<tr><th>No</th><th>Sub-activity</th><th colspan="3">Executed Item</th></tr>
<tr><td rowspan="20">2.7.1</td><td rowspan="11">Seminar

Jun 13-14, 2013</td><td colspan="3">The first seminar was conducted at Yangon with 52 participants. Speaker and titles are shown in below:</td></tr>
<tr><td>Speaker</td><td colspan="2">Title</td></tr>
<tr><td>MD</td><td colspan="2">Current road construction and maintenance in Myanmar</td></tr>
<tr><td>Ms. Mya Mya Win</td><td colspan="2">the RRL's job and challenges for Ayeyarwady road problems</td></tr>
<tr><td>Mr. Thet Zaw Win</td><td colspan="2">Current Conditions and Design Practices for Highways</td></tr>
<tr><td>Mr. Aung Myint</td><td colspan="2">Topics from seminar and results</td></tr>
<tr><td>Mr. Furuki</td><td colspan="2">Pavement Damage and their Countermeasures in Tropical Countries</td></tr>
<tr><td>Mr. Sone</td><td colspan="2">Road Technology Standards in Japan</td></tr>
<tr><td>Mr. Miyatake</td><td colspan="2">Soft ground improve methods in Japan</td></tr>
<tr><td>Mr. Kubo</td><td colspan="2">Pavement</td></tr>
<tr><td>Prof. Omine</td><td colspan="2">Combined Technology on Countermeasure for Soft Ground</td></tr>
<tr><td>May 22, 2014</td><td colspan="3">Road materials and improve methods seminar was conducted at HQ of the PW, NPT with the bridge salt damage survey report at Rakhine state by the specialist from MILT Japan (Mr. Sone & Mr. Watanabe)</td></tr>
<tr><td rowspan="7">May 28, 2014</td><td colspan="3">Reporting Seminar about PP-1 at NPT</td></tr>
<tr><td>Speaker</td><td colspan="2">Title</td></tr>
<tr><td>Mr. Kyaw Linn</td><td colspan="2">Opening speech</td></tr>
<tr><td>Mr. Kyaw Shein</td><td colspan="2">Outline of PP-1</td></tr>
<tr><td>Mr. Aung Myo Oo</td><td colspan="2">Executed works by PP-1</td></tr>
<tr><td>Ms. Kyi Kyi Thwe</td><td colspan="2">Introduction of High embankment behavior observation work</td></tr>
<tr><td>Prof Omine</td><td colspan="2">Notice on the execution of high-embankment work on soft ground</td></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td colspan="2">Seminar Participants</td><td colspan="2">Seminar Speakers</td></tr>
<tr><td>Jun 16, 2015</td><td colspan="3">Final Seminor was executed inviting 3 members from Japan
Agenda and Speakers were as follows
✓ Goal, Input, Output, and Remaining Issues of the JICA TCP (Expert Miyake)
✓ Pavement Design of PP-2 Project (Daw Hnin Yu Aung)
✓ Construction Management Activities in the PP-2 (U Thet Zaw Win)
High Embankment Behavior Study in Delta Area (Daw Htar Zin Thinn Zaw)
Road Construction, Improvement condition and future plan in Myanmar (U Aung Myint Oo)
Application experience and new information about Soft Ground manual in Japan (Mr. Hiroaki Miyatake)
Future suggestion about high embankment stability at soft ground and monitoring (Prof Ohmine)
Technical Cooperation and the Future (Mr Moriyasu FURUKI)</td></tr>
</table>

No	Sub-activity	Executed Item	Remarks
2.7.2	Workshop	Six regular workshops were held as shown in Table 2.10. Every WS report was submitted to the PW side. The 4th WS was a small one as it was OJT. It was held 15 times in order to train the practical calculating of high-embankment stability and settlement.	

Table2.10 Outline of Workshop

	Theme	Date	Place	Attendants	Remarks
1st	Presentation of approach of the PCM method and discussion of revising evaluation indicators in the Project Design Matrix (PDM)	27/May/2013	Central Training Center (CTC), Yangon	Approx. 50 persons	
2nd	- Pavement design approach, - Operation method of the stabilizer, - Quality control method of soil material - Construction procedure on-site - Analysis method of ground behavior (lecture by Prof. Omine)	13/Dec/2013	Central Training Center (CTC), Yangon	Approx. 30 persons	
3rd	- Monitoring of high-embankment behavior of Kyew-chan-yay-kyaw Bridge approach road - Necessity reason of high-embankment behavior observation - Types of necessary observation instruments - Know how to install observation instruments - How to obtain measurement data from observation instruments. - Enhancement of knowledge about high-embankment analysis	28/Mar/2014 2:00 -4:00	STRL (Soil Test & Research Laboratory)	23 persons	
4th	Practical training of data analysis for stability and settlement (Target is young engineers from the SRL and the RRL based on the discussion with PD.)	3/June/2014 - 10/Dec/2014	SRL Meeting Room	10 person x 15 times	Conducted once a week during Jun, Aug, Nov and Dec
5th	Site reconnaissance of High Embankment work	23/Feb./2015	Bogaley Office	60 engineers	Presentation about outline of high-embankment behavior-observation work. Site reconnaissance where installed survey equipment
6th	Workshop of soil stabilization work by applying Soil Mixing Plant in the PP-2	29/Apr.2015	Bogaley Office	53 engineers	Presentation of the following agendas by the MOC - Pavement design - Material mix design - Material quality control - Operation method of the plant - Field training Details of the workshop is described in the completion report of PP-2

Anlysis of Project Purpose about PDM

Lectures by Prof Omine

Participants for the 3rd WS about the necessity of high-embankment behavior observation work

9th and 10th small workshop

No	Sub-activity	Executed Item	Remarks
2.7.3	OJT	Soil mix testing work The PW and the JICA team jointly worked on the soil material test for determination of subgrade CBR and the mixing ratio of stabilized material in the RRL. The PW obtained such methodologies through OJT.	OJT for PP-2 stabilization works mixing ratio was held begining April 6th as soon as the soil mixing plant installation was completed.
		Construction Supervision Work of PP-1 The TCP will implement the OJT for construction supervision work including work procedures, dimension control, quality control for soil material and machinery works on-site through the construction period (Jan-Apr/2014).	OJT for the supervisory work of PP-2 was held between the begining of March and middle of May.

		PP-2 OJT for the installation of equipment for high-embankment behavior observation work was held.	The PP-2 OJT for survey methods of high-embankment behavior observation was held.
		PP-2 OJT for stabilization by using the Soil Mixing Plant	The MOC engineers learned from the plant manufacturer executing the work by self-education in principal. The team also supported their operation work.
		PP-2 OJT for High Embankment Behavior Observation methods	There were twice changing of survey staff during the Project. The TCP team checked the status of transfer of work evrery times and executed supplementary OJT. The TCP team recognized that the analysis work of the data is difficult to the site surveyors, and conducted a separate OJT to young engineers of the RRL.
2.7.4	1st Training in Japan Sep 30 to Oct 11, 2013	The training was conducted with the aim to enhance the knowledge by introducing current Japanese current methods. The participants appreciated the curriculum, especially the site inspection of the Ariake Sea-side road. Details of the training are summarized in the Completion Report for the Training in Japan.	
	2nd Training in Japan Sep 28, to Oct 10, 2014	The training, held for 5 trainees, mainly introduced about the effort in Japan for soft ground countermeasures and recycling pavement as future techniques for Myanmar. Trainees said in their report that they could get deep knowledge about road maintenance methods and organizational structures and technique in the laboratory or companies in Japan. Details of the training is described in the Completion Report for the Training in Japan.	
	3rd Training in Japan Oct 2014	3 staff members of the RRL received a one-week training in Japan with the assistance of MILT (Japan). This is the activity of long-term experts.	
	4th training in Japan Jan24~Feb 5	10 Engineers participated under in assistance by HIDA[15]. This is the activity of long-term experts.	

Ariake Sea side Road (2013)

5 Participants at the JICA Kyushyu (2013)

5 Participants (2014)

Visiting ACC plant in Nagasaki (2014)

[15] the Overseas Human Resources and Industry Development Association

No	Sub-activity	Executed Item
2.7.5	Assistance Committee in Japan	The assistance committee was held as follows:
	The 1st on Apr.02, 2013	1) Explanation of the outline of the TCP, current progress, and the technical assistance committee (JICA Mr. Tsuchihashi) 2) Outline of Ayeyarwady area roads 3) Explanation of the first seminar and of the first training in Japan (subject and time schedule) 4) Outline of the Grass root Project with current progress (by Mr. Komuro)
	Seminar at Myanmar Jun.09-Jun.16, 2013.	Speakers: Mr. Furuki (pavement in tropical countries), Mr. Sone (Japanese road standards) Mr. Miyatake (countermeasures for soft ground) Mr. Kubo (pavement) Prof Omine (countermeasures for soft ground)
	The 2nd on Jul.31, 2013.	1) Cancellation of the assignment of Dr Fujimoto 2) Report of the seminar (Mr. Furuki) 3) Current situation of the project (Mr. Miyake) 4) Explanation of the draft work plan(Mr. Kaneda) 5) Pavement manual from the Grassroots Project 6) Observation of embankment behavior
	TV meeting Sep. 18, 2013	1) Cooperation methods between the TCP and Grass root Project 2) Discussion regarding the Scope of Work of manual editing by each team (preparation or revision of pavement technical standards was decided not to be done by the TCP.)
	3rd Meeting at JICA HQ Dec. 27, 2013	There was a request to execute a training seminar on the pavement design calculation. There was a question on whether the evaluation indicator was studied or not.
	4th one At NILIM[16] on Apr 14, 2014.	1) Site reconnaissance of salt damaged bridges in Rakhine 2) A seminar about on trial work results of soft ground treatment (in May or June) 3) Issues detected in the TCP 4) Technical Transfer Methodology (recommendation to deliver a text book about work contents explanation with photographs) 5) Progress report of PP-1 6) Recommendation of the contents of the TCP record
	5th Meeting in JICA/HQ Nov. 20, 2014	1) Validity of construction cost of soil stabilization work in PP-1 2) Concerned point in case of applying multi-layer analysis method to pavement design work in PP-2

[16] National Institute for Land and Infrastructure Management

Chapter 3 Issues and their Solutions on the Execution of the Project and Lessons to learn

3.1 Issues detected on the execution of the Project and their solutions

Table 3.1 shows issues were detected during the execution of the project.

Table 3.1 Issues detected during the project execution, countermeasures, and proposed solutions

	Detected Issue	Executed Activity	Proposal to solve
1. The Overall MOC Projects Implementation Plan	On starting the TCP, the total projects development information was obscured and was not updated by the PW.	Information was collected from as many of the relevant staff of the PW as possible.	It is strongly expected to establish procedures for collecting knowledge and the management function as the function of the central office.
2. Mixing Test	A strength test was executed by changing the level of compaction of stabilized soil. However, in the on-site works, variation of the strength fluctuations were recognized regarding the mixing of additives due to varying degrees of compaction and uncertainty.	Technical transfer was conducted on the testing at the RRL as follows; ・Procedure for soil mixing tests ・Selection of mixing soil considering soil properties (PI,etc) and effective utilization of local soil and sand ・strength test in accordance with the additive ratio of lime and cement. ・Evaluation stabilized subgrade in pavement structure design	It is necessary to collect data at the site about frequency and compaction time on mixing materials with additives to secure the required strength. In addition, it is expected to study about the additional coefficient of additives to satisfy the quality control standards according to the site conditions and equipment to be used.
3. Procurement Process of Equipment	The TCP team prepared the specification and quotation for all of original equipment to be procured. However, all of it was procured by another project.	Although information was given in late, the TCP has tried to adjust to the changing of the conditions.	It is necessary to get related information on time and to implement the TCP in efficient way.
4. Coordination with Other Projects	The TCP has been implementing many other similar projects[17] concurrently, and all the projects requested laboratory-mixing tests to the RRL. Therefore, the RRL was obliged to conduct various kinds of mix-components tests simultaneously. This confusion has caused the delay of laboratory mixing test for the TCP.	There were attempt to get other projects information independently by contacting them directly	Adjustment by the Japanese side should be considered. The PW also should consider outsourcing testing, if the work volume overburdens the RRL.
5. New construction of Embankment and Observation of Embankment	The PW does not have enough of a budget and time to carrying out countermeasure work, such as sand piling. Therefore, the site is limited to carrying out countermeasure work for	Behavior observation work of high-embankment at the Kyew Chan Ye Kyaw bridge approach road commenced in March 2014 with the starting of embankment	Technical transfer of “information-oriented construction methods” has been executed. The purpose is the feedback to

[17] Such as Grass Root Project, Supply of Stabilizer by No-Project Grant, trial pavement by the assistance of MLIT, Japan (Ministry of Land, Infrastructure, Transport and Tourism), and Poverty reduction road project etc.

	Detected Issue	Executed Activity	Proposal to solve
	settlement and behavior observation. Other issues include: 1) immature survey technique of total station, and 2) the decision of the authorities to take responsibility of the data analysis and compilation of such knowledge.	work. The work was suspended between May and middle of Dec, and completed at the end of April 2015.	site engineers about the analysis results of site conditions.
6. Seminar	Summary of answers from the participants' questionnaire show that the understanding level is appreciable, but interest is not so high.	The TCP team asked for the PW staff's request items. However, there were few requests.	Requests of the PW should be accepted by the MD. It is expected to get needs directly from young engineers
7. Workshop 1 (Study of PCM & PDM)	1) There is some misunderstanding among the PW staff that the TCP team will conduct project under cooperation with the PW.	The purpose and methods are explained at every meeting to increase the understanding of the PW staff.	The PW staff is expected to have an enough preparation time to ensure ownership and initiative.
	2) Preparation work of the text is executed by the JICA experts.	The texts were prepared in advance.	It is necessary for the PW to be aware of the importance of the preparation work of the reference data.
	3) Allowed time for the workshop is one day (5 hours). It is not enough to learn a new system or methods.	The TCP have proposed to extend the time for workshop, but it was not accepted due to their busy time schedule.	Extending of the time for the Workshop To carry out OJT instead of WS (but in the case of OJT, key members could not participate)
	4) PW staff has their primary works, and cannot spend enough time as the counterpart of the TCP.	JICA experts requested to assign PW staff a few days per week as the project days.	(Achievement of desirable output will be impossible, if participation is only from a small time-sharing base).
Workshop 2 (Implementation method of PP-1 and Observation of High-embankment)	A 2nd Workshop was planned from 2 months before, and prepared (including the invitation of Prof. Omine from Nagasaki Univ.). However, attendance of all staff from the site office of PP-1 was cancelled 2 days before of the WS.	WS was conducted only by the staff from the RRL, SRL, YTU and the local office without attendance of important site engineers.	The PW side is expected not to change the schedule suddenly, and to adjust their schedule according to a planned process.
Workshop 3	Enough time is needed to master high embankment stability and consolidation settlement analysis. However, training for senior engineers seemed to be difficult due to their busy time schedule	The 3rd Workshop was held at the SRL for the Outline Presentation	Enhancement of knowledge about high embankment analysis is only needed by a few staff. Each trainee needs basic knowledge and English ability.
Workshop 4		Young engineers were invited to a practical training (15 WS were conducted)	
Workshop 5		60 engineers were invited to the half day. WS for site reconnaissance of high embankment and behavior observation.	

	Detected Issue	Executed Activity	Proposal to solve
Workshop 6	There was a comment that the stabilization cost of PP1 is relatively expensive. There was some trouble mixing the subbase course with the stabilizer, because of the big aggregate in the existing subbase course	The MOC and the team presented a more effective and economical approach for the stabilization work by applying the plant. A cost comparison analysis with conventional construction methods was carried out.	It is recommended that the MOC will apply the equipment for each specific work as follows. - Simple mixing work by backhoe - In-situ mixing work by the stabilizer - Chemically mixing work by the plant in the yard
8. Training in Japan	The training was implemented before PP-1. Therefore, it did not included the detected issues and solutions on site.		As shown in the results of the questionnaires, study about "countermeasures on embankment" and "shallow soil stabilization" is a critically important task for the engineers in Myanmar. It requires not only basic skills, but also introduction of advanced practical technologies.
9. Possible Scope of Work of the Pilot Project	The Japanese side has planned many activities on purpose to solve the troubles on site, but most of them objected to such a proposal due to budget conditions.	Project contents have been adjusted to meet with the PW budget.	It is necessary to establish a work plan on considering the PW conditions and to give advice to solve the detected issues.
10. Quality Assurance of the Pilot Project	Quality control at the site is not enough due to lacking a QC manual and no penalties for unacceptable finishing quality. Site engineers are not familiar with the quality control.	A QC engineer from the RRL was trained not only to carry out field test but also discussed with the JICA team how to evaluate testing data acoording to acutual mixing soil conditions Site engineer participated in the consultation for on-site testing and quality improvement.	Preparation of manuals is necessary for the quality control and construction management of stabilization work.
11. Counterpart for Practice of the Technical Cooperation Project (TCP)	Counterparts of this TCP were in charge of more than five foreign aid projects, which are proceeding simultaneously, and it is not easy to conduct the TCP with their ownership.	There was an attempt to find out technical issues and to propose its solution for the works.	It is expected for both the recipient country and donor's side to reconsider the policy and team organization in order to enhance the real technical ability that will be attained through the execution of the projects.
12. Preparation of the Soft Ground Treatment Manual	Delta areas with soft ground spread in Ayeyarwady, western Rakhain and Eastern regions. Practical countermeasures were not adopted such as for consolidation settlement, stability of embankment and slope collapse.	As the guideline for the countermeasure on the soft ground area, "Soft Ground Treatment Guidelines" issued by the Japanese Road association was translated into English and modified to meet with Myanmar's conditions.	Preparation of the Myanmar Language version by the MOC for the usage by site engineers. The contents have many theoretical items that are difficult for the site engineers. It is desirable to prepare a more practical handbook. Follow-up by Japanese engineers is necessary.

3.2 Lessons to Learn

Lessons learned through this TCP are as follows:

The TCP (Technical Cooperation Project) will be conducted to enhance the capacity of the recipient country's government staff in advance of the execution of a grant or loan project. Positive participation of the staff is desirable as an important prerequisite condition. The Myanmar social structure changed to an open democratic structure since around 2013 and many overseas assistance projects were executed at a stretch. These obliged busy working conditions resulted in all government staff not sufficiently engaging in activities for the capacity building. While, many staff in short time seminars to satisfy their curiosity, most of them answered in the questionnaires after the seminars that it was useful and desirable to conduct these kinds of seminars again. Training in Japan also received a favorable reception.

The solutions of following issues are required.

Table 3.2 Issues detected and recommendable solutions

Issues	Recommendable solution
1) Most of local officers stay in the same position for around three years. Therefore the changing of counterparts staff becomes one of the premises of a 3 years TCP	Following countermeasures are required: ✓ Taking over to the successor their received technical transfer matters by themselves ✓ Execution of TOT (Training of Teacher) ✓ Early preparation of manuals
2) Short seminars re appropriate for introducing the outline of some subjects. However, a longer time is essential for mastering the practical learning of a specific subject.	Upon starting the TCP, it is desirable to present to the C/P side the subjects and lengths of seminars and training workshops, as well as the necessary basic knowledge of participants. In addition, it is desirable to receive the introduction of appropriate personnel names, if possible.
3) Language ability is necessary to enhance the engineering capacity through WS and OJT. There was a request from the PW side for the enhancement of language ability to the participants through the TCP process.	It is not easy to enhance the language ability through the TCP. It is better to assign some interpreter or translator who can understand technical terms, or the participants should be selected from the people who can understand the technical contents。
4) It is difficult for the C/P staff in busy conditions to participate in seminars, WS, and OJT; therefore, they requested to receive reference books such as manuals as one of the methods for the future capacity building.	The PW side strongly requested English versions of Japanese standards or manuals. However, it is not enough to transfer the simply translated one, because the national conditions are different. It should be modified to meet the recipient country conditions. In addition, organizational establishment is expected to make possible the continuous efforts to study and improve the received one for the Myanmar side. However, it is not easy under the restricted conditions for budget and working time. It is expected to discuss this with the C/P side during the study for the formulation of the project

5) The district office has to deal with many projects related to road sectors, such as rehabilitation, repair and widening, by utilizing limited resources (e.g., equipment, labor and budgets) during the dry season usually from December to April. Therefore, the site work did not achieve planned progress due to a delay of mobilization of equipment at the initial stage (Feb – Mar) in the PP-2. Those had been applied to the other work sites during that period.	The TCP presented brief information of the PP-2 to the MOC to assist smooth implementation of the preparation work in December 2014. However, detailed contents (e.g., pavement thickness, mix ratio of stabilized material) were not finalized until February 2015 because trial material mixing tests took a longer time than the initial plan. Therefore, this incident was also one of the causes of the work delay. The RRL should make an appropriate program and implementation schedule of the test in accordance with the current capacity. It will support the preparation work of the district office concerning cost estimates and materials procurement.
6) The TCP detected many issues threatening traffic safety through the site investigation in aspects of road geometric structure and the traffic safety facility. The TCP listed up and categorized those issues according to 6 major causes, and presented the proposals for the improvement. Note the proposals were also classified to 3 levels in accordance with the practicability (i.e. difficulty).	The TCP identified that even small changes will achieve significant improvements at many locations. The TCP suggested immediate action by the MOC for mitigation of traffic accidents.

Chapter 4 Achievement ratio of the Project

4.1 Results of the Mid-term Evaluation of the Project

The Mid-term evaluation of the project was executed during two weeks beginning Aug 10, 2014.

The Mid-term Joint-evaluation Team is composed of the following members:

Table 4.1 Mid Term Joint Evaluation team members

Chief	Miyake Shigeki	JICA Social Infrastructure/Peace building Department, Transportation & Information telecommunication Group, Chief of Second Team
Administration	Tsuchihashi Toru	JICA Social Infrastructure/Peace building Department, Transportation & Information telecommunication Group
Evaluation	Shirai Kazuko	Kaihatsu Management Consulting, Inc.
Evaluation team from the PW	Mr. Aung Myint Oo	Project Director (Since Aug 2014) Deputy Chief Engineer, Planning Dept., PW-HQ
	Ms. Hla Hla Thwe	Project Manager Superintending Engineer, Road Dept., PW-HQ
	Ms. Mya Mya Win	Assistant Project Manager, RRL, Deputy Superintending Engineer

The time schedule of the meeting with the PW and JCC was changed as follows due to the PW budget draw up conference to be held every six months.

Table 4.2 Mid Term Joint Evaluation team time schedules

Major Original schedule	Actual schedule	Remarks
Explanation and discussion about Draft MoM and Evaluation Report on Aug 20	First the drafts were explained to PM (Project Manager) and Assistant PM on Aug 19, and explained to MD (Managing Director) in the afternoon (about one hour).	
Finalization of MoM and approval from JCC on Aug 21	MoM was signed by MD on Aug 20.	JCC was not opened, and MD signed alone.

Record of Discussion is attached in Annex 4-2.

The summary of the evaluation results are as follows

Relevance	relatively high	The PW has a strong will to analyze a variety of standards such as BS, AASHTO and Japanese ones, modifying the standard to apply to roads in Myanmar.
Effectiveness	middle	The indicator to measure the improvement of road conditions is not appropriate for measuring the capacity enhancement of the PW engineers. The enhancement of practical skills and knowledge of the road technical staff directly contributes to capacity enhancement of the PW
Efficiency	relatively low	C/Ps is not able to engage fully with project activities. Some of activities were changed due to lack of the PW's budget.
Impact		The daily life of local residents near the PP-1 site improved in terms of traveling time, and access to hospitals and markets
Sustainability	Middle,	Budget issues might be critical for extension of road with stabilizing methods, since the construction cost is nearly two times higher than the ordinary Macadam method. All engineers appreciated new skills and knowledge of soil testing and construction work.

Below are important comments from the discussion with the MD.

Table 4.3 Important comments during the Mid Term Joint Evaluation

Comment from Evaluation team	It is necessary to improve the shortage of mutual communication. JICA is expected to study introducing stabilization methods into the JICA loan projects for the continuous execution of them even after the completion of this TCP.
Comment from MD	It is desirable for the manuals to show 3 or more alternative countermeasure methods categorized by their cost in order to diffuse the construction methods introduced by the TCP. It is not limited to stabilization work. Important TCP results include the preparation of the manual, which will be remained in the future. Technical transfers should be executed on the manual.

The evaluation team explained that the achievement ratio is difficult to know from the indicators in the original PDM (It was approved at the first JCC in Sep 2013) and proposed a new PDM with a new indicator for version 2.0. PDM Ver. 2.0 is shown in Annex 1. This new indicator was signed by the MD on Dec 17, 2014 through meetings between the PW and the TCP team as shown below:

Table 4.4 History of New PDM acceptance

Date	History
May 27, 2013	Opened PCM-WS (Workshop) and prepared PDM Ver. 1.0
Sep 5, 2013	PDM Ver. 1.0 is approved officially at JCC
Dec 2013	The TCP team proposed a new indicator for the progress report (Chapter 4), because the current indicators are not enough to show the achievement degree of project outputs.
Aug 2014	The Mid-term Evaluation Team pointed out the necessity for revision of PDM indicators. The joint evaluation team prepared a draft of PDM Ver. 2.0, and requested for the PW to approve the new PDM (Annex 1)
Oct 16, 2014	The TCP team has proposed discussing PDM Ver. 2.0 with the counterparts. The PW side proposed having a meeting with the TCP members about the contents of PDM Version 2.0.
Nov 29, 2014	The meeting with the PD was held and discussed regarding the procedures for approval from the PW side. The PD promised to confirm with the MD about the approval method.
Dec 17, 2014	The PD had negotiated with the MD who signed off on the table of indicators for PDM Version 2.0.

4.2 Results of Terminal Evaluation of the Project

The Terminal Evaluation of the Project was executed for two weeks beginning on Mar 8, 2015.

The Terminal Joint Evaluation team is composed of the following members:

Table 4.5 Terminal Evaluation Joint team members

Team Leader	Mr. Yoshihiro Kakishita	Senior Advisor to the Director General, Infrastructure and Peace building Department, JICA
Cooperation Planning	Mr. Toru Tsuchihashi	Highway Engineer (Road and Bridge), Planning and Coordination Division, Team 1 Transportation and ICT Group, Infrastructure and Peace building Department, JICA
Evaluation Analysis	Mr. Masato Onozawa	Consultant, IC Net Inc.
Evaluation team from the PW	Mr. Aung Myint Oo	Project Director, Public Works, Ministry of Construction, PW
	Ms. Hla Hla Thwe	Project Manager, PW
	Ms. Mya Mya Win	Deputy Superintendent Engineer, RRL, PW

The record of the discussion is attached in Annex 4-3.

The summary of the evaluation results are as follows

Relevance	High	Policies of the Myanmar and Japanese sides are largely consistent
Effectiveness	Medium	Although the Output 2 {The practical skills and knowledge of the road technical staff are enhanced} is not yet fulfilled. Tangible signs of fulfilling the all the outputs and achieving the project purpose are observed
Efficiency	Medium	The input is delivered as almost initially agreed on and scheduled. The unexpected departure of the Chief Advisor due to his health created an adverse impact on the process.
Impact	Relatively High	The Project introduced subjects, such as treatment of soft soil, soil consolidation, compression, soil stabilization etc. which were technologically significant
Sustainability	Overall medium,	The current trend of expanding and maintaining the road network will continue under minimal funding allocated to the local level.
Technical sustainability	High with some reservation	(i) To what extent PW staff understands knowledge and skills. A continued effort is expected. (ii) To what extent PW establishes institutional arrangements for knowledge and skills. It is expected to develop a training program to cover the subject of the manual for all engineers. (iii) To what extent efforts of Human Research Development (HRD) is continued to systematically to extend the knowledge to other engineers It is important for the PW to provide training opportunities to their all staff by improving the act of staffing and the comprehensive master plan for HRD

Below are comments from the Evaluation Team and the MD.

Table 4.6 Important comments during Joint Terminal Evaluation

Comment from Evaluation team	Continuous Improvement and Updating of the Manual	The Team recommends the manual for soft soil treatment shall be improved and revised continuously by the Editing Committee after completion of the Project
	Rational Choice for Construction Planning and Methodologies	The Team recommends PW facilitates road construction projects employing more rational decision-making and selection of construction planning and methodologies
	Adoption and Dissemination of the Outcomes from the Project	The Team recommends the PW applies and extends the outcomes from the Project to other projects carried out by the PW.
	Use of Technologies	The JICA expects to use and apply the technologies transferred through the Project, e.g., to use lime/cement stabilization methodology in upcoming foreign funded projects. Application of the new design method for high embankments shall be adopted in the next bridge construction project
Comment from MD	At the end of project, the soft soil treatment manual will be discussed and accepted by the PW. The technological knowledge and skill of the PW engineers will also be improved in the behavior of high embankment and road construction with stabilization.	

	The PW expected to create a new manual for geotechnical investing, design, quality control, quality assurance, construction management and maintenance for the road construction with stabilization. However, the PW did not achieve it from the Project. The outcome of the Project did not meet the PW's expectations. We should evaluate the Project output by the input to the Project.

Terminal Evaluation Team has mentioned that most of the activities finished, except the Pilot Project 2 stabilization work using the soil mixing plant.

4.3 Achievement Ratio

The Project Achievement Ratio at the end of Jun 2015 based on the indicators of the PDM is summarized as follows:

Table 4.7 Project Achievement Ratio

Narrative Summary	Objectively Verifiable Indicators	Means	Results
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.	1. The enhancement of skills and knowledge of the engineers regarding road design and construction is confirmed by the hearing from more than 30 staff.	The Project team asked to 50 staff members about the effectiveness of enhancing skills and knowledge of the engineers regarding road design and construction	Answers summarized as follows: >17 staff members received sufficient knowledge >24 staff members received some knowledge > 9 staff members were negative Therefore it might be said that the knowledge of 41 staff members was enhanced
	2. By the end of the project, road length constructed by the technology introduced in the Pilot Project is extended by more than 2.6 km.	Road length utilized stabilization work introduced in the Pilot Project is confirmed to the PW. PP-1: 1.6 km PP-2: 0.6 km Others: 0.0 km Total: 2.2 km	Due to the restriction of the PW budget, the total length of the stabilized road is 92% of the target length. But stabilization methods were adopted for the road improvement ADB loan project between Maubin~Pyapon
Outputs 1 Road technology standards and manuals for designing and construction works are improved.	1-1. New soft soil treatment manual is discussed and accepted by PW.	80 copies of the Soft Ground Treatment Manual (Guideline) were delivered on June 22, 2015 to the MOC, RRL, BRL and YTU. A total of 4 explanation and discussion meetings were conducted The MOC side announced that this manual will be officially accepted	The Soft Ground Treatment Manual (Guideline) was explained and discussed with the participants of the MOC Minister, PS, executive officers and engineers on June 10, 2015. The MOC requested improving the following items: 1) Reduce the total page number 2) Change to easy-to-understand contents 3) Add construction works examples
	1-2. More than 10 engineers are executing the work	The TCP team has delivered 50 copies of 4 kinds of	7 engineers out of 10 staff members answered that they are

	by using the manual.	manuals/books during the project. However, only 10 of the 50 participants to the WS on Apr 2015 answered that they received one.	using the manual (on Apr 29, 2015.
Outputs 2 The practical skills and knowledge of the road technical staff are enhanced.	2.1. The total number of the PW trained staff is more than 300 numbers.	Various kinds of seminars and workshops were executed as shown in Activity No. 2.7	Total accumulated number of the trained staff is around 400.
	2.2. 50% of participants evaluate training/seminars favorably.	To the Apr 29 questionnaire for 50 participants, 72 % of answered that they have not had any opportunity to participate in a training/seminar by the JICA TCP, 15% showed no answer 12 % answered that he/she participated in a training/seminar 1% answered they have not had good results	more than 90% of participants in a seminar WS OJT evaluate favorably

In conclusion, the project achieved almost of its purposes except the Output 1-2 “More than 10 engineers are executing the work by using the manual”

However many engineers expect to utilize the manual for future projects, if they have a chance to be engaged with it.

Chapter 5 Recommendation for achieving the Overall Goal

The Overall Goal of the TCP is stated in the Project Design Matrix (PDM) as follows.

Overall Goal: Roads in the delta areas of Ayeyarwady Region are improved.
Quantitative target：The road improved by the stabilization technique is more than 10 km long.
Qualitative target：Travel time is reduced by 10% as compared to before the project.

Recommendations for achieving the Overall Goal are considered as follows.

Expected Element	Contents	Remarks
1: Construction of road structure with sufficient durability	Confirmation and analysis of the property of ground foundation.	This was enhanced during the TCP period.
	Planning and implementation of necessary countermeasure work.	A small budget and short construction period is the breaking point
	Examination of soil material to be used for road construction	Site soil materials are variable. Subgrade CBR is less than 3 in many cases.
	Improvement of soil material based on mixing tests	Poor site soil is expected to improve. The mixing ratio with lime, cement, and/or sand should be designed in a laboratory test.
	Design work based on appropriate design conditions	The pavement structure should be designed according to the following factors; 1) Future accumulated traffic volume by conversion to ASAL 2) Subgrade CBR (min 3) 3) Each layer's Structure Number
	Implementation of appropriate quality control during construction period	The following should be kept in mind during pavement construction 1) Securing quality materials 2) Compaction to designated density 3) Control methods for the designed thickness and width of each layer The following should be executed during the construction of high embankment on soft ground: 1) Pre-soil Investigation to grasp the underground clay soil conditions. 2) Pre-checking of stability and settlement 3) Pre-study of countermeasure work and the execution, if necessary. 4) Behavior observation survey of the settlement board and 3D peg survey on the ground

Continue to next page

2: Implementation of appropriate maintenance work	Development of maintenance manual	The MOC should establish an editorial committee to develop the manuals by applying its own resources. Type of the manuals are recommended as follows. 1) Road maintenance manual 2) Slope maintenance manual 3) Bridge maintenance manual
	Establishment of maintenance department	The MOC should establish a department in charge of the maintenance work. Continuous implementation of a training program and/or workshop is crucial for the capacity development.
	Establish work implementation cycle	The MOC should establish and follow a cycle (inspection – evaluation – repair work planning – work execution – recording) during the work implementation.
	Development of road inventory system	The MOC should develop a road inventory containing the following information/data of the responsible road network. 1) Location and length 2) Geometric dimensions 3) Pavement structure 4) Traffic volume 5) Project (repair and/or rehabilitation) history The MOC will prepare a work implementation program by referring to the above data. Note the data should be regularly updated.

Monitoring items are shown in Annex 8, which is expected after the completion of the Project

Table of Contents of Annex

PDM V2.0

Project Title: Project for Improvement of Road Technology in Disaster-affected Areas in Myanmar	Version. 2.0
Target Areas: Delta areas of Ayeyarwady Region	Date December, 2014
Target Group (Beneficiaries): Road Technical Staff of the Public Works	Project Period Jul 2012 – Jul 2015

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Roads in the delta areas of Ayeyarwady Region are improved.	1. The road improved by the stabilization technique is more than 10 km. 2. Driving hour or travelling time is reduced 10% comparing before execution of project.	1. Hearing from PW 2. Report by actual measurement by district office	
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.	1. The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff. 2. By the end of the project, road length constructed by the technology introduced from Pilot Project is extended longer than 2.6 km.	1. Questionnaire to C/P. 2. Pilot Project Report.	Budgetary and human resources necessary for road construction are continuously allocated by the Government of Myanmar.
Outputs 1. Road technology standards and manuals for designing and construction works are improved. 2. The practical skills and knowledge of the road technical staff are enhanced.	1-1. New soft soil treatment manual is discussed and accepted by P.W. 1-2. More than 10 engineers are executing the work by using the manual. 2.1 Total number of trained staff of PW is more than 300 numbers. 2.2 50% of participants evaluate training/seminars favorably.	1-1 Hearing from PW. 1-2. Hearing from PW. (Interview from site engineer) 2-1. Records of the pilot project(s) and training programs 2-2 Questionnaire for trainees.	P.W approves the manuals.

PDM V2.0

Activities	**Inputs**		**Important Assumptions**
0 Conduct the baseline. 0-1. Number of the road technology standards and manuals adaptive to Delta area 1-1. Review Myanmar standards and manuals of road technologies for designing and construction works 1-2. Analyze the issues and challenges on the road technologies for designing and construction works in Myanmar. 1-3. Conduct research on construction conditions including soft ground. 1-4. Specify the road technologies for designing and construction works necessary to be developed. 1-5. Develop the road technology standards and manuals, and revise them based on the outcomes of the pilot project(s) as necessary. 1-6. Convene the workshops/seminars to share the contents of the road technology standards and manuals with the road technical staff across the country. 2-1. Select pilot project(s). 2-2. Conduct the research activities on construction conditions including soft ground. 2-3. Formulate the work plans, including outline design, cost calculation, quality control, etc., of the selected pilot project(s). 2-4. Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans-Conduct training on road construction for technical staff, operators, etc. through the pilot project(s). 2-5. Monitor the pilot project(s) based on the plans. 2-6. Convene the workshops/seminars to share the experiences, outcomes, etc. of the pilot project(s)	Japanese side 1. Experts [Long term Experts] ・Chief Advisor/ Road Technology ・Road Technical Standards ・Project Coordinator [Short term Expert] ・Road planning and Assessment ・Road Survey and Design ・Construction technology ・Quality Control ・Others as necessary 2. Training of counterpart personnel in Japan and/or the Third Countries 3. Provision of machinery and equipment 4. Local expenses for the project activities ・Teaching materials for training/ workshops/seminars ・Others	Myanmar's side 1. Personnel ・Chairperson ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project offices and facilities necessary for the project implementation 3. Expenses for implementing pilot projects in the delta areas of Ayeyarwady River 4. Administrative and operational expenses ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel ・Others as necessary	Natural disasters do not give a profound effect to the project activities. **Pre-condition** Understanding and cooperation on road construction are obtained from the local people residing in the target areas.

PDM V1.0-1.(for Reference to compare with V2.0)

Project Title: Project for Improvement of Road Technology in Disaster-affected Areas in Myanmar	Version . ~~0~~ *1.0*
Target Areas: Delta areas of Ayeyarwady Region	Date ~~February 1, 2012~~, *June 2013*
Target Group (Beneficiaries): Road Technical Staff of the Public Works	Project Period Jul 2012 – (36 Months)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Roads in the delta areas of Ayeyarwady Region are improved.	1. The length (km) of road construction under the control of the PW is increased in the delta areas. ~~2. The road conditions (Good, Fair, and Poor) are improved in the delta areas. **Note1**~~ 2. *Reduced driving hour or traveling time.*	1. ~~Monthly~~ Report on Development of Road Network in Ayeyarwady Delta Area ~~("Monthly Report")~~ ~~2. The Monthly Report~~ *2.Report by actual measurement by district office*	
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.	~~1. The number of construction plans/ works adaptive to the delta areas conducted by PW is increased. **Note2**~~ *1. Road length constructed by the technology introduced from Pilot project* 2. *Improved road conditions in delta area*	~~1. The Monthly Report~~ ~~2. Annual Report on Training Program prepared by the Central Training Center~~ 2. *Report by actual measurement by district office*	Budgetary and human resources necessary for road construction are continuously allocated by the Government of Myanmar.
Outputs 1. Road technology standards and manuals for designing and construction works are improved. 2. The practical skills and knowledge of the road technical staff are enhanced.	1-1. The number of the road technology standards and manuals ~~adaptive to the delta areas~~ developed by the PW is increased. ~~2-1. Level of understanding of road technical staff is improved after the pilot project(s) and training in comparison with before~~ 2.1 *Number of trained engineers (Seminar WS OJT).*	1-1. Road technology standards and manuals 2-1. Results of the comprehension tests 2-2. Records of the pilot project(s) and training programs	The road technical staff capacitated by the Project continues working for their respective positions.

Note1: Deleted sentences are shown by cancel line from V 0 and new added sentences are shown by italic

PDM V1.0-1 (for Reference to compare with V2.0)

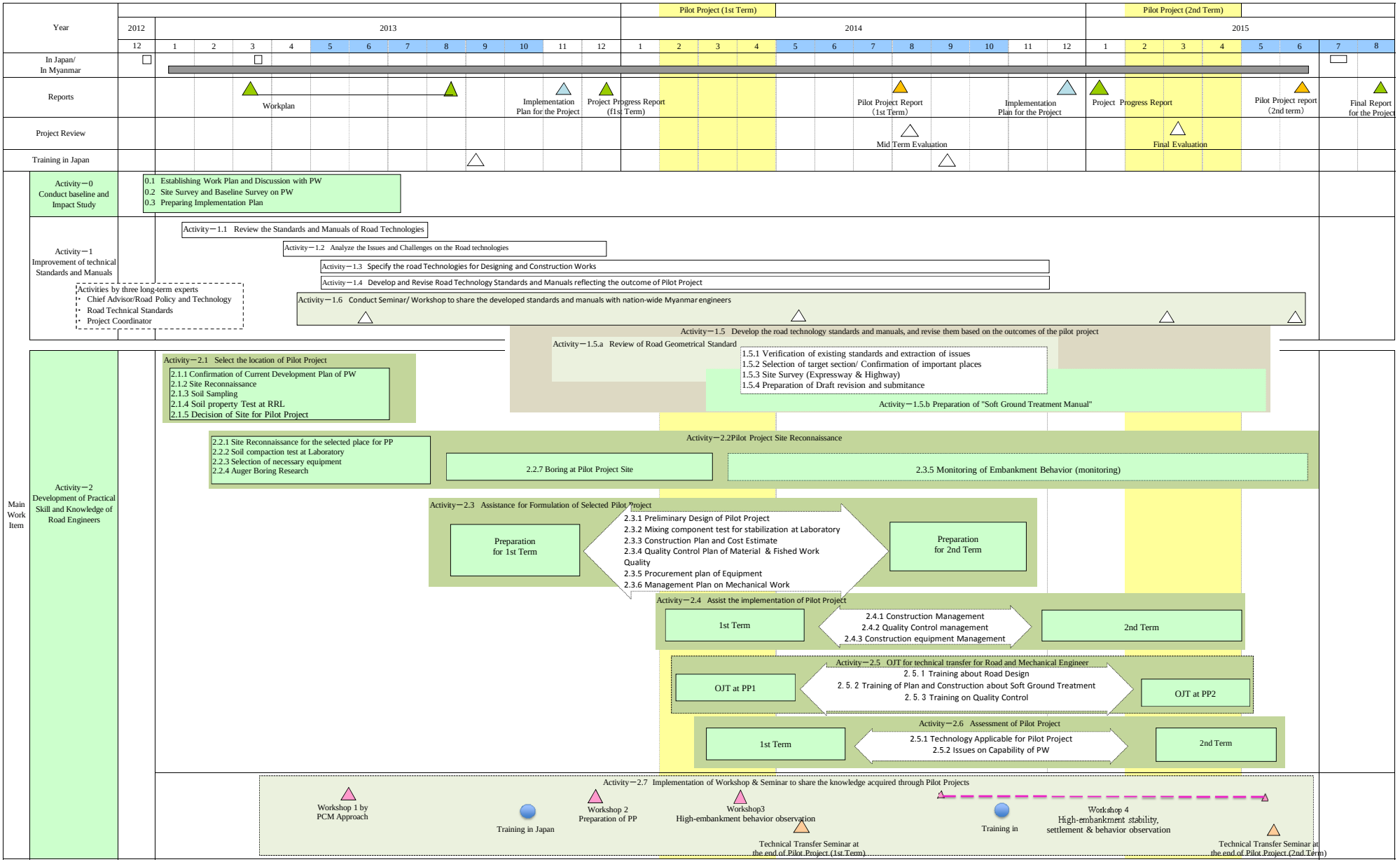
Activities	**Inputs**		**Important Assumptions**
0 Conduct the baseline. ~~0-1 Construction plans/ works adaptive to Delta area.~~ 0-2 Number of the road technology standards and manuals adaptive to Delta area ~~0-3 Understanding level of road technical staff.~~ 1-1. Review *Myanmar* standards and manuals of road technologies for designing and construction works ~~in Myanmar.~~ 1-2. Analyze the issues and challenges on the road technologies for designing and construction works in Myanmar. *1-3. Conduct research on construction conditions including soft ground.* 1-4. Specify the road technologies for designing and construction works necessary to be developed. 1-5. Develop the road technology standards and manuals, and revise them based on the outcomes of the pilot project(s) as necessary. 1-6. Convene the workshops/seminars to share the contents of the road technology standards and manuals with the road technical staff across the country. 2-1. Select pilot project(s). 2-2. Conduct the research activities on construction conditions including soft ground. 2-3. Formulate the work plans, including outline design, cost calculation, quality control, etc., of the selected pilot project(s). 2-4. Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans ~~with teaching materials for training /workshops/seminars.~~ 2-5. Conduct training on road construction for technical staff, operators, etc. through the pilot project(s). 2-6. Monitor the pilot project(s) based on the plans. 2-7. Convene the workshops/seminars to share the experiences, outcomes, etc. of the pilot project(s) ~~and to reflect the results to the development of standards and manuals~~	Japanese side 1. Experts [Long term Experts] ・Chief Advisor/ Road Technology ・Road Technical Standards ・Project Coordinator [Short term Expert] ・Road planning and Assessment ・Road Survey and Design ・Construction technology ・Quality Control ・Others as necessary 2. Training of counterpart personnel in Japan and/or the Third Countries 3. Provision of machinery and equipment 4. Local expenses for the project activities ・Teaching materials for training/ workshops/seminars ・Others	Myanmar's side 1. Personnel ・Chairperson ・Project Director ・Project Manager ・Counterpart personnel 2. Provision of the project offices and facilities necessary for the project implementation 3. Expenses for implementing pilot projects in the delta areas of Ayeyarwady River 4. Administrative and operational expenses ・Electricity, water, communication, etc. ・Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel ・Others as necessary	Natural disasters do not give a profound effect to the project activities. **Pre-condition** Understanding and cooperation on road construction are obtained from the local people residing in the target areas.

Modification of PDM (Ver.01 → Ver.02)

PDM (Ver. 01)	PDM (Ver. 02)
Overall Goal *Roads in the delta areas of Ayeyarwady Region are improved.*	
<Objectively Verifiable Indicators>	
1. The length (km) of road construction under the control of the PW is increased in the delta areas. ⇨	1. The road improved by the stabilization technique is more than 10 km.
2. Reduced driving hour or traveling time. ⇨	2. Driving hour or traveling time is reduced 10% comparing before execution of Project.
Project Purpose *The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyawardy Region is enhanced.*	
<Objectively Verifiable Indicators>	
1. Road length constructed by the technology introduced from Pilot Project. ⇨	1. The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff.
2. Improved road conditions in delta area. ⇨	2. By the end of the Project, road length constructed by the technology introduced from Pilot Project is extended longer than 2.6 km.
<Means of Verification>	
1.&2. Report by actual measurement by District Office. ⇨	1. Questionnaire to C/P . 2. Project report.
Outputs *1. Road technology standards and manuals for designing and construction works are improved.* *2. The practical skills and knowledge of the road technical staff are enhanced.*	
1. The number of the road technology standards and manuals developed by the PW is increased. ⇨	1-1. New soft soil treatment manual is accepted by PW. 1-2. More than 10 engineers are executing the work by using the manual.
2. Number of trained engineers (Seminar, Workshop and On-job training (OJT)). ⇨	2-1. Total number of trained staff of PW is more than 300 numbers. 2-2. 50% of participants evaluate training / seminars favorably.
<Means of Verification>	
1. Road technology standards and manuals. ⇨	1-1. Soft soil treatment manual accepted 1-2. Interview from site engineer
2-1. Results of the comprehension tests. 2-2. Records of the pilot projects and training programs. ⇨	2-1. Records of the pilot project(s) and training programs 2-2. Questionnaire for training 2-3. Hearing from engineers
<Important Assumptions>	
	(Additional)
	PW approves the manuals.

(Kyaw Linn)
Managing Director
Public Works

Work Flow Chart (New Version)



ANNEX 3 Prepared Reports List

	Plan and Reports	Date
1	Project Implementation Plan	Nov 2013
2	Inception Report	Feb 2013
3	Work Plan	Sep 2013
4	Seminar Report 1	Jun 9-16, 2013
5	Workshop 1 Report	May 27, 2013
6	Workshop 2 Report	Dec 13, 2013
7	Workshop 3 Report	Mar 28, 2014
8	Workshop 4 Report (Total 13 times)	Jun 2014-Dec 2014
9	Progress Report 1	Dec 27, 2014
10	Soil Property Test and Stabilization Mixing Test Report	Mar 2014
11	Pilot Project Implementation Plan	Feb 2014
12	Pilot Project Report 1	July 2014
13	Mid Term Evaluation Report	
14	Soft Ground Treatment Manual (Draft)	Nov 2014
15	Progress Report 2	Jan 2015
16	Terminal Evaluation Report	May 2015
17	Pilot Project Report 2	June 2015

	Monthly Report	Date
	Monthly Report	January 2013-Jun 2015

	Training in Japan	Date
1	Implementation Report 2013[1]	Nov 2013
2	Implementation Report 2014	Dec 2014

[1] with Lecture fee and travel expenses detailed statement

Minutes of Meeting

The 1st Joint Coordinated Committee Meeting on Improvement of Road Technology in Disaster Affected Area

Date : September 5, 2013 between 10:30am and 11:30am
Venue : Conference Room of MOC, Nay Pyi Taw
Participants : (Please referred to the attendant List)
Agenda :

1) Approval of Work Plan prepared by TCP (Technical Cooperation Program) members
2) Approval of revision of PDM (Project Design Matrix) for TCP
3) Others

1. Process:

U Kyaw Linn, Managing Director of Public Works, has made opening speech, and U Kyaw Shein, Deputy Chief Engineer of Planning in Public Works, has explained the draft work plan.
Mr. Kaneda, chief of short-term experts, has explained about the necessary revision of PDM, which was proposed at PCM (Project Cycle Management) Workshop held on May 7, 2013.
All of above agenda was approved without any modification.
During above process, various kinds of Q&A were held as shown in below:

2. Discussions:

(1) U Kyaw Linn asked JICA officers about questions and opinions for the work plan.

Mr. Miyake, director of JICA headquarter, explained that macadam would be suitable for Myanmar based on his inspection results of roads in Rakhine state. JICA experts and Seminar lecturers have recommended them also after the survey of soft soil in the Ayeyarwady area. He said that he would also like to introduce Japanese pavement method. He also explained about Dr. Fujimoto situation. JICA doctor decided his health condition is not suitable for working abroad. As for the absence of the chief advisor, number of man-month of short term experts will be increased and dispatch of technical support team from MLIT will be conducted.

Mr. Morikawa explained that standard and manual developed in this project should be suitable for whole Myanmar. In addition, support and arrangement from PW side is quite important to realize smooth acquisition of machinery and equipment.
U Kyaw Linn said road standards and manuals are very important for whole country. And he said that road No. 7 is selected for the Pilot Project because this road is also very important in this region. Stabilizer is provided from Embassy of Japan and it will be utilized effectively.
He also said that macadam method is still used all over Myanmar. However, now it is starting in southern region to upgrade from macadam to well grade base coarse with asphalt concrete overlaying.

Mr. Miyake pointed two problems;

First, macadam is constructed in labor base and quite difficult to use equipment. Secondly, stabilizer is not suitable for the improvement of current macadam layer in Myanmar. If used, the machine can be broken by big stones.

U Kyaw Linn explained that crush rock is difficult to produce in Rakhine state due to the shortage of quarry site with good quality. Good ones can be getting only in far place, and their supply is not easy. Therefore, instead of crush rock layer, we consider concrete pavement or granular base there. On the other hand, crush rock is rather easy to obtain at the Ayeyarwady Delta.

(2) U Kyaw Linn asked opinions from U Aung Myint about pavement design and U Khin Maung about geometric design.

U Aung Myint said that macadam method was used due to qualified materials and economic point of view. And there are now only 2 stabilizers for the project and some tools are still being needed for macadam base projects. He commented about the past working methods on minimum CBR. For the trial section in Delta area, PW should reconstruct existing sub grade to get specified compaction.
He asked what the kinds of pavement layer shall be applied, if the existing sub grade was stabilized?
Is it needed to change pavement layer to verified design method or Japanese method or traditional method compare to stabilize?

U Khin Maung Aye explained that Geometric Design was introduced in MOC since 1969. During Geometric Design review on Asian highway and ASEAN Highway, it has almost same standard as MOC class 3.
According to ASEAN Highway standard agreement, MOC should follow the Asian and ASEAN Highway standard. Review on road research in 1986-88, standard no 5 was not so agreeable, for 2 lane highway with 16 feet road lane which is not used now in other countries.
It should be minimum 18 feet (5.5 meter). It is a standard which is not so different with Myanmar. He suggested reviewing result of Tech section in Yamethin, different kind of tech result done by road researchers sponsored by UNDP.

U Kyaw Linn said they have to do asphalt concrete for ASEAN 2 lane road. And they have to upgrade existing roads to asphalt concrete road before 2015 AEC. Among 5000km roads in country, 3000km has been completed as 2-lane asphalt road. Some of the rest of 2000km are one-lane asphalt road and some are earthen road. Therefore which is preferable upgrading to 24 ft or 18 ft?

U Khin Maung Aye said that 24 ft is enough and satisfied the ASEAN standard.

U Kyaw Linn said they have estimated for 2 years budget and already submitted for government, but approved amount was too less. Therefore they will submit to minister for national planning,

and minister will divide for budget. Dr. Kanzaw (national planning minister) will decide to propose to ADB, JICA or EU for the projects loan.

U Khin Mg Aye proposed to consider for prioritize of beneficial roads. This time, road and bridges should be upgraded to clear missing link.

U Kyaw Linn said there is no missing links but bridges should be upgraded, because some of them are temporary one and not durable.
AH 1 (Tamu-Myawaddy) is important and first priority and have to be finished.
AH2 (Taunggyi-Kyaing tone –Tachililake) is 2nd priority, but Loi Lin-Hsipaw, Than byu zayat-Myeik –Dawei-Kawtthaung are not so important. AEC, all vehicles will be using AH1.

(3) Mr. Kaneda said JICA experts are planning to support modifying geometrical standard.

Furthermore, JICA experts are considering supporting modifying standards of drainage, soft ground treatment, or road maintenance. Maintenance might be studied in next project. He asked the priority of development of manuals as Public Works.

U Kyaw Linn answered pavement including shoulder is the first priority. Soft ground treatment is the second, and third one will be drainage.

Mr. Miyake told that pavement manual (including stabilization) would be prepared by grass root project. Therefore, this area is not treated by this project. This project would like to consider assisting to prepare soft-ground treatment manual or drainage manual.

U Kyaw Linn and U Aung Myint agreed to prepare soft-ground treatment manual or drainage manual in this technical project.

(4) Mr. Sanjo asked about the possibility of privatization reform of MOC, because the technical cooperation is executed by Government to Government base.

U Kyaw Linn answered that Public Works is not only for the regularity body for MOC, but also for government contractor.
It is true that reforming is considered as two parts, one is regulatory body and another will be in regional institutions. Regional offices and regional engineers are under consideration to reform and to resign by compromising.
However most of engineers don't want to resign from government sectors.
It's become big issue to reform. Because of Myanmar geographical situation, nobody wants to go highlands due to difficult access, and that will affect for the works. Therefore, government is planning to reform gradually as privatization by teaching knowledge about privatization like reforming conducted in the New Zealand.

3. Conclusion:

It was acknowledged by the JCC members as follows:

(1) Draft of Work Plan

(2) Revision of Project Design Matrix (PDM)

(3) The priority of development of manuals

(1^{st} priority) Pavement including shoulder

(2^{nd} priority) Soft Ground Treatment

(3^{rd} priority) Drainage

The meeting was adjourned at approx. 11:30 a.m.

Approved by

U Kyaw Linn	Mr. Masaru Miyake
Managing Director	JICA Expert
Public Works, MOC	

Annex 4

<Participant List>

1. Chairman		
U Kyaw Linn	Managing Director	PW

2. Members from Myanmar side			
(1)	U Win Tint	Deputy Managing Director	Work
(2)	U Win Pe	Deputy Managing Director	Planning
(3)	U Khin Maung Kyaw	Chief Engineer	Road Department
(4)	U Ohn Lwin	Chief Engineer	Road Department
(5)	U Thein Zaw	Chief Engineer	Airfield
(6)	U Khin Maung Thein	Chief Engineer	Building
(7)	U Saw Win Naing	Deputy Chief Engineer	Road Department
(8)	U Sai Kyaw Moe	Deputy Chief Engineer	Road Department
(9)	U Win Lwin	Deputy Chief Engineer	Bridge
(10)	U Khin Thet	Deputy Chief Engineer	Airfield
(11)	U San Wai	Deputy Chief Engineer	Airfield
(12)	U Myint Kyi	Superintending Engineer	Ayeyarwady Division
(13)	Daw Khin Than Win	Deputy Superintending Engineer	Road Department

3. **Members from Japan side**			
(1)	Mr. Miyake Shigeki	Director	JICA Headquarter
(2)	Mr. Sanjo Akihito	Deputy Chief representative	JICA Myanmar Office
(3)	Dr. Morikawa Maki	Project Formulation Advisor	JICA Myanmar Office

4. Counterpart			
(1)	U Kyaw Shein	Project Director DCE	Planning
(2)	Daw Hla Hla Thwe	Project Manager SE	Road Department
(3)	Daw Mya Mya Win	Assistant Project Manager DSE	RRL
(4)	U Aung Myo Oo	Assistant Project Manager EE	Phyapon District
(5)	U Thet Zaw Win	Assistant Project Manager EE	Road Department
(6)	Daw Yin Yin Swe	Assistant Project Manager EE	Soil Research Laboratory
(7)	Daw Htar Zin Thinn Zaw	Executive Engineer	RRL
(8)	U Nyi Nyi Zaw	Executive Engineer	Quantity Survey
(9)	Daw Zin Zin Htike	Executive Engineer	Quantity Survey
(10)	Daw Su Mon Kyaw	Township Engineer	Phyapon District
(11)	Daw Ei Ei Mon	Assistant Engineer	Road Department
(12)	U Aung Myint	Consultant	RRL

5. JICA Expert			
(1)	Mr. Miyake Masaru	Long Term Expert	JICA Expert
(2)	Mr. Ishida Kazuki	Long Term Expert	JICA Expert
(3)	Mr. Kaneda Koki	Short Term Expert	JICA Expert

6. Other Attendants			
(1)	Daw Lwin Lwin Mi	Executive Engineer	Road Department
(2)	U Aung Kyaw Han	Executive Engineer	Road Department
(3)	U Myint Oo	Executive Engineer	Road Department
(4)	Daw Myint Myint Sein	Executive Engineer	Yangon Division

Meeting Memo in July 4-2013

Main subject	(1) Submission of draft Work (2) Arrangement of JCC (3) Discussion and confirmation of the contents of Pilot Project		
Date/Time	3/Jul (Wed): 17:30 – 18:00 4/Jul (Thu): 13:00 – 14:30		
Place	MOC/HQ		
Attendance	**(3/Jul)** MD U Kyaw Linn CE(Planning) U Kyaw Shein PD PM Daw Hla Hla EE U Nyi Nyi Zaw U Thet Zaw Win **(4/Jul)** DMD U Win Tint CE (Road) U Khin Maung Kyaw CE (Planning) U Kyaw Shein PD PM Daw Hla Hla Dr. Zin Zin Htike Dr. Hlaing Moe DSE U Thet Zaw Win	(Long Term Expert) Mr. Miyake Mr. Ishida	(Short Term Expert) Mr. Kobayashi Dr. Yoneyama
(1) Submission of draft work plan	JICA Expert team submitted the draft work plan to PW on 3/Jul (Wed). The plan will be finalized in accordance with the comments and suggestion from JICA/HQ and PW. Currently submission date of the final version will be at the beginning of August.		
(2) Signing of Minutes of Meeting	Signing of Minutes of Meeting for “revision of PDM” and “procurement of equipment” was completed by U Kyaw Shein and Mr. Miyake. 2 sets of the original Minutes was made and each party keeps 1 original.		
(3) Revision of the period for the Technical Cooperation project	JICA Expert team just explained about current condition.		
(4) Date of Joint Coordinating Committee (JCC)	JICA requested PW to implement JCC during 1st week of September. PW will decide the date and attendants. The date and attendants will be announced from Daw Hla Hla Thwe to Mr. Ishida. Currently, approximately 20 members from Myanmar side including Minister, Vice-minister, CE will attend the JCC.		
(5) Disposition of road stabilizer during Pilot Project	JICA requested PW for exclusive application of the road stabilizer during the Pilot Project period (Jan – Mar, 2014). PW answered that the stabilizer will arrive at Myanmar in October, 2013. Subsequently, PW will have the training for operation work conducted by the manufacturer (SAKAI). PW will provide the information of the training to JICA as listed below. - Date and period - Location (classwork and field training) - Curriculum and training schedule - Number of the trainees their organizations - Textbook - etc. The above information will be through Daw Hla Hla to Mr. Ishida. Furthermore, PW promised the arrangement of the stabilizer for the project after the training.		
(6) Future road improvement program in Ayeyarwady Region	JICA requested PW to provide future road improvement program in Ayeyarwady Region. PW responded the program till Mar/2016 exists. But, Planned road construction length varies every year. Furthermore, currently PW and local government share the construction length of almost 50% each. However, PW length will be decreasing and local government length/BOT		

	length will be increasing in the future due to the government policy. Dr. Yoneyama will send the form of the program as attached in Table A.2-2 in page 3, Appendix-A of draft work plan. PW will fill the form and send to Mr. Ishida by e-mail within 2 weeks. Furthermore, PW will collect the data of the current driving hour in Ayeyarwady Region. This Collected data will be filled in Figure 1-2 in page 4, chapter-1 of draft work plan and send to Mr. Ishida by e-mail. PW said that it will take more than one month to measure the driving time and some routes are impassable because some bridges are not constructed yet on the routes. JICA suggested that PW will mark "impassable" on the figure in such a case.
(7) Pavement type and work execution method for the Pilot Project	PW and JICA confirmed to apply DBST by equipment based method for the surface course in the Pilot Project.
(8) Topographic survey work in the Pilot Project section	PW will conduct the topographic survey work in 3 candidate sections of the Pilot Project. Output drawings such as cross sections (25m interval) and profile will be prepared into Auto-CAD format before JCC.
(9) (10) Site investigation for the Pilot Project section	JICA Experts (Mr. Ishida, Mr. Miyake, and Dr. Yoneyama) will visit the site on Road No.7 with Executive Engineer in Phyapon District Office at 9 am on 10/Jul. Purpose of the visit is for the identification of the deteriorated location caused by ground movement (e.g. settlement, landslide). The result of the investigation will be utilized to consider the countermeasure work. JICA requested PW to dispatch the staffs to the investigation for the training. PW answered that they will dispatch one engineer from RRL and one geometric division engineer, Daw Ei Ei Mon.
(11) Capability of the PW for monitoring work of ground movement	JICA proposed to conduct monitoring work of the ground movement during the Pilot Project. The work content is described in page 66 – 70, chapter-3 of draft work plan. PW will carefully examine the content by considering their capability including tool and manpower. Furthermore, involvement of SRL is necessary for boring work and core sampling work. PW will have internal discussion for the involvement of SRL. The content will be finalized in accordance with the result of the above examination and the discussion. Moreover, PW suggested using piezometer to measure vertical settlement instead of settlement measurement board. JICA responded the measurement method and the instrument should be simplified for the broadly application in other region. Furthermore, the risk of stolen and broken of the instrument should be minimized. Therefore, JICA preferred to use the board. Note training of the measurement and analysis method will be conducted before the commencement of the Pilot Project.
(12) Budget preparation for the Pilot Project	JICA requested PW for the allocation of the sufficient budget for the Pilot Project. PW responded to make an effort as much as possible. Application of the supplemental budget also will be considered.
(13) Official unit rate of construction work	JICA requested to confirm the existence of the official unit rate of construction work in PW. PW responded to confirm "cost estimate department". PW will send the answer before JCC.
(14) Current status of the translation work of the 2 sets of the manuals	JICA requested to confirm the current status of the translation work of the manuals requested in April. PW responded to complete the work before JCC.
(15) Member of Project Implementation Body	JICA requested to include SRL into the Project Implementation Body (PIB) indicated in Figure 1-8, page 11, chapter-1 of draft work plan. PW will have internal discussion for this matter. Furthermore, "Consultant" will be placed on the another line of PW members.

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY,
AND
PUBLIC WORKS, MINISTRY OF CONSTRUCTION,
THE GOVERNMENT OF THE REPUBLIC OF THE UNION OF MYANMAR
ON
JAPANESE TECHNICAL COOPERATION
FOR
THE PROJECT FOR IMPROVEMENT OF ROAD TECHNOLOGY
IN DISASTER AFFECTED AREA

The Japanese Mid-term Review Team (hereinafter referred to as "the Team") organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Mr. Shigeki Miyake visited the Republic of the Union of Myanmar (hereinafter referred to as "Myanmar") from 11 to 22 August, 2014 for the purpose of conducting a Mid-term Review of "the Project for Improvement of Road Technology in Disaster Affected Area" (hereinafter referred to as "the Project").

During its stay in Myanmar, the Team joined by the Myanmar side evaluator had a series of discussions and exchanged views with authorities concerned of the Government of Myanmar (hereinafter referred to as "Myanmar side") in order to jointly evaluate the achievements of the Project.

As a result of the discussions, the Team and Myanmar side agreed to the matters in the documents attached hereto.

Nay Pyi Taw, 20 August 2014

_____	_____
Mr. Shigeki Miyake	U Kyaw Linn
Team Leader	Managing Director
Japanese Mid-term Review Team	Public Woks
Japan International Cooperation Agency	Ministry of Construction
Japan	The Republic of the Union of Myanmar

Attachment-1

The Team presented the Joint Mid-tem Review Report and explained the results including recommendations. The Team and Myanmar side discussed the contents of the Joint Mid-term Review Report and adopted the Report as Attachment 1.

JOINT MID-TERM REVIEW REPORT

ON

THE PROJECT

FOR

IMPROVEMENT OF ROAD TECHNOLOGY

IN DISASTER AFFECTED AREA

IN

THE REPUBLIC OF THE UNION OF MYANMAR

AUGUST 2014

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ANNEX LIST

LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
BOT	Built, Operation & Transfer
BS	British Standards
CAD	Computer Aided Design
CE	Chief Engineer
C/P	Counterpart
CTC	Central Training Center
DD	Deputy Director
DDA	Department of Development Affairs of Ministry of Border Affairs
DMD	Deputy Managing Director
DSE	Deputy Superintending Engineer
ED	Executive Director
EE	Executive Engineer
GOM	The Government of the Republic of the Union of Myanmar
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
MLIT	Ministry of Land, Infrastructure, Transportation and Tourism (Japan)
MOC	Ministry of Construction
M/M	Minutes of Meeting
PDM	Project Design Matrix
PO	Plan of Operations
PP	Pilot Project
R/D	Record of Discussions
RRL	Road Research Laboratory
SRL	Soil Research Laboratory

1. INTRODUCTION

1.1 Objectives of the Mid-term Review

The Objectives of the Mid-term Review are as follows:
(1) To review the accomplishments of the Project in terms of inputs, activities, and outputs;
(2) To examine the process of project implementation;
(3) To identify obstacles and/or enabling factors that affect project implementation; and
(4) To provide recommendations regarding the measures to be taken for the remaining period of the project.

1.2 Methodology

The Team reviewed related documents and information collected through questionnaires and interviews with Japanese experts, Myanmar C/Ps, pilot famers and relevant stakeholders. The Team analyzed the Project from the viewpoints of 1) achievements of the Project, 2) implementation process, and 3) the five evaluation criteria.

(1) Achievements of the Project
Achievements of the Project were measured in terms of Inputs, Outputs, Project Purpose, and Overall Goal in the light of the Objectively Verifiable Indicators of the PDM version 1.0 (attached in ANNEX 2).

(2) Implementation Process
Implementation process of the Project was reviewed to see if the activities have been implemented according to the schedule shown in the PO, and to see if the Project has been managed properly, identifying contributing/hindering factors that have affected the implementation process.

(3) Evaluation based on the Five Evaluation Criteria
The Project is evaluated against the Five Evaluation Criteria (see the following table) of the OECD Development Assistance Committee (DAC), which is the standard measurement applied by JICA.

Five Evaluation Criteria

1. Relevance	Degree of compatibility between the development assistance and priority of policies of the target group, the recipient, and the donor.
2. Effectiveness	A measure of the extent to which an aid activity attains its objectives.
3. Efficiency	Efficiency measures the outputs -- qualitative and quantitative – in relation to the inputs. It is an economic term which is used to assess the extent to which aid uses the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted.
4. Impact	The positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the activity on the local, social, economic, environmental and other development indicators.
5. Sustainability	Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn. Projects need to be environmentally as well as financially sustainable.

Source: New JICA Guideline for Project Evaluation First edition (June, 2010) P.23

1.3 Members of the Team

The members of the Team are as follows:
(1) Japanese Side

Name	Role in the Team	Position, Organization
Mr. Shigeki Miyake	Leader	Director Team 2, Transportation and ICT Group, Infrastructure and Peacebuilding Dept., JICA
Mr. Toru Tsuchihashi	Cooperation Planning	Highway Engineer (Road & Bridge), Planning and Coordination Div. Infrastructure and Peacebuilding Dept., JICA
Ms. Kazuko Shirai	Evaluation Analysis	Consultant Kaihatsu Management Consulting, Inc.

(2) Myanmar Side

Name	Role in the Team	Position, Organization
U Aung Myint Oo	Leader	Project Director, Deputy Chief Engineer, Planning Dept., PW-HQ
Daw Hla Hla Thwe	Team member	Project Manager, Superintending Engineer, Road Dept., PW-HQ
Daw Mya Mya Win	Team member	Assistant Project Manager, Deputy Superintending Engineer, RRL

1.4 Schedule of the Review

The review was conducted from 11 to 22 Aug 2014 in Myanmar. The detailed schedule is attached in Annex 3.

2. OUTLINE OF THE PROJECT

2.1 Background

Road structure in the Government of the Republic of the Union of Myanmar (hereinafter referred to "GOM") is very vulnerable to inundation. Especially in Ayeyarwady Division, as that area is located in coastal area, they have huge risk of suffering the damage from disasters. When Cyclone "Nargis" hit these areas, inadequate road condition hindered relief operation and recovery effort. These risks are seriously considered by Public Works responsible for road construction and maintenance. However, they cannot take enough actions and road network available for all-year round has not yet established. Uniform technical standard of road is applied for all areas, but proper road technique is different in other respective areas. To secure the availability of roads through all year round, it is essential to develop the standard with consideration of area characteristic, long-term maintenance and proper technique for target area. In addition, some engineers' technical level is also low because training center gives training on road technology but that training is only general one and isn't advanced one for road construction and maintenance under special condition such as soft-ground, Vulnerability of roads in Myanmar is caused by the lack of budget and road technology mentioned above. To secure the availability of roads for life and security of local people, upgrade of technical standard and enhancement of capacity of engineers are indispensable.

Under such circumstances, GOM requested to the Government of Japan in August 2011 for a “Technical Cooperation Project for Improvement of Road Technology in Disaster Affected Area”. In response to the request, JICA carried out the preparatory study in February 2012 to determine the details of the project components. The Record of Discussions (hereinafter referred to as “R/D”) about the framework of the Project was signed in July 2012.

2.2 Project Overview

2.2.1 Overall Goal

Roads in the delta areas of Ayeyawardy Region are improved.

2.2.2. Project Purpose

The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyawardy Region is enhanced.

2.2.3. Outputs

There are two outputs;

(1) Road technology standards and manuals for designing and construction works are improved.

(2) The practical skills and knowledge of the road technical staff are enhanced.

2.2.4 Implementing Organization

The implementation organization is PW.

2.2.5 Target Group

The target group of the Project is Road Technical Staff of PW.

3. INPUTS PROVIDED TO THE PROJECT

3.1 Japanese side

Items	Actual Inputs
Dispatch of Experts	1) Long-term Experts: initially three (3) experts (Chief Advisor, Road Technology Standards, Project Coordination), two (2) experts (Road Technology Standards, Project Coordination) at present 2) Short-term Experts: seven (7) experts, total 15.66MM
Provision of Equipment	- Boring machine, testing equipment, etc. (total cost: US$ 127,9555)
Training in Japan	- Training in Japan was conducted from September to October in 2013 for five (5) participants from PW.
Project Expenses	- The Project bored US$ 117,588 for holding seminars / workshops

3-2. Myanmar side

Items	Actual Inputs
Assignment of Counterparts	- JCC Chairman (MD of PW) - Project Director (D.C.E-Planning), Project Manager (S.E.-Road) , Assistant Project Manager (D.S.E-RRL) - C/P (RRL, SRL, CTC)
Working Environment Preparation	- Office space at MOC building and CTC
Project Budget	- 400 million kyat for PP-1

4. ACHIEVEMENT OF THE PROJECT

4.1 Achievement of Activities

The activities for PP-1 of Output 2 have been completed mostly before rainy season of 2014 in spite of the delay on the beginning. As the preparation work of guideline/manual (activity 1-5), the Soft Soil Treatment Manual (Myanmar version – by English) is now on going. Those manual and recommendations will be submitted to PW by the end of the Project.

Several road projects are simultaneously on-going in Ayeyawardy delta area at present. In such circumstances, pre mixing test, transportation of machineries and material were delayed, which hindered smooth implementation of PP-1 for Output 2.

The Project also sifted its plan from behavior observation by building new embankment to behavior observation of existing embankment due to lack of PW's budget.

Details of achievement of activities are described as follows:

0-1 Make a project planning paper	The Project completed the Implementation Plan soon after the project commencement
0-2 Conduct baseline and impact survey	# The Project conducted the base line data survey # Numbers of standards and manuals were identified to be ten. # Translation of two manuals from Myanmar language to English has not been completed.
0-3 Make a Work Plan	The Work Plan was completed.
Activities for Output 1: Road technology standards and manuals for designing and construction works are improved	
1-1 Review the standards and manuals of road technologies for designing and construction	The Project reviewed 10 kinds of manuals, and accumulated comments.
1-2 Analyze the issues and challenges on the road construction works in Myanmar	#The Project exchanged views on the plan with PW engineers. (PW engineers agreed with the plan and already solved some problems.)
1-3 Conduct research on construction conditions including soft ground	# The Project conducted a field survey of national road in Ayeyawardy delta area to grasp present condition of road design and construction works. # Based on the result of survey, the short-term experts are

	preparing the Soft Soil Treatment Manual with approval of the JCC.
1-4. Specify the road technologies for designing and construction necessary to be developed	# The pavement manual has already been formulated by the Japan Infrastructure Partners (JIP) under the Grass Root Project supported by JICA. The Project decided to discuss issues of formulate the Soft Soil Treatment Manual under the acceptance of JCC.
1-5 Develop road standards and manuals, and revise them based on the outcomes of the pilot project(s) as necessary	# The Project will revise necessary part of the Soft Soil Treatment Manual based on the Pilot Projects.
1-6 Conduct workshop/seminars to share the contents of the road technology standards and manuals with the road technical staff across the country	# The Project has conducted the following seminars on Japanese road technology standards: - Seminar on soft ground and pavement (June 2013) - Seminar on soft soil ground (December 2013) - Seminar on geometric design and road safety facility, salt damaged bridge and soft soil ground (May 2014) # The Project will conduct seminars on the Soft Soil Treatment Manual
Activities for Output2: **The practical skills and knowledge of the road technical staff are enhanced.**	
2-1 Select pilot project(s)	# The Project identified PW's road development plan, conducted a field survey in Ayeyawardy delta area, and collected soil materials for test use at RRL. # Based on results of these activities, the Project selected and evaluated the project site for PP-1. # The site for high embankment is decided.
2-2 Conduct research activities on construction conditions including soft ground	# The Project discussed with the manager of Pyapon District Office on countermeasure of shoulder repair works near the road starting section, and possibilities of negative impact for local residents. # The Project also conducted stabilization treatment mixing test, selected machineries for PP-1, and conducted a boring test by out-sourcing company.
2-3 Formulate the work plan, including outline design, cost calculation, quality control, etc., of the selected pilot project(s)	# The Project conducted a topographic survey to draft drawing with CAD including quantity calculation # The Project implemented mixing test at RRL. # The Project developed construction plan by making construction work sequences, in which kind of the inputs and key points needed in construction site are illustrated.
2-4 Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans	# The Project executed capacity enhancement for construction management, quality control, progress control, and machinery management in PP-1.
2-5 Conduct training on road construction for technical staff, operators, etc. through the pilot project(s)	# The Project conducted intensive training on design, construction management, quality control, and machineries management in PP-1.
2-6 Monitor the pilot project(s) based on the plans	The Project monitored work progress of PP-1 through the weekly meeting
2-7 Convene the workshops/seminars to share the experiences, outcomes of the pilot project(s)	# The 1st seminar (13, 14 June 2013) on pavement in tropic area, introduction of Japanese road standards, countermeasures against soft soil ground, and pavement for 52 participants # The 2nd WS (14, December 2013) on construction plan of PP-1 and high embankment observation for 39 participants from RRL, SRL, YTU, and district offices # The Project held completion report seminar of PP-1 (May 28, 2014) in Nay Pyi Taw for 40 participants.

4.2 Achievement of Outputs

The following are the achievements of the two Outputs based on the Objectively Verifiable Indicators (herein after OVI) in the PDM version 1.0.

Preparation works of standards/manuals are on-going as planned in Output1.Capacity enhancement works for the engineers of RRL, SRL and district office is now on going well through the On the Job Training on trial stabilization, behavior observation and analysis of high embankment by utilizing stabilizer donated by non-project grant and boring machine procured in this project.

The seminar, work shop and training also contributed for the capacity enhancement, in which practical engineering subject were covered.

Output1. Road technology standards and manuals for designing and construction works are improved	Indicators: 1) The number of the road technology standards and manuals is increased. Result: # The Project is preparing the Soft Soil Treatment Manual.

Output2: The practical skills and knowledge of the road technical staff are enhanced.	Indicators: 2) The number of trained engineers (Seminar, Workshop and On-the job training (OJT) Result: # PCMWS-1（May 2013）: 39 participants # Introduction of advanced technology in Japan for road Sector(June 2013）: 52 participants # 2nd PCMWS (December 2013）:40 participants # Road material & Bridge inspection seminar:15 participants from PW # Pilot Project Reporting meeting: 29 participants from PW-HQ 29 （total 131 participants）

4.3 Achievement of the Project Purpose (prospect)

The Project Purpose:

The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyawardy Region is enhanced.

The achievement of each indicator of the Project Purpose is described as follows:

Indicator 1) Road length constructed by the technology introduced from Pilot project	1.6km of road was constructed by the technology introduced from PP-1 so far.
Indicator 2) Improved road conditions in delta area	The indicator is not appropriate to measure the project purpose.

4.4 Achievement of Overall Goal

Overall goal:

Roads in the delta areas of Ayeyawardy Region are improved.

In order to achieve Overall goal, it is necessary to 1) construct durable paved roads, and 2) conduct appropriate maintenance. The Project identifies soil characteristics, plans and implements countermeasure works, and searches for appropriate soil materials for construction of durable roads during the project period. Maintenance is indispensable for long lasting roads even though it is not covered by the Project scope.

The prediction of achievement of Overall goal is described as follows:

Indicator 1) The length (km) of road construction under the control of the PW is increased in the delta areas	It is expected 10 km to be extended with introduced technologies by the Project after 3 to 5 years of the project end
Indicator 2) Driving time and travel time are shortened	10 % is expected to be shortened

5. IMPLEMENTATION PROCESS

5.1 Implementation process of Activities

PP-1 stabilization trial work has completed in June 2014 on the delay as mentioned in 4-1. The earthwork at the target project about high embankment treatment has started since February 2014, and suspended in May 2014 due to entering to rainy season. Preparation work for behavior observation, such as installation of equipment as PP-2 works has completed in March 2014. The phase 2 trial stabilization works scheduled in PP-2 will be finalized in May 2015. Issue is the possible delay of procurement of Soil plant up to February 2015.

5.2 Methodology/Skill Transfer

New technology, testing skills and new knowledge, such as stabilization method, methods of high embankment on soft ground were transferred through domestic training and C/P training in Japan, seminars, workshop and OJT during implementation of PP-1 and PP-2. Engineers participated actively in practical training in the field. At the time of training in SRL for boring machine, all the engineers gathered to learn how to operate the machine, sharing new knowledge and skill for future use.

5.3 Project Monitoring System

5.3.1 Reporting System

The Project is reported to JICA HQ and JICA Myanmar Office as follows:

1) The Project submitted the 1st Progress Report
2) The Project submitted the Completion Report of PP -1
3) Long-term expert submitted the 1st Interim Report (Japanese)

The JICA HQ and JICA Myanmar Office monitor the Project through above reports, discussion with Japanese experts and C/P, and provide necessary support to the Project.

5.3.2 Joint Coordination Committee (JCC)

The JCC as the highest decision making mechanism, was held in February 2012 to discuss and approve the following subjects of approval of PDM and PO.

Although the Project does not have a regular meeting on working level gathering all the working level of C/P, Japanese experts visit C/P for consultation as needed.

6. REVIEW BY FIVE EVALUATION CRITERIA

6.1 Relevance

Relevance of this project is relatively high as evidenced by the following factors;

6.1.1 Policy priority

The GOM has prioritized in road construction in the 3rd Five Year Road Development Plan (2011/12 ～ 2015/16) in the 30 years Road and Bridge Development Plan (2001/02～2030/31).

The technical standards have not been largely changed since the time of Detailed Planning Survey for this project conducted in 2012.

The Project objective is in line with the national plans at present as well.

6.1.2 Needs of Target Group

1) PW

- The Project is preparing recommendations for modification of the existing standard, of which already contributed improvement of some roads in Myanmar.
- Considering Myanmar society, economic status and environment, PW has a strong will to analyze a variety of standards such as BS, AASHTO and Japanese one, modifying the standard to apply for roads in Myanmar.
- PW also recognizes that the new skills and knowledge for soft soil stabilizing countermeasures transferred from PP-1 and PP2 have benefitted especially for younger engineers of PW.

2) RRL & SRL

In RRL, technical transfer on soil testing method for soft soil countermeasure work is particularly in line with the need of the engineers. The boring machine procured by the Project was another example of fulfilment of SRL's needs for improvement of soil testing.

3) Pyapon District Office

The engineers at Pyapon District Office of PW had an opportunity to learn how to conduct survey, soft

soil treatment, to supervise construction works, and to operate the stabilizer through the implementation of PP-1.

6-1-3 Relevance of the Project Plan

The Team identified that indicators in the present PDM version 1 are needed to be modified since they are not clear with target figures, and a logical relation between the indicators of Project purpose and Output is not clear.

6.2 Effectiveness

Effectiveness of this project is as middle evidenced by the as following factors;

6.2.1 Achievement of Project purpose

- The indicator-1 of the Project purpose is not measurable due to lack of target figure set. Although in the circumstance of limited budget of PW, and in which the stabilization methods are not approved yet, it is expected that road length constructed by the technology introduced from PP-1 and PP-2 will exceed its covering length in Road no.7 in Pyapon district by the end of the Project.
- The indicator to measure improvement of road condition is not appropriate to measure the capacity enhancement of PW engineers.

6.2.2 Logicality and contribution of Outputs

- Some of recommendations for modification of Myanmar road standards have been accepted and applied for improvement of road in Myanmar. However, C/P side regards these recommendations as a source for comparison among other ones' standards for future development of Myanmar road standards.
- The enhancement of practical skills and knowledge of the road technical staff are directly contributing capacity enhancement of PW.

6.3 Efficiency

Efficiency of this project is relatively low as evidenced by the following factors;

6.3.1 Achievement of Outputs

- As for the achievement of Output1, the Project is preparing the Soft Soil Treatment Manual. Some of the recommendations for modification of standards have been adopted by PW, and applied for improvement of roads.
- The practical skills and knowledge of PW engineers at RRL, SRL, and Pyapon District office were enhanced through OJT, Intensive Training Program of PP-1.

6.3.2 Inputs

(1) Japanese side

- Six (6) months of delay in dispatching long-term experts due to delay of issue of Visa hampered the smooth commencement of the Project activities with close discussion of testing works in the 1st project year.
- Expertise and instruction of Japanese experts for C/P are effective to ensure the quality of activities.
- Provision of boring machine was effective to upgrade SRL engineers' capacity to conduct soil test.

(2) Myanmar side

- Although some C/P s are not able to fully engaged in the project activities due to simultaneously on-going projects, they are very eager and active to absorb new skills and knowledge from the Project.
- Some of activities, such as drainage layer construction work and sodding work for slope, were changed due to lack of PW's budget.

6.4. Impact

6.4.1 Prospect of Achievement of the Overall Goal

Cost of stabilizing method is twice higher than that of ordinary Macadam method. Even though it is costly, using stabilizer is effective in Ayeyawardy delta area. It depends on PW's budget

And the result of examination of effectiveness of the method whether they can extend the length with such method.

As for the indicator-2, the Team identified that travel hour for students already decreased near the PP-1 site. However, the target figure of hour is still needed for appropriate evaluation.

6.4.2 Impact to Environment and Society

Pyapon district office received some reference from surrounding district office on implementation of PP-1 and some non-targeted engineers participated in training. These factors show some impacts to non-targeted area in Ayeyawardy delta area.

As above mentioned, daily life of local residents near PP-1 site improved in terms of traveling time, access to hospital and market.

6.4.3 Negative Impact

There was no negative impact identified in this review survey.

6.5 Sustainability

Sustainability of this project is middle as evidenced by the following factors;

6.5.1 Institution

PW owns the Center for Training for Construction (CTC) to train engineers on design, testing, and construction works. The collaboration between the Project and CTC was not identified during the survey, however, RRL showed their will to continue capacity enhancement of engineers with CTC after the Project period.

SRL assured appropriate operation and maintenance of the boring machine. They appointed a high level engineer to handle the machine for evading possible troubles by multiple users.

6.5.2 Finance / budget

Stated as above, shortage of budget caused delay and change of project activities. In future, budget issue might be critical for extension of road with stabilizing methods, since the construction cost is nearly twice higher than the ordinary Macadam method.

6.5.3 Ownership of the Target Groups

PW has strong ownership in establishing the appropriate standards by themselves. Establishment of road standards requires a long period of analysis with consideration of all the conditions of society, economy and budget.

6.5.4 Skills and Knowledge

All the interviewed C/Ps at PW, RRL, SRL and Pyapon district appreciated new skills and knowledge of soil testing and construction work. Administrative know-hows such as report writing and conducting periodical meeting were also appreciated among Pyapon district engineers. They showed strong will to maintain these new skills and techniques after the end of the Project, however, it depends on budget and approval whether they can continue to construct roads with stabilizing method or not in future.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- The Project has implemented its activities to recover the delayed schedule by extending construction period and changed the contents of construction works. Monitoring of the entire management of the Project is not done by either side of Japanese or Myanmar side. Closer communication between C/P and Japanese experts on working level is needed for smooth implementation of the Project activities.
- The achievement of Project Purpose (Effectiveness) depends on how far PW can improve the road in delta area. However, it is not allowed for Pyapon district to extend the road with stabilizing method before the recommended standards are approved.
- Considering Efficiency of the Project, management aspect of PP-1 and PP-2 such as transportation of machineries and materials, largely affects progress of the Project.
- While C/P has strong will to maintain the transferred skills and knowledge, it depends on budget and approval from PW-HQ whether they can use those skills and knowledge after the Project end. Contrary, according to the study by Japanese experts, maintenance cost and durability of stabilized road is much less than that of ordinary one. Without clear and continuous explanation of cost benefit and actual results of experiments, it would be difficult for PW to maintain stabilizing method in longer term.

7.2 Recommendations

- Increase the frequency of meetings and continuous revision of technical manuals.
  Because of the scattered office and busy schedule of PW members and Japanese experts, it is difficult to have prompt discussion an agreement among them The Team recommends to have JCCs more frequently or establish technical committees in specific fields for the close communications, as soon as possible.
  For example, the technical committees could have a function to revise and update the manuals continuously so as to fully apply for Myanmar's economic and social conditions.

- Revision of the Project Design Matrix (PDM)
  PDM 1.0 was drafted in the first JCC in September 2013. However the Team found some ambiguities in the PDM. Therefore the Team suggests revision of the present PDM by referring the attached PDM (See ANNEX 7) by the next JCC.

- Monitoring of the outputs of the Project by PW
  The outputs of the Project, e.g. construction manuals for soft soil condition and practical knowledge obtained by pilot projects, will be shared among the Project participants. The Team suggests that PW monitors the competitiveness of pilot projects among the existing methods and proceed to approve them appropriately.

- Secure the budget for the road construction
  It is important to secure the appropriate road construction budget for rural areas. The Team suggests that PW monitor the result of pilot projects after the Project period and compare with the existing methods from the perspective of lifecycle cost.

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY,
AND
PUBLIC WORKS, MINISTRY OF CONSTRUCTION,
THE GOVERNMENT OF THE REPUBLIC OF THE UNION OF MYANMAR
ON
JAPANESE TECHNICAL COOPERATION
FOR
THE PROJECT FOR IMPROVEMENT OF ROAD TECHNOLOGY
IN DISASTER AFFECTED AREA

The Japanese Terminal evaluation Team organized by Japan International Cooperation Agency (hereinafter referred to as "JICA") headed by Mr. Yoshihiro Kakishita visited Myanmar from 9 to 20 March, 2015 for the purpose of conducting a Terminal Evaluation of "the Project for Improvement of Road Technology in Disaster Affected Area" (hereinafter referred to as "the Project").

During its stay in Myanmar, the Japanese Team joined by the Myanmar side Evaluator had a series of discussions and exchanged views with authorities concerned of the Government of Myanmar (hereinafter referred to as "Myanmar side concerned authorities") in order to jointly evaluate the achievements of the Project.

As a result of the discussions, the Evaluation Team and Myanmar side concerned authorities agreed to the Joint Terminal Evaluation Report attached hereto.

Nay Pyi Taw, 19 March 2015

Mr. Yoshihiro Kakishita	U Kyaw Linn
Team Leader	Managing Director
Japanese Terminal Evaluation Team	Public Woks
Japan International Cooperation Agency	Ministry of Construction
Japan	The Republic of the Union of Myanmar

ATTACHED DOCUMENT

I. The Terminal Evaluation of the Project

The Evaluation Team presented the Joint Terminal Evaluation Report and explained the results including recommendations. The Evaluation Team and Myanmar side concerned authorities discussed the contents of the Joint Terminal Evaluation Report and other related point.

ATTACHMENTS:

1 Joint Terminal Evaluation Report
2. Other related point

Attachment 1

JOINT TERMINAL EVALUATION REPORT

ON

THE PROJECT

FOR

THE PROJECT FOR IMPROVEMENT OF ROAD TECHNOLOGY

IN DISASTER AFFECTED AREA

IN

THE REPUBLIC OF THE UNION OF MYANMAR

MARCH 2015

Abbreviation

AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
ASEAN	Association of South - East Asian Nations
BOT	Build, Operate and Transfer
BS	British Standards
C/P	Counterpart
CAD	Computer Aided Design
CE	Chief Engineer
CTC	Central Training Center
DAC	Development Assistance Committee
DD	Deputy Director
DDA	Department of Development Affairs of Ministry or Border Affairs
DMD	Deputy Managing Director
DSE	Deputy Superintending Engineer
ED	Executive Director
EE	Executive Engineer
GDP	Gross National Product
GOJ	Government of Japan
GOM	The Government of the Republic of the Union of Myanmar
HRD	Human Resources Development
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
LLC	Life Cycle Cost
M/M	Minutes of Meeting
MLIT	Ministry of Land, Infrastructure, Transport and Tourism (Japan)
MOC	Ministry of Construction
OECD	Organization of Economic Cooperation and Development
OJT	On-the-Job Trainings
PDCA	Plan Do Check and Action
PDM	Project Design Matrix
PO	Plan of Operations
PP	Pilot Project
R/D	Record of Discussions
RRL	Road Research Laboratory

SRL	Soil Research Laboratory
TCP	Technical Cooperation Project
TOT	Training of Trainers
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WTO	World Trade Organization
YTU	Yangon Technical University

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LIST of ANNEX

1 Introduction

1.1 Objectives of the Terminal Evaluation

The Japan International Cooperation Agency (JICA) has been cooperating with the Department of Public Works, (PW) of the Ministry of Construction (MOC) of the Republic of the Union of Myanmar in the implementation of the "Project for the Improvement of Road Technology in Disaster Affected Area in the Republic of the Union of Myanmar" (The Project) since July 2012. The objectives of the Terminal Evaluation are to assess the performance of the project at the three month prior to the end of the duration to make sure the achievement of the Outputs and the Project Purpose, and their indicators. Based on the result of the analysis, the direction of the project implementation as well as the issues to be resolved would be addressed among the parties concerned.

1.2 Methodology

The Terminal Evaluation shall be carried out in accordance with the JICA Guideline for Project Evaluation. The guiding principles of the evaluation are as follows:

(1) The Project Design Matrix (PDM) (attached in Table-1) is to be agreed upon by both sides and utilized as a basis of the evaluation process,

(2) The achievement of the Project is to be confirmed by collecting data defined in the objectively verifiable indicators of the PDM;

(3) Achievements of the Project were measured in terms of Inputs, Outputs, Project Purpose, and Overall Goal in the light of the Objectively Verifiable Indicators of the PDM, and

(4) The Project is evaluated against the five evaluation criteria defined by the Development Assistance Committee (DAC) Evaluation Quality Standard of the Organizational for Economic Cooperation and Development (OECD) which is the standard measurement applied by JICA (Explained in the Table-1).

In addition, more holistic perspective in assessing the overall achievements of the PW-JICA collaboration since the launch of the Project shall be employed. More specifically, what and to what extent the road construction in the Ayeyarwady Region of Myanmar has and has been changing through the interventions by the Project.

1.3 Key Terms of the DAC Principles for Evaluation of Development Assistance

JICA applies the following five (5) criteria for value judgment of the Project review and evaluation as a standard measurement defined in the DAC Principles for Evaluation of Development Assistance and the Glossary of Key Terms in Evaluation and Results Based Management[1] explains the description of the five evaluation criteria (Table-1).

[1] The DAC Principles for the Evaluation of Development Assistance, OECD (1991), Glossary of Terms Used in Evaluation, in 'Methods and Procedures in Aid Evaluation', OECD (1986), and the Glossary of Evaluation and Results Based Management (RBM) Terms, OECD (2000).

Table-1 General Description of the Five Evaluation Criteria

Criteria	General Description
Relevance	Degree of compatibility between the development assistance and priority of policy of the target group, the recipient, and the donor.
Effectiveness	A measure of the extent to which an aid activity attains its objectives.
Efficiency	Efficiency measures the outputs – qualitative and quantitative – in relation to the inputs. It is an economic term which is used to assess the extent to which aid uses the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted.
Impact	The positive and negative changes produced by a development intervention, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the activity on the local social, economic, environmental and other development indicators.
Sustainability	Sustainability is concerned with measuring whether the benefits of an activity are likely to continue after donor funding has been withdrawn. Projects need to be environmentally as well as financially sustainable.

Source: New JICA Guideline for Project Evaluation First edition (June, 2010) P.23

1.4 Members of the Joint Terminal Evaluation Team

(1) Myanmar Side

Name	Title and Affiliation
U Aung Myint Oo	Project Director, Public Works, Ministry of Construction, PW
Daw Hla Hla Thwe	Project Manager, PW
Daw Mya Mya Win	Deputy Superintendent Engineer, RRL, PW

(2) JICA Side

Designation	Name	Title and Affiliation
Team Leader	Mr. Yoshihiro Kakishita	Senior Advisor to the Director General, Infrastructure and Peacebuilding Department, JICA
Cooperation Planning	Mr. Toru Tsuchihashi	Highway Engineer (Road and Bridge), Planning and Coordination Division, Team 1 Transportation and ICT Group, Infrastructure and Peacebuilding Department, JICA
Evaluation Analysis	Mr. Masato Onozawa	Consultant, IC Net Inc.

1.5 Schedule of the Terminal Evaluation

The terminal evaluation was conducted from 8 to 21 March 2015 in Myanmar. The detailed schedule is shown in the Annex 3.

2 Outline of the Project

2.1 Background

The road construction and maintenance in the Republic of the Union of Myanmar faces a variety of challenges and difficulties. In Ayeyarwady Division, as the area is located in the coastal zone of the country, they are prone to face significant risks damages from disasters. When Cyclone "Nargis" hit these areas in 2008, inadequate road condition hindered relief operations and recovery efforts. Such risks have been seriously considered by GOM. The Public Works (PW), a agency responsible for road construction and maintenance in Myanmar, however, is not able to ensure full access to its road network all year round under any weather conditions due to lack of adequate road construction technologies are not fully developed and applied by meeting a variety of parameters, PW is in need of developing the standards take into the consideration of natural conditions, the need of long-term maintenance and proper road technologies matching the respective region.

In addition, some engineers' technical level has much room for improvement because its training center gives training on road technology but the training provided are limited to general one and isn't advanced one for road construction and maintenance under special condition such as soft-ground, Such challenges of roads in Myanmar is caused by the lack of budget and road technology mentioned above. To secure the availability of roads for life and security of local people, upgrade of technical standard and enhancement of capacity of engineers are indispensable.

Under such circumstances, GOM requested to the Government of Japan (GOJ) in August 2011 for a "Technical Cooperation Project for Improvement of Road Technology in Disaster Affected Area". In response to the request, JICA carried out the preparatory study in February 2012 to determine the details of the project components. The Record of Discussions (R/D) on the framework of the Project was signed in July 2012.

2.2 The Project Overview

2.2.1 Overall Goal

Roads in the delta areas of Ayeyarwady Region are improved.

2.2.2 Project Purpose

The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.

2.2.3 Outputs of the Project

(1) Road technology standards and manuals for designing and construction works are improved.

(2) The practical skills and knowledge of the road technical staff are enhanced.

2.2.4 Implementing Organization

The implementation organization is PW of MOC

2.2.5 Target Group

The target group of the Project is Road Technical Staff of PW.

3 Project Performance and Inputs

3.1 Implementation of the Activities

3.1.1 Inputs from the Japanese Side

Inputs includes dispatch of experts, trainings in Japan, trainings, seminars and workshops in Myanmar, the Project cost, provision of equipment. Basically the inputs have been arranged as initially agreed.

(1) Dispatch of Experts

Long-term experts and short-term experts are dispatched as shown in ANNEX 5.

(2) Local Cost

The local cost borne by the Japanese side is shown in Table-2. The detailed breakdown of the local cost borne by the Japanese side is shown in ANNEX 8.

Table-2 Local Cost Borne by the Japanese Side

Year	JFY 2012	JFY 2013	JFY 2014	JFY 2015 (Planned)	Total
Local Cost	6,080	62,890	53,527	15,000	123,997

Unit: in US Dollar

(3) Equipment Provided

The list of equipment provided from the Project is shown in ANNEX 7. The soil mixing plant is scheduled to be installed in April 2015.

3.1.2 Inputs from the Myanmar Side

(1) Appointment of Counterpart Personnel

The Managing Director (MD) of PW has served as the Project Director whilst a Deputy Chief Engineer (DCE) has been appointed as the Project Manager to oversee the overall implementation of the Project. Engineers of various departments of PW are assigned to the Project as counterparts and involved a variety of activities in the course of the implementation (See ANNEX 4).

(2) In-kind Contribution of Office and Facilities

The Myanmar side provided the Project the office space for JICA experts. PW has allowed the Project for use of rooms for meetings and training activities in its premises.

(3) Cost for the Pilot Projects

The Myanmar side provided the cost necessary for carrying out the two pilot projects. The total cost borne by the Myanmar side is 772.0 million Kyats.

(4) Local Expenses

Administrative and operational costs for electricity, water supply are borne by the Myanmar side.

3.2 Achievement of the Activities

The Project so far has made significant progresses since the beginning of the Project. The adverse impacts of the assignment change were minimal and the gap to the original one was negligible.

Except the PP-2 and tasks related to the final seminar, the activities have been completed mostly at the time of the evaluation. Remaining tasks include finalization of the guideline/manual (activity 1-5), the Soft Soil Treatment Manual and the final seminar for dissemination of the analytical results of the PP-2.

Those manual and recommendations derived from the Activities will be compiled and to be submitted to PW by the end of the Project. The current status of the Activates is summarized in the Table-3.

Table-3 Achievement of Activities

Activities	Achievement
Activities for Output 0: Conduct the baseline	
0-1. Number of the road technology standards and manuals adaptive to Delta area	[Completed] • Total of 10 technical standards and manuals on the road construction technologies were identified. • The standards for road technologies on British Standards (BS) and those of the American Association of State Highway and Transportation Officials (AASHTO) are utilized mainly for material analyses and pavement structure design.
Activities for Output 1: Road technology standards and manuals for designing and construction works are improved.	
1-1. Review Myanmar standards and manuals of road technologies for designing and construction works	[Completed] • The Project has reviewed the standards and manuals utilized by PW. List of • The Project prepared a note on geometric structures and traffic safety of expressways and highways in Myanmar for further discussion and improvement.
1-2. Analyze the issues and challenges on the road technologies for designing and construction works in Myanmar.	[Completed] • Based on the analysis and observation from site visits and survey, the Project exchanged views with the C/P on a variety of issues related to the road technologies in Myanmar. • The Project submitted a work plan for review and the plan were accepted by the Myanmar side. • The issues on geometric structure and the traffic safety of the expressways were reviewed with PW engineers. 147 items were identified unsafe or not appropriate between the Yangon - Naypyitaw section in light of the existing standards. So far, 33

Activities	Achievement
	items listed were fixed or resolved by PW.
1-3. Conduct research on construction conditions including soft ground.	[Completed] • The Project conducted field surveys of the union roads in the Ayeyarwardy delta to understand the present condition of the road design and the construction works. • Based on the result of survey, issues on analysis of high embankment and soft soil treatment needs to be discussed as the priority area among the road construction technologies. • The Project excluded the development of the pavement manual since it was already completed by the Japan Infrastructure Partners (JIP) funded by the JICA Partnership Program.
1-4. Specify the road technologies for designing and construction works necessary to be developed.	[Completed] • The short-term experts are newly assigned to prepare the Soft Soil Treatment Manual covering such issues as analysis of soil consolidation, soil compaction.
1-5. Develop the road technology standards and manuals, and revise them based on the outcomes of the pilot project(s) as necessary.	• The first draft manual of soft soil treatment has been prepared and submitted to PW for review. • The submission of the review by PW will be by the end of April 2015. The Project is to finalize the draft by middle of coming June... • Upon completion of the PP-2, the manual will be revised based on the results of PP-2
1-6. Convene the workshops/seminars to share the contents of the road technology standards and manuals with the road technical staff across the country.	• The Project has organized seminars covering a variety of topics in the road technologies. Date, topics and number of participants are shown in ANNEX 9. • Final seminar is planned upon the completion of the PP-2. The prospective topics on the final seminar will be soft soil treatment manual and the analysis of the PP-2.
Activities for Output 2: The practical skills and knowledge of the road technical staff are enhanced.	
2-1.Select pilot project(s).	• The Project identified and reviewed the PW's road development plan, conducted a field survey in Ayeyarwady delta area, and collected soil materials for soil testing at the RRL. • Based on the results of these studies, the Project identified and assessed the sites for PP-1 and PP-2. The suitable site for high embankment was identified.
2-2. Conduct the research activities on construction conditions including soft ground.	• The Project discussed with the engineers of PW (both central and district levels) on a variety of issues associated to the pilot projects for detailed design and construction plan for implementation of the projects. • Based on the plan the Project consult with the Executive Engineer of the Pyapon District Office on implementation and supervision of the projects. • The Project also conducted stabilization treatment mixing test, and selected machinery for pilot projects. • The Project carries out monitoring activities of the pilot projects (movement of embankment, core boring, etc.)
2-3. Formulate the work plans, including outline design, cost calculation, quality control, etc., of the selected pilot project(s).	• The Project demonstrated typical procedures for construction management throughout implementation of the pilot projects. • This includes preparation of construction plan, survey, soil testing, temporary facilities, etc. to ensure the quality control over the process.
2-4. Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans Conduct	• The Project executed capacity enhancement covering a variety of technologies and technique on construction management, quality control, progress control, etc. in PP-1. • The Project conducted practical training on design, construction

Activities	Achievement
training on road construction for technical staff, operators, etc. through the pilot project(s).	management, quality control, etc. in PP-1.
2-5. Monitor the pilot project(s) based on the plans.	• The Project monitored the work progress of PP-1 by undertaking regular weekly meeting.
2-6. Convene the workshops/seminars to share the experiences, outcomes, etc. of the pilot project(s).	• The first seminar (13 to 14 June, 2013): selected topic on pavement in tropical zone, introduction of Japanese road standards, countermeasures against soft soil ground, and pavement. The Number of participants was 52. • The second seminar (14 December 2013): selected topic on construction plan of PP-1 and high embankment observation for 39 participants from RRL, SRL, YTU, and district offices. • The Project held a seminar for reporting the completion of PP-1 (May 28, 2014) in Nay Pyi Taw for 40 participants.

3.3 Achievement of Outputs

As the result of the activities, the following achievements of the Outputs are observed.

Table- 4 Achievement of Outputs

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
Outputs: 1. Road technology standards and manuals for designing and construction works are improved.	1-1. New soft soil treatment manual is discussed and accepted by P.W.	1-1 Hearing from PW.	• The first draft of the soft soil treatment manual has been submitted to PW for review. The comments and feedback will be compiled by mid May. • The finalization of the draft will be completed by the May.
	1-2. More than 10 engineers are executing the work by using the manual.	1-2. Hearing from PW. (Interview from site engineer)	• A various practices have been observed on the operational procedures for each step on the construction cycle throughout the pilot projects (e.g. survey, research, design, supervision, inspection, operation and maintenance). C/Ps have attained and improved these skills of the works (e.g. geographic survey, quality control, soil research, soft soil treatment method, construction management, etc.) • The casebook on the stabilization methodology based on the two pilot projects has been prepared and scheduled to complete upon completion of PP-2 expected in June 2015. • Many technique and approaches taught through seminars and workshops are being adopted by the counterpart gradually. The adoption process is still in progress. Many sign of full adoption and behavioral changes are observed.
2. The practical skills and knowledge of the road technical staff are	2-1 2.1 Total number of trained staff of PW is more than 300 numbers.	2-1. Records of the pilot project(s) and training programs	• A series of seminars and workshops held since 2012. The calmative total of staff members of PW trained was 318 and summarized as following

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
enhanced.			

Year	Seminar Title	No of total participants
C/P Training in Japan		
2013	Workshop for Enhancing Road Engineering (14 days)	5
2014	Workshop for Enhancing Road Engineering (14 days)	5
2014	Pre-workshop b/w NILIM & RRL (8 days)	3
2014	Japanese Expressway Technologies (10 days)	10
	Total	23
Seminars		
2013	Road engineering	53
2014	Road materials and road improvement	15
	Total	68
Workshops		
2013	Project Design Management	50
2013	Chemical Stabilization for PP-1	9
2013	Stabilized Material Test Results in Pavement Design	5
2013	Implementation of PP-1	30
2014	Stabilized Road Improvement Work	7
2014	Reporting on PP-1	29
2014	Study on High Embankment on Soft Ground (1)	11
2014	Analysis of High Embankment on Soft Ground (2)	10
2014	Analysis of High Embankment on Soft Ground (3)	10
2014	Analysis of High Embankment on Soft Ground (4)	9
2014	Analysis of High Embankment on Soft Ground (5) (6)	9
2014	Summary of the workshops on the new manual (7)	5
2014	Preparation of Laboratory Test (8)	6
2014	Preparation of Laboratory Test (9)	6
2014	Preparation of Laboratory Test (10)	6
2014	Settlement Analysis Using the Textbook	9
2015	High Embankment Behavior Observation and Analysis	51
	Total	171
Training in the PP-1		
2014	Operation of Machinery	13
2014	Control of Stabilization Materials	37

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
			2014 | Field Density Test at PP-1 | 6 Total | 56 Calmative Total of the C/P Trained | 318
	2.2 50% of participants evaluate Training/seminars favorably.	2-2 Question-naire for trainees.	• During the workshops attainment and comprehension of the topics covered were monitored by the experts by a variety of assessment tools for attainment (e. g. question and answer, discussion, paper & pencil mini-test, practices-based examination, practice using computer, etc) instead of collecting approval rating.

3.4 Achievement of Project Purpose

The achievement of the Project Purpose is explained in Table- 5.

Table- 5 Achievement of the Project Purpose

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
Project Purpose:	1. The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff.	1. Questionnaire to C/P.	Signs of adoption are observed. Some examples: (1) Discussion throughout the process of the preparation of the Soft Soil Treatment Manual (2) Deepen and enhanced the understanding of analysis of soil consolidation by integrating the theories and data collected from the observation/ monitoring at the site. (3) Advantages of lime/ cement stabilization methods fully understood for further adoption to section next to the PP-2 when funding is secured. (4) Quality control throughout the construction process adopted by engineers involves (e.g. district office, RRL, etc.) (5) Adoption of the new calculation methods for high embankment have been trained through WS
	2. By the end of the project, road length constructed by the technology introduced from Pilot Project is extended longer than 2.6 km.	2. Pilot Project Report.	• Total length of the sections applied the lime stabilization method are as shown in the following: PP-1 | 1.6 | Donated stabilizer used PP-2 | 0.6 | In progress. Soil plant will be used. Total | 2.2 | • The length of PP-2 was changed from 1.0km originally planned to 0.6km due to the restriction of budget allocation for this year. • The length of the PP-2 was changed from 1.0km originally panned to 0.6 km due to the procurement and budget disbursement procedures of the both sides. The Myanmar side plans to continue the remaining section in the next fiscal year.

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
			• Despite above change in length, the technical contents for PP-1 and PP-2 has been unchanged and taught to C/P as planned through OJT.

3.5 Achievement of Overall Goal

The achievement of Overall Goal is summarized in Table- 6.

Table- 6 Achievement of Overall Goal

Narrative Summary	Objectively Verifiable Indicators	Method of Measurements	Result
Overall Goal: Roads in the delta areas of Ayeyarwady Region are improved.	1. The road improved by the stabilization technique is more than 10 km. 2. Driving hour or travelling time is reduced 10% comparing before execution of project.	1. Hearing from PW 2. Report by actual measurement by district office	1. Total length of the road improvement is projected 10 km. • PW explained that the total length of the road improved by the stabilization technique is planned more than10 km. PW believes the new technology shall be retained and strengthened within the organization by practicing and applying continuously every year. • Improvement of the road conditions of the entire road section of PP-1 and PP-2 will be completed. It contributes better access to the market. It will benefit to the well being and social and economic activities of the local residents and will contribute to poverty alleviation in the region. 2. Upon the completion of the Route 10 (which the PP-2 is part of) the access between Bogale and Mawgyun will be secured (expected as early as April 2017). As the result, more than 30 thousand people will benefit from a reduced travel time to Yangon by at least 1.5 to 2.0 hours by automobile. The above route will be accessible throughout a year.

4 Project Implementation Process

4.1 Project Implementation

(1) Activities Planned in the PDM

Overall, the Team observed that the Project has been carried out according to the schedule and the planned activities will be completed by the end of June, 2015.

(2) Favorable Factors

Under the leadership of the Managing Director of PW, positive disciplines for improving road technologies have been established; for example, engineers of PW has shown strong interest on soft soil treatment and stabilization technologies presented in the seminars/workshops; PW has borne the construction cost for PP-1 and PP-2 which is 471 million Kyat and ? Kyat respectively.

(3) Non-favorable factors:

Due to the current policy changes of Myanmar, un-expected in-flow of donor assistances has been experienced at PW. Most senior-level counterparts are occupied with many different commitments. The availability of C/P personnel and securing close consultation and collaborating in many circumstances has been a challenge for implantation of the Project.

5 Evaluation Results

5.1 Relevance: [High]

The Team concluded that the relevance of the project remains high. Policies of the Myanmar and Japanese sides are largely consistent since the detailed planning study of the Project.

5.1.1 Myanmar Policies Perspective

The Project is aligned with the current "3rd Five Year Road Development Plan (2011/12-2015/16)" under the 30-years Road and Bridge Development Plan (2001/02-2030/31). The GOM has prioritized in road construction for supporting economic and social activities. The current Five Year plan stipulates that construction and improvement of 10 road sections, total of 888.8km with minimum pavement width of 3.66m (12 feet) in the Ayeyarwady Region. The above road development plan remains unchanged largely since the time of the Detailed Planning Survey for this technical cooperation project (TCP) carried out in 2012. In addition, PW holds above policy for expanding and maintaining the Union Road network and requires dealing with soft soil conditions in the Ayeyarwady Region. The project's objective is in line with the national plans as well as PW's responsibilities.

5.1.2 ODA Policy of Japan Perspective

The project is aligned with ODA policy of the government of Japan as well as that of JICA. The Ayeyarwady Region is located in the costal state of Myanmar where the risks associated to major disasters, cyclones and heavy rains are high. Japanese Assistant Policy (April, 2012) and JICA's assistant program to Myanmar is designated to improve the quality of life and safety of residents in the disaster prone areas in Myanmar.

5.1.3 The Project Approach Perspective

The approach adopted by the Project meets the needs and context of PW. One of the most critical challenges for PW is capacity development at both the organizational and individual levels. The past situation was as follows;

PW, an agency under MOC responsible for plan develops and maintain the Union Road Network endeavors every effort to maintain the quality of road construction despite of restricted resources (e.g. budget, machine power, choice of technology, etc.). For example, securing high quality road construction materials such as sand, gravels and soil with reasonable cost is extremely difficult in

Ayeyarwady Region due to geological and geographic conditions. In addition, technical capacity of designing earth work in the soft soil conditions is limited because the design procedures and the technical guidelines ensuring the safe and stable embankment have not been established in Myanmar. The TCP to support development of such capacity contributes the safety and the quality of any structures built on soft grounds. Therefore the relevancy of the Project remains high as initially planned.

The Project introduced the practical methods on (i) how to carry out the analysis of soil consolidation of soft soil, (ii) understanding through the experiment and analysis, the actual behavior of high embankment on the soft soil site, and (iii) how to integrate lab analysis and actual planning, designing and management the construction projects. In addition, the Project introduced a mechanism to maintain quality employing PDCA cycle for the construction management by practical on-the-job training. To enhance the learning of the engineers of PW, practical examples in Myanmar and Japan were introduced and compared during the study visits to Japan.

Further, the Project has dealt with geometric and safety structure of expressways to improve drivability and the safety. Based on the site survey, potential high risk items have been identified and personated to division concerned for improvement and repair. The items in the recommendation were put in action for immediate repair. It has provided the basis of understanding necessary clearance for high-standard road design.

5.2 Effectiveness : [Medium]

The Project is now on the right track toward achieving the Project Purpose. Given one of the major activities, namely the PP-2, is still in the process of the preparation, the Output 2 is not yet fulfilled. Tangible signs of fulfilling the all Outputs and achieving the Project Purpose are observed. These examples are explained in the following:

5.2.1 Improvement of the Road Technology Standards and the Manuals for Designing and Construction Works

The progress of the Output 1 shows that the preparation is judged by the revised indicators "1-1.New soft soil treatment manual is discussed and accepted by PW." and "1-2. More than 10 engineers are executing the work by using the manual". The first draft of the manual for soft soil treatment has been prepared and the draft manual has been submitted to PW for review. The experts will finalize and revise the manual as necessary upon the receipt of the feedback from PW and the completion of the PP-2.

More than 10 engineers use the manual for their work. Along with the each step of the project cycle (i.e. plan, research and survey, design, supervision, inspection and monitoring), many engineers of respective divisions involves. The manual and the guidelines as well as contents of the training provided are given to those engineers for reference of their work. According to the Myanmar side, the translation of these manuals into the Myanmar language is scheduled within six

months. The official approval of the documents by the administration of PW is expected after one month after the translation. Especially, the new calculation methods in the manual will be applied in the analysis of high embankment in the approach roads to the Htee Chant Bridge construction project in the Sageing Region.

5.2.2 Enhancement of the Practical Skills and Knowledge of the Road Technical Staff

The revised indicators of Output 2 "The practical skills and knowledge of the road technical staff are enhanced" include "2.1 Total number of trained staff of PW is more than 300 numbers" and "2.2 50% of participants evaluate training/seminars favorably". The calmative total of the participants of the training and seminar carried out by the Project has been 318, exceeding the indicator of 300. The final number will be confirmed by the end of the Project.

5.2.3 Adoption and Localization of the Technology Suitable for Myanmar

Some items listed in the recommendations of on geometric and safety structure of expressway has been immediately adopted and put into repair and modification. There are 147 items listed in the both side of the Yangon – Naypyitaw section of the express way and 33 items have been repaired. Those items not adopted, however, are either, technically and financially unable to repair. The recommendation has introduced the fundamental knowledge of necessary clearance and its application for securing traffic safety. The team acknowledges that MOC has been preparing the regulatory frameworks on road and transportation with technical assistance from other donor. The practical knowledge, such as implication of the clearance for safety works help the Myanmar side accelerates the preparation of the regulatory framework.

5.2.4 Adoption and Further Use of New Technology

It is rather difficult to list any particular revisions of procedures regarding the analysis of high embankment on the soft soil ground at the time of evaluation. According to the PW, full adoption of the new calculation methodology needs some time because PW needs to ensure the stability and safety of the high embankment site over the time. PW would like to utilize the monitoring facility of the PP-2. PW would also like to see if no serious effects caused by soil consolidation occurred at PP-2.

The district office of PW, in the other hand, indicates that the lime/cement stabilization method shall be fully adopted in the Ayeyarwady Region. The initial cost of the new method is relatively high under the current circumstances. This is one of obstacle for full adoption in the region because the funding for road construction is limited. The office is carefully conducting monitoring of the surface condition at PP-1 and PP-2 (when completed) to get concrete evidence of advantages over conventional pavement methods. The office would like to ensure the total cost over design period would be lower than those of the conventional one. If the durability and the cost effectiveness (life cycle cost) exceed those of the conventional one, they well be encouraged to allocate funding to adopt the stabilization method fully in the region.

5.3 Efficiency : [Medium]

Overall efficiency of the Project is considered "Medium". The inputs are delivered as almost initially agreed and scheduled. Unexpected departure of the Chief Advisor due to his health created an adverse impact on the process. The activities, however, have been catching up with the original implementation plan, according to the experts.

5.3.1 Input and Activities

The overall operation, which includes schedule and timing of the Project Activities and the Inputs, the quality and the quantity of the resources to be utilized, are determined and provided according to the mutual consultation processes by two sides. According to the interview, the quality, the quantity and the scheduling of provision of the resources have been generally satisfactory. The issue on securing good communication among the members of the Project, however, has been a challenge for everyone in the Project. After the assignment change, more meetings for coordination, more supports with a personal-touch in the workshops have created more open work relationship. Better communication and close consultation have encouraged, as the result, the overall communication problems have been improved. At the same time, the situation however has been somehow persistent due to the physical setting of the Project locations, delegation of the power and duties over different offices, unavailability of C/P due to other commitments and their routing work.

5.3.2 Adoption and Application of the New Technologies in PW

On the other hands, JICA side pointed out that PW seems to have no clear plan to disseminate and fully adopt the new technology to civil engineers of PW. The technical contents introduced in the manual shall be fully adopted in planning, designing, construction management and monitoring since they are very fundamental one. To do so, use of technical contents through training is advised.

5.3.3 Obstacles and challenges for Full Adoption

The Japanese experts have observed many positive signs of adopting the technology despite the existence of some barriers and obstacles. These obstacles need to be cleared. For example, lime-based (or cement-based) stabilization technology the Project introduced is one of the promising technical alternatives because of its strength, durability, effective use of materials on-site and ease of maintenance. The team have introduced and provided precise analysis of Life-cycle cost to justify full adoption of the technology.

5.3.4 Consideration for Improved Efficiency

Overall, the Project pays specific attention to ensure efficiency throughout the process. For example, the topics for preparation of technical manuals and guidelines were decided to avoid

duplication by reviewing manuals and guideline PW have used. Improvement of geometric and safety structures were selected by its practicality, importance and urgency. The recommendation such as issues on clearance and the safety facilities, etc provide technical frameworks and the foundation of other donor activities.

In the course of the implementation of the pilot projects, the specific attentions are paid in the followings:

(1) The road sections selected were one of 10 priority road sections to be upgraded and were of importance due to heavy traffic. The both sites are suitable for testing and experimenting the effectiveness of soft soil stabilization methodology,
(2) The sites selection were appropriate for collecting on-site soil for earth work, and
(3) The locations of the sites were decided from the view of securing the on-site soil collection, the stock yard, the detour route and labor recruitment from nearby villages.

5.4 Impact : [Relatively High]

5.4.1 Possibility of Achieving the Project Overall Goal

To see the achievement of the Overall Goal, "Roads in the delta areas of Ayeyarwady Region are improved", the Team agreed to use the two indicators in the evaluation. They are: (i) The road improved by the stabilization technique is more than 10 km; and (ii) Driving hour or travelling time is reduced 10% comparing before execution of project.

At the timing of the Evaluation, the length of the road improved in the Ayeyarwady Region, the Team estimates additional 10 km will be extended after 5 years from the termination of the Project. The second indicator will be fulfilled as early as April 2017. Upon the completion of the Route 10 (which the PP-2 is part of) the access between Bogale and Mawgyun will be completed. As the result, more than 30 thousand people will benefit from a reduced travel time to Yangon by at least 1.5 to 2.0 hours by automobile. Currently estimated travel time is 5-6 hours from the area. The above route will be accessible throughout a year.

Since the road connection contribute overall quality of life of the nearby community, the completion of the entire section of the pilot projects will have the following positive impacts:

(1) The travel time to large markets such as Yangon improved,
(2) Social and economic activities in the region facilitated, and
(3) Access to social services (e.g. education, health care, etc.) improved.

5.4.2 Technical Impacts

In terms of integrating theories and practices, the topics covered and introduced are mostly the first time in Myanmar. Topics covered in the new manual, such as treatment of soft soil, soil consolidation, compression, soil stabilization etc. are important subject within the whole area of road technology. Prior to the Project, the manuals and guidelines on soil, however, had not been

available in Myanmar and the capacity of understanding and utilizing the subject area has not been fully developed at PW. The Project introduced these subjects and it was technologically significant since soil engineering is one of the fundamental subjects for able civil engineers. .

5.5 Sustainability : [Overall medium, technical sustainability is high with some reservations]

5.5.1 Policy Sustainability

GOM is supposed to continue the current policy of extending the Union Road Network in order to support social and economic activities of Myanmar. The current trend of expanding and maintaining the road net work will continue. Therefore, the technology acquired will be utilized because the construction and upgrading of road in the Ayeyarwady Region will continue.

5.5.2 Fiscal Sustainability

Fiscal sustainability is defined as follows in the context of the Project: whether or not activities arranged and funded under the Project will be financed by PW's own budget after JICA withdraws. It is also important for road engineers of PW to engage themselves in services under the favorable financial environment.

In the course of the TCP the experts observed and encountered problems caused by shortage of resources, in particular funding. PW generally does not have its own sufficient budget to sustain such necessary activities. In order to meet the demand of upgrading and maintaining the level of road conditions and access to the network, PW compromises the quality of pavement and facility due to the funding limitation. Such situation causes adoption of low quality standard. To upgrade the level of fiscal sustainability, sufficient funding shall be provided to activities. At the same time, PW should rationalize its decision for selection of technology taking cost and benefit into account for better funding allocation. In any cases, minimal funding shall be allocated to the local level if PW considers such construction and maintenance activities are important.

5.5.3 Institutional Sustainability

Institutional sustainability is defined as follows in the context of the Project: (i) whether or not some institutional settings are backed with laws and regulations in PW, and (ii) whether or not the relevant technologies and procedures introduced by the Project, namely, new method/procedure for analysis, lime stabilization etc. are adopted and continued in accordance with solid plans.

For the first part, Project has utilized the existing institutional and organizational setting of PW. Although, some are totally new, tasks and approaches were introduced based on the duties and responsibilities of the existing organizational/ institutional setting of PW under the leadership of the Managing Director of PW.

As for the second part, the Team recognizes it is the time of transition for PW since the opening of the market. The roles and responsibilities of PW and the officers of PW will be changing in the

foreseeable future. More road projects may be relied on the services provided by consultants and contractors in the form of BOT supported by foreign funding. The staff engineers of PW will need to assume the role of administrator with technical capabilities. In light of such trend, the staff training and the future scope of the work of technical cooperation projects shall be aligned to the role change. To achieve the satisfactory level of institutional sustainability, PW need to develop its own plan for adopting such trend.

5.5.4 Technical Sustainability

Technical sustainability is defined as follows in the context of the Project: (i) to what extent PW staff understand knowledge and skills introduced under the Project (ii) to what extent PW establishes institutional arrangements (e.g. the procedures for analysis, quality control, etc.) for knowledge and skills accumulated through OJT and the pilot projects, and (iii) to what extent efforts of HRD is continued systematically (e.g. OJT and career development) to extend the knowledge to other engineers in accordance with overarching HRD strategy, if any.

As for the first element, this is long process. But the Team observed the fundamental methodology, techniques and principles of road technologies, such as soft soil treatment, soil stabilization and construction management, have been transferred to PW though the series of seminars and workshop as well as day-to-day interaction with the experts. They seem to be being adopted gradually among many core staff members of PW. A continued effort to practice and review such technical subjects and tasks will enhance the acquired capacity and extended to all counterparts gradually.

As for the second element, the Project submitted the Soft Soil Treatment Manual (due finalization based on the feedback provided from C/P). The Project proposed PW to translate the Manual into the Myanmar language and to acknowledge officially for wider utilization across the organization. The contents of the manual is foundation of the soil engineering which is useful to all civil engineer and is a subject that shall be understood by all engineers of PW. It is further expected to develop training program to cover the subject of the manual for all engineers.

As for the third element, PW has not yet developed overarching HRD plan by expertise of its staff. It is important for PW to provide training opportunities to its all staff particularly engineers as much as possible. However, the current ability of the school is still limited because of lack of staffing and comprehensive master plan for HRD, and inadequate human resources capable for providing appropriate training to staff of all levels.

6 Conclusion

The Team concludes that the Project has been implemented on track and is showing good results. The C/Ps is now on the way of acquiring knowledge and knowhow for soft road technologies through the Project Activities.

7 Recommendations

7.1 Toward the End of the Project Duration

Both sides agreed that the Project will be terminated in July 2015 as the result of the Terminal Evaluation. It is suggested that the Project outputs (e.g. the manual for soft soil treatment and the casebook on soil stabilization), which is now processing, will be finalized toward the termination in accordance with the schedule, June, 2014.

7.2 Recommendations

7.2.1 Continuous Improvement and Updating of the Manual

The Team recommends the manual for soft soil treatment shall be improved and revised continuously after completion of the Project by the Editing Committee shown in ANNEX 10. The committee members were nominated after the Mid-Term Review for editing the Manual for Soft Soil Treatment. The intention of the formation of the committee was to help PW to institutionalize the technical capacity of soft soil treatment through collective activities and to retain the advanced knowledge among the members nominated. The Team recommends the mission of the committee shall be re-defined to continue updating and reviewing technical information on soft soil treatment technologies and revising the manual periodically. To do so, the purpose, activities, and frequency of regular meeting shall be clarified prior to the end of the TCP

7.2.2 Rational Choice for Construction Planning and Methodologies

The Team acknowledges PW's endeavors to fulfill its mandate for improve and maintain the Union Road Network. Understanding al the current situations of PW, the Team recommends PW to facilitate road construction projects employing more rational decision-making and selection of construction planning and methodologies. The planning and selection of construction technologies shall be carried out based on scientific evidence such as the result of survey and testing. The choice shall be made carefully by taking a various factors (e.g. life span cost, durability, reasonable duration of construction period necessary, etc.) into account.

7.2.3 Adoption and Dissemination of the Outcomes from the Project

The Team recommends PW to apply and extend the outcomes from the Project to other projects carried out by PW. The Team expects PW to adopt technical capacity covered through the Project. The Project has been implemented at the midst of transition at the rapid reform in Myanmar. The role and the responsibilities of the engineers of PW are changing accordingly. To meet such situation, the Team further recommends PW to adopt and acknowledge not only the technical aspects of the Project but also managerial and administrative aspects. In the course of the TCP, the experts have carefully designed to carry out the Activities aiming at enhancing PW's capacity in overseeing, supervising and administering not just as an engineer but administrator of the public sector. The experts have demonstrated to C/P such approaches suitable for government engineers. Such knowledge and skills can be adoptable either PW implement projects by its own or entrust contractors to do the jobs. To do so, the outputs prepared by the experts shall be used for PW to train young engineers to enhance their capacity and to further transfer the C/P's

knowledge and experiences attained through the Project.

7.2.4 Use of Technologies

As the principle of the TCP, JICA expects to use and apply the technologies transferred through the Project. By doing so, the capacity of PW will be much enhanced. During the evaluation, PW's prospective plan to use lime/cement stabilization methodology in coming foreign funded projects was encouraging. Application of new design method for high embanking shall be adopted in the next bridge construction projects. The stabilization technologies may be used in future poverty alleviation projects. If additional training aiming at any particular projects is necessary, the Japanese expert will assist PW to carry out such workshop.

7.3 Lesson Learned

In the course of the Project, the related needs such as geotechnical investigation, design, quality control and assurance, construction management and maintenance of road construction with stabilization has been arisen in spite of not being described in the PDM. The lessons derived from the experience was that mutual and close consultation between both sides were essential to discuss such matter both at the initial and midtime stage of the cooperation project. And with such addressing, the design of the projects can be more flexible and practical when the situation changes significantly in the cooperation projects onward.

[END]

PDM V2.0

(1/2)

Project Title: Project for Improvement of Road Technology in Disaster-affected Areas in Myanmar	Version. 2.0		
Target Areas: Delta areas of Ayeyarwady Region	Date December. 2014		
Target Group (Beneficiaries): Road Technical Staff of the Public Works	Project Period Jul 2012 – Jul 2015		
Narrative Summary	**Objectively Verifiable Indicators**	**Means of Verification**	**Important Assumptions**
Overall Goal Roads in the delta areas of Ayeyarwady Region are improved.	1. The road improved by the stabilization technique is more than 10 km. 2. Driving hour or travelling time is reduced 10% comparing before execution of project.	1. Hearing from PW 2. Report by actual measurement by district office	
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced.	1. The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff. 2. By the end of the project, road length constructed by the technology introduced from Pilot Project is extended longer than 2.6 km.	1. Questionnaire to C/P. 2. Pilot Project Report.	Budgetary and human resources necessary for road construction are continuously allocated by the Government of Myanmar.
Outputs 1. Road technology standards and manuals for designing and construction works are improved. 2. The practical skills and knowledge of the road technical staff are enhanced.	1-1. New soft soil treatment manual is discussed and accepted by P.W. 1-2. More than 10 engineers are executing the work by using the manual. 2.1 Total number of trained staff of PW is more than 300 numbers. 2.2 50% of participants evaluate training/seminars favorably.	1-1 Hearing from PW. 1-2. Hearing from PW. (Interview from site engineer) 2-1. Records of the pilot project(s) and training programs 2-2 Questionnaire for trainees.	P.W approves the manuals.

PDM V2.0

(2/2)

Activities	Inputs		Important Assumptions
0 Conduct the baseline. 0-1. Number of the road technology standards and manuals adaptive to Delta area 1-1. Review Myanmar standards and manuals of road technologies for designing and construction works 1-2. Analyze the issues and challenges on the road technologies for designing and construction works in Myanmar. 1-3. Conduct research on construction conditions including soft ground. 1-4. Specify the road technologies for designing and construction works necessary to be developed. 1-5. Develop the road technology standards and manuals, and revise them based on the outcomes of the pilot project(s) as necessary. 1-6. Convene the workshops/seminars to share the contents of the road technology standards and manuals with the road technical staff across the country. 2-1. Select pilot project(s). 2-2. Conduct the research activities on construction conditions including soft ground. 2-3. Formulate the work plans, including outline design, cost calculation, quality control, etc., of the selected pilot project(s). 2-4. Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans-Conduct training on road construction for technical staff, operators, etc. through the pilot project(s). 2-5. Monitor the pilot project(s) based on the plans. 2-6. Convene the workshops/seminars to share the experiences, outcomes, etc. of the pilot project(s)	Japanese side 1. Experts [Long term Experts] ・ Chief Adviser/ Road Technology ・ Road Technical Standards ・ Project Coordinator [Short term Expert] ・ Road planning and Assessment ・ Road Survey and Design ・ Construction technology ・ Quality Control ・ Others as necessary 2. Training of counterpart personnel in Japan and/or the Third Countries 3. Provision of machinery and equipment 4. Local expenses for the project activities ・ Teaching materials for training/ workshops/seminars ・ Others	Myanmar's side 1. Personnel ・ Chairperson ・ Project Director ・ Project Manager ・ Counterpart personnel 2. Provision of the project offices and facilities necessary for the project implementation 3. Expenses for implementing pilot projects in the delta areas of Ayeyarwady River 4. Administrative and operational expenses ・ Electricity, water, communication, etc. ・ Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel ・ Others as necessary	Natural disasters do not give a profound effect to the project activities. **Pre-condition** Understanding and cooperation on road construction are obtained from the local people residing in the target areas.

Plan of Operation (1)

ANNEX 2

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

Inputs	Year	1st Year (JFY2012)				2nd Year (JFY2013)				3rd Year (JFY2014)				4th Year (JFY2015)				Remarks
	Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Expert																		
Chief Adviser/ Road Technology	Plan																	Dr. Akira Fujimoto
	Actual																	
Project Coordinator	Plan																	Mr. Kazuki Ishida
	Actual																	
Road Technical Standards	Plan																	Mr. Masaru Miyake
	Actual																	
Leader/ Road Planning and Assessment	Plan																	Mr. Koki Kaneda
	Actual																	
Sub-Leader/ Design	Plan																	Mr. Hiroaki Kobayashi
	Actual																	
Supervision I	Plan																	Mr. Masataka Fujikuma
	Actual																	
Supervision II	Plan																	Mr. Noor Akmar
	Actual																	
Research/ Soft Ground Countermeasure	Plan																	Dr. Hideki Yoneyama
	Actual																	
Material Quality Control	Plan																	Mr. Hirokazu Miyamoto
	Actual																	
Mechanical Work Quality Control	Plan																	Mr. Yukio Kosaka
	Actual																	
Soft Soil Embankment Study	Plan																	Mr. Kuniaki Nishijima
	Actual																	
Soft Soil Treatment Manual I	Plan																	Mr. Fumihiko Yokoo
	Actual																	
Soft Soil Treatment Manual II	Plan																	Mr. Asuaka Suzuki
	Actual																	
Equipment																		
Boring Machine (JFY2013 Donation Equipment)	Plan																	
	Actual																	
Total Station (JFY2013 Hand-Carry Equipment)	Plan																	
	Actual																	
Equipment for Observation of High Embankment (JFY2013 Hand-Carry Equipment)	Plan																	
	Actual																	
Soil Plant Equipment (JFY2014 Donation Equipment)	Plan																	
	Actual																	
Training in Japan																		(JFY2013) Five (5) Counterparts (JFY2014) Five (5) Counterparts
JFY2013 (Workshop on Enhancing Road Engineering)	Plan																	
	Actual																	
JFY2014 (Workshop on Enhancing Road Engineering)	Plan																	
	Actual																	
In-country/Third country Training																		
	Plan																	
	Actual																	

Plan of Operation (2)

ANNEX 2

Activities / Sub-Activities		Year	1st Year (JFY2012)				2nd Year (JFY2013)				3rd Year (JFY2014)				4th Year (JFY2015)				Responsible Organization	
		Quarte	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	Japan	Myanmar
Output 0: Preparation for the project																				
0	Conduct the baseline.	Plan																	JICA	PW-MOC
		Actual																		
0	Number of the road technology standards and manuals adaptive to Delta area.	Plan																	JICA	PW-MOC
		Actual																		
Output 1: Road technology standards and manuals for designing and construction works are improved.																				
1	Review Myanmar standards and manuals of road technologies for designing and construction works.	Plan																	JICA	PW-MOC
		Actual																		
1	Analyze the issues and challenges on the road technologies for designing and construction works in Myanmar.	Plan																	JICA	PW-MOC
		Actual																		
1	Conduct research on construction conditions including soft ground.	Plan																	JICA	PW-MOC
		Actual																		
1	Specify the road technologies for designing and construction works necessary to be developed.	Plan																	JICA	PW-MOC
		Actual																		
2	Develop the road technology standards and manuals, and revise them based on the outcomes of the pilot project(s) as	Plan																	JICA	PW-MOC
		Actual																		
2	Convene the workshops/seminars to share the contents of the road technology standards and manuals with the road	Plan																	JICA	PW-MOC
		Actual																		
Output 2: The practical skills and knowledge of the road technical staff are enhanced.																				
2	Select pilot project(s).	Plan																	JICA	PW-MOC
		Actual																		
2	Conduct the research activities on construction conditions including soft ground.	Plan																	JICA	PW-MOC
		Actual																		
2	Formulate the work plans, including outline design, cost calculation, quality control, etc., of the selected pilot	Plan																	JICA	PW-MOC
		Actual																		
2	Assist the road technical staff of the PW to implement the pilot project(s) based on the work plans Conduct training on road	Plan																	JICA	PW-MOC
		Actual																		
3	Monitor the pilot project(s) based on the plans.	Plan																	JICA	PW-MOC
		Actual																		
3	Convene OJT for Road Engineers and Mechanical Engineers through Pilot Project.	Plan																	JICA	PW-MOC
		Actual																		
3	Convene the workshops/seminars to share the experiences, outcomes, etc. of the pilot project(s)	Plan																	JICA	PW-MOC
		Actual																		

Annex 4-3-30

A-57

Plan of Operation (3)

ANNEX 2

Activities / Sub-Activities	Year	1st Year (JFY2012)				2nd Year (JFY2013)				3rd Year (JFY2014)				4th Year (JFY2015)				Responsible Organization	
	Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	Japan	Myanmar
Duration / Phasing	Plan																	July 25, 2012	
	Actual																	~ June 30, 2015	
Monitoring																			
Joint Coordination Committee	Plan																	Conducting of at least 1 time per year.	
	Actual				Kick-off														
Set-up the Detailed Plan of Operation	Plan																		
	Actual																		
Submission of Monitoring Sheet	Plan																		
	Actual																		
Monitoring Mission from Japan	Plan																	(Mid-term) Aug 11 ~25, 2014	
	Actual																		
Joint Monitoring	Plan																		
	Actual																		
Post Monitoring	Plan																		
	Actual																		
Reports/Documents																			
Quarterly Report/ Monthly Report (for Long-term Experts)	Plan																		
	Actual																		
Work Plan/ Progress Report (for Short-term Experts)	Plan																		
	Actual																		
Project Completion Report	Plan																		
	Actual																		
Public Relations																			
Establishment and Operation of Web Site	Plan																		
	Actual																		
Update of Web Site	Plan																		
	Actual																		

Outline Schedule for Terminal Evaluation
on Project for Improvement of Road Technology in Disaster Affected Area

No.	Date	Evaluator of Japanese Side			Evaluator of Myanmar Side	Participants (JICA Staff, Experts)	Place
		Mr. Yoshihiro KAKISHITA [Leader]	Mr. Toru TUCHIHASHI [Plan & Coord.]	Mr. Masato ONOZAWA [Evaluation]	U Aung Myint Oo (PW) Daw Hla Hla Thwe (PW) Daw Mya Mya Win (RRL)		
1	Mar 08			Arr. At YGN			
2	Mar 09 Mon			1000 Meeting w/ JICA Office			
				1400 Meeting w/ JP Experts		Mr. Miyake Mr. Ishida Mr. Kobayashi Mr. Miyamoto	
3	Mar 10 Tue			1000 Interview to C/Ps		U Aung Myo Oo	MOC Project Office
				1100 Interview to JP Experts		Mr. Miyake Mr. Ishida	
4	Mar 11 Wed			move (YGN to NPT)			
				1030 Interview to C/Ps		Daw Yin Yin Swe	PW-HQ
				1100 Meeting w/ Myanmar Side Evaluator		U Aung Myint Oo Daw Hla Hla Thwe	
				1400 Interview to C/Ps		U Aung Myint Oo Daw Hla Hla Thwe U Khin Maung Kyaw U Kyaw Phone Lwin	
5	Mar 12 Thu			(AM) Interview to Counterparts (Spare)			
				move (NPT to YGN)			
6	Mar 13 Fri			0600 move (YGN to Pyapon)			
				1000 Interview to District Office		U Thet Zaw Win	
				1400 move (Pyapon to Bogale)		U Win Naing	
				1500 Observation -PP-2 Site -High Embankment Site			
				1600- Interview to JP Experts		Mr. Kobayashi Mr. Miyamoto	
7	Mar 14 Sat			0700 move (Bogale to YGN)			
				PM Interview to C/Ps (RRL&BRL)		Daw Mya Mya Win U Aung Myint Daw Htar Zin Thin Zaw U Nyi Nyi Kyaw	
8	Mar 15 Sun	Arr. at YGN	Arr. at YGN				
		1300 Internal Meeting					
9	Mar 16 Mon	0930 Meeting w/ JICA Office					JICA Office
		1400 Meeting w/ JP Experts				Mr. Miyake Mr. Ishida Mr. Kaneda Mr. Kobayashi	MOC Project Office
10	Mar 17 Tue	move (YGN to NPT)					
		1430-1530 Explanation of Evaluation report				U Aung Myint Oo Daw Mya Mya Win Mr. Miyake Mr. Ishida Mr. Kaneda Mr. Kobayashi	PW-HQ
11	Mar 18 Wed	1000 Explanation & Discussion of Evaluation report with PW-MD				U Kyaw Linn U Aung Myint Oo Daw Hla Hla Thwe Daw Mya Mya Win Mr. Morikawa Mr. Miyake Mr. Ishida Mr. Kaneda Mr. Kobayashi	PW-HQ
12	Mar 19 Thu	AM/PM Signing of MM					PW-HQ
		move (NPT to YGN)					
13	Mar 20 Fri						
		13:30 TV conference w/ JICA-HQ					JICA Office
		1500 Report to JICA Myanmar Office & EOJ				Mr. Watanabe (EOJ)	
		1600 Feedback meeting w/ JP Expert				Mr. Miyake	
14	Mar 21 Sat					Mr. Miyake Mr. Kobayashi	MOC Project Office
		Leave YGN	Leave YGN	Documentation			

LIST OF PROJECT COUNTERPART PERSONNEL

ANNEX 4

(as of February 28, 2015)

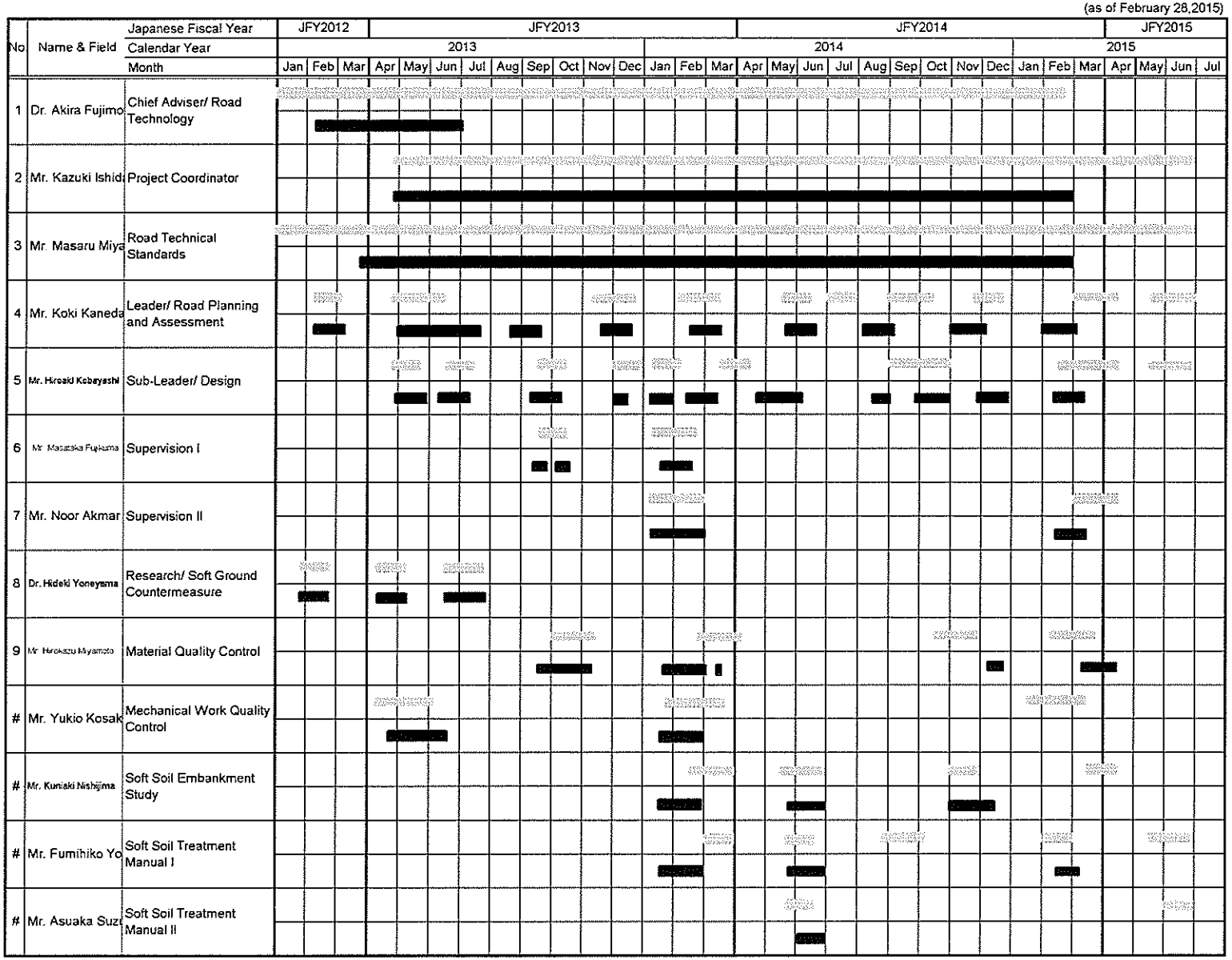
No.	Cooperation Field	Name of Expert	Counterparts Information		
			Name	Department	Position
1	Chief Adviser/ Road Technology	-	U Aung Myint Oo	PW-HQ (Planning Dept.)	Deputy Chief Engineer
			Daw Hla Hla Thwe	PW-HQ (Road Dept.)	Superintending Engineer
			Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Aung Myint	Road Research Laboratory (R	Adviser
2	Project Coordinator	Mr. Kazuki Ishida	U Aung Myint Oo	PW-HQ (Planning Dept.)	Deputy Chief Engineer
			Daw Hla Hla Thwe	PW-HQ (Road Dept.)	Superintending Engineer
			Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			Daw Htar Zinn Thin	Road Research Laboratory (R	Executive Engineer
3	Road Technical Standards	Mr. Masaru Miyake	U Khin Maung	MOC Adviser	Adviser
			U Khin Maung Kyaw	PW-HQ (Road)	Chief Engineer
			U Kyi Zaw Myint	Expressway Unit	Superintending Engineer
			Daw Thein Nu	PW-HQ	Deputy Superintending Engineer
			U Htet Zaw Win	Pyapon District Office	Executive Engineer
			U Aung Myo Oo	PW-HQ (Airfield)	Deputy Superintending Engineer
			U Nyi Nyi Zaw	PW-HQ (Quantity Survey)	Executive Engineer
4	Leader/ Road Planning and Assessment	Mr. Koki Kaneda	U Aung Myint Oo	PW-HQ (Planning Dept.)	Deputy Chief Engineer
			Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			Daw Yin Yin Swe	Soil Research Laboratory (SR	Executive Engineer
5	Sub-Leader/ Design	Mr. Hiroaki Kobayashi	U Aung Myo Oo	PW-HQ (Airfield)	Deputy Superintending Engineer
			Daw Su Mon Kyaw	Pyapon District Office	Assistant Engineer
6	Supervision I	Mr. Masataka Fujikuma	U Aung Myo Oo	PW-HQ (Airfield)	Deputy Superintending Engineer
			Daw Su Mon Kyaw	Pyapon District Office	Assistant Engineer
7	Supervision II	Mr. Noor Akmar	U Tun Tun Hlaing	Pyapon District Office	Junior Engineer (2)
			U Myo Min Min	Pyapon District Office	Junior Engineer (2)

No.	Cooperation Field	Name of Expert	Counterparts Information		
			Name	Department	Position
8	Research/ Soft Ground Countermeasure	Dr. Hideki Yoneyama	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Nyi Nyi Kyaw	Road Research Laboratory (R	Assistant Engineer
9	Material Quality Control	Mr. Hirokazu Miyamoto	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Nyi Nyi Kyaw	Road Research Laboratory (R	Assistant Engineer
10	Mechanical Work Quality Control	Mr. Yukio Kosaka	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Nyi Nyi Win	PW-HQ (Mechanical Section)	Assistant Engineer
11	Soft Soil Embankment Study	Mr. Kuniaki Nishijima	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			Daw Kyi Kyi Thwe	PW-HQ	Superintending Engineer
			Daw Yin Yin Swe	Soil Research Laboratory (SR	Executive Engineer
			Daw Phyu Phyu	Soil Research Laboratory (SR	Assistant Engineer
			Daw Hnin Hnin Soe	Soil Research Laboratory (SR	Assistant Engineer
			U Nay Lin Tun	Road Research Laboratory (R	Assistant Engineer
			U Than Naign	Special Airfield Construction U	Assistant Engineer
			U Aung Kyi	Special Airfield Construction U	Engineer
12	Soft Soil Treatment Manual I	Mr. Fumihiko Yokoo	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Nay Lin Tun	Road Research Laboratory (R	Assistant Engineer
13	Soft Soil Treatment Manual II	Mr. Asuka Suzuki	Daw Mya Mya Win	Road Research Laboratory (R	Deputy Superintending Engineer
			U Nay Lin Tun	Road Research Laboratory (R	Assistant Engineer

ANNEX 5

LIST OF DISPATCHED JAPANESE EXPERTS

(as of February 28,2015)



ANNEX 6

LIST OF EXISTING MANUALS, STANDARDS and RELATED MATERIALS

(as of February 28,2015)

<Manuals & Standards>

No	Title	Language	Content	Date of Publication	Model	Form	Pages	Original/Copy	Author	Publisher	Received	Remarks
1	Overseas Road Note 31, A guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries	English	Standards for Pavement Design in UK	1993	A4	Binding	42	Copy	Overseas Centre Transport Research Laboratory, Crowthorne, Berkshire, United Kingdom	RRL	2013/2/13	
2	Road Construction Specification	English	Road Construction Specification	2004	A4	Binding	166	Copy		RRL	2013/2/16	
3	Road Maintenance Manual	Myanmar	Road Maintenance Manual		A4	CD-R		Copy			2013/2/16	
4	Surface Dressing Manual	Myanmar	Dressing Manual		A4	CD-R		Copy				
5	Road Research and Development Project BUR/81/021; Pavement surfacing; Their Properties &Applications to Roads in Burma	English	Selection of Pavement Surfacing	1981	A4	Binding	14	Copy	Prepared by L. S. Hitch, Highway Engineer(Design), N. D. LEA ASSOCIATION LTD.	RRL		For GOM and RR & DP by UNDP T/C
6	Road Research and Development Project BUR/81/021; Axle Load Survey Demonstration, January, 1987	English	Report of Axle Load Survey	1987	A4	Binding	28	Copy	Prepared by D. R. Saunders, Highway Engineer (Planning), N. D. LEA ASSOCIATES LTD.	RRL		For GOM and RR & DP by UNDP T/C
7	Highway Construction Specifications, April, 1989	English	Highway Construction Specifications	1989	A4	Binding	77	Copy	Prepared by C. A. Koch, Highway Engineer (Construction) and U ManSan Thaung, Executive Engineer	RRL	2013/2/23	For GOM and RR & DP by UNDP T/C
8	Road Research and Development Project BUR/81/021; General Specifications for Highway Bridge Construction in Burma, March, 1989 No. 40, Golden Valley Road, Rangoon	English	General Specifications for Highway Bridge Construction in Burma	1989	A4	Binding	86	Copy		RRL	2013/2/23	
9	Road Research and Development Project BUR/81/021; Inventory of Construction Corporation Roads April, 1988	English	Inventory of Construction Corporation Roads	1988	A4	Binding	35	Copy	Prepared by D. R. Saunders, Highway Engineer (Planning), N. D. LEA ASSOCIATES LTD.	RRL		For GOM and RR & DP by UNDP T/C
10	Road Research and Development Project BUR/81/021; Road Roughness Surveys, May, 1988	English	Report of Road Roughness Surveys	1988	A4	Binding	28	Copy	Prepared by D. R. Saunders, Highway Engineer (Planning), N. D. LEA ASSOCIATES LTD.	RRL		For GOM and RR & DP by UNDP T/C
11	Design Standards for Highways											

ANNEX 6

<Related Materials>

No	Title	Language	Content	Date of Publication	Model	Form	Pages	Original/Copy	Author	Publisher	Received	Remarks
1	Road Research Laboratory(Public Works)	English	Outline of RRL (Road Research Laboratory)		A4	Binding	15	Copy		RRL		GOM / MOC PW
2	Report on Soil Testing on Research Laboratories (S.T.R.L) Kamakyi Road, Thuwunna, Yangon.	English	Outline of SRL (Soil Research Laboratory)	2012	A4	Binding	18	Copy		SRL	2013/2/8	GOM / MOC PW
3	Soil Testing on Research Laboratories (S.T.R.L) Kamakyi Road, Thuwunna, Yangon.	English	Outline of SRL (Soil Research Laboratory) <Revised Edition>	2012	A4	Binding	19	Copy		SRL	2013/2/21	GOM / MOC PW
4	An Information Booklet on Training Activities and Training Centers of The Ministry of Construction	English	Information on Training Activities and Training Centers of The Ministry of Construction		A4	Binding	23	Copy		SRL	2013/2/5	GOM / MOC PW, CTC
5	Base Workshop (South) Ywa Ma, Insein Yangon	English	Information of MTC (Mechanical Training Center)		A4	Paper	9	Copy	GOM / MOC, PW, MD	MTC	2013/1/25	PowerPoint
6	Practical Guide to Pavement Design for Tropical Countries (AASHTO methods, Design of shoulders slopes & drainage)	English	Guideline for Pavement Design	1984	A4	Binding	71	Copy	France. Ministère de la coopération, Centre expérimental de recherches et d'études du bâtiment et des travaux publics	RRL		
7	Road Condition(kilometer) of Ayeyarwardy Region, Pathein	Myanmar	Report of Road condition(kilometer) of Ayeyarwardy Region		A4	Binding	150	Copy		RRL	2013/2/23	
8	Road Research and Development Project BUR/81/021; Bitumen Emulsions; A Report on Their Production & Use in Burma	English	Report of Bitumen Emulsions	1988	A4	Binding	30	Copy	Prepared by L. S. Hitch, Highway Engineer(Design), N. D. LEA ASSOCIATION LTD.	RRL		For GOM and RR & DP by UNDP T/C
9	Ayawardy Delta District, Delta Region Route No. 11, Inventory	English	Inventory of Route. 11	2013	A4	Binding	152	Copy		RRL		GOM / MOC PW
10	After Construction (1) Maubin-Yelagale-Shwedaungmaw-Kyaikpi-Mawlamyinegtun Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
11	After Construction (2) Mawlamyinegyun-Hlaingbone-Thitpoak-Kwinpouk-Pyinzalu Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
12	After Construction (3) Labutta-Tingangyi-Pyinzalu Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
13	After Construction (4) Labutta-Thongwa-Oaktwin-Hteiksun Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
14	After Construction (5) Bogale-Kyeinchaung-Katonkani Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
15	After Construction (6) Bogale-Setsan-Htawpine-Ama Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
16	After Construction (7) Pyapon-Kyaonkadun-Dawnyein-Ama-Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		

No	Title	Language	Content	Date of Publication	Model	Form	Pages	Original/Copy	Author	Publisher	Received	Remarks
17	After Construction (8) Kyaonkadun-Setsan Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
18	After Construction (9) Pathein-Talatkhwa-Mawtinsun Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
19	After Construction (10) Bogalae-Mawlamyinegyun-Wakema-Myaungmya Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
20	After Construction (11) Pathein-Ngapudaw Road	English	Outline of Road Construction		A4	Paper	1	Copy		RRL		
21	Pyapon(Final)_Route No. 7	Myanmar	Road Map (Route 7)		A4	CD-R/ Map	1	Copy		Pharpone PW	2013/2/1	Translation into English
22	Route No. 7	Myanmar	Road Map (Route 7)	2012	A4	CD-R/ Map	1	Copy		Pharpone PW	2013/2/1	Translation into English
23	Pharpone-Kyunkadone-Dawnyein-Amar Road(51 miles 5Pharlone)_Road Map	Myanmar	Pavement Classification Map (Route 7)	2012	A4	Paper	1	Copy		Pharpone PW	2013/2/1	Translation into English
24	Route No. 2 Mawlamyaing Kyun-Hlaing Bone-Thit Pote-Kwin Paunt-Pyin Salu, Road Construction Plan	Myanmar	Road Construction Plan (Route 2)	2012	A4	Paper	1	Copy		Pharpone PW	2013/2/1	Translation into English
25	Ayeyarwady District, Connection Road Construction Plan The Map of Connection Road from Route No. 10, Bogalay-Mawkyun-Warkhae Ma Road to Route No. 2, Mawkyun-Pyin Salu	Myanmar	The Map of Connection Road from Route No. 10, Bogalay-Mawkyun-Warkhae Ma Road to Route No. 2	2012	A4	Paper	1	Copy		Pharpone PW	2013/2/1	Translation into English
26	Pharpone-Kyunkadone-Dawnyein-Amar Road(51 miles 5Pharlone)	Myanmar	Budget Allocation of the Past Road Construction	2012	A4	Paper	1	Copy		Pharpone PW	2013/2/1	Translation into English
27	Report on Subsurface Soil Investigation of Maubin River Bridge Site, Maubin Township, Ayeyarwady Division, April, 1996	English	Report on Subsurface Soil Investigation of Maubin River Bridge Site	1996	A4	Binding	27	Copy	Soil Testing & Research Laboratories, Kamakyi Road, Thuwunna, Yangon	SRL	2013/2/5	GOM / MOC PW
28	Report on Subsurface Soil Investigation Bokalay River Bridge, Bokalay-Kyein Chaung-Ka Don Ka Ni Road, Ayeyarwady Division, May, 2010	English	Report on Subsurface Soil Investigation Bokalay River Bridge	2010	A4	Binding	56	Copy	Soil Testing & Research Laboratories, Kamakyi Road, Thuwunna, Yangon	SRL	2013/2/5	GOM / MOC PW
29	Report on Subsurface Soil Investigation, Kywe Chan Ye Kyaw Bridge, Mawgyun-Wakema Road, November, 2010	English	Report on Subsurface Soil Investigation, Kywe Chan Ye Kyaw Bridge	2010	A4	Binding	68	Copy	Soil Testing & Research Laboratories, Kamakyi Road, Thuwunna, Yangon,	SRL	2013/2/5	GOM / MOC PW
30	Report on Subsurface Soil Investigation The Kan Chaung Bridge, Bogalay-Satsun-Ahmar Road, Ayeyarwady Region, December, 2010	English	Report on Subsurface Soil Investigation Tha Kan Chaung Bridge	2010	A4	Binding	30	Copy	Soil Testing & Research Laboratories, Kamakyi Road, Thuwunna, Yangon,	SRL	2013/2/5	GOM / MOC PW

ANNEX 7

LIST OF THE PROVISION EQUIPMENT

(as of February 28, 2015)

NO	ITEM	QTY.	MODEL	MANUFACTURER	Amount		Installation Place	Purchased Date	Condition (*1)	Frequency of Use
					US$	Kyat				
<JFY 2013>										
(Donation Equipment)										
1.	Boring Machine	1 set	D2-K92-P2	TOHO	101,500.00	-	SRL	02/03/201	1	b
2.	Soil Mixing Plant	1 set	NVG1801	NAKAYAMA	65,838,950 Yen	-	PW-MOC	03/28/201	-	-
(Hand-Carry Equipment: Local Purchase)										
1. Total Station		1 set	R-425VN	PENTAX	-	6,500,000	RRL	2/24/2014	1	b
2. Equipment for Observation of High Embankment										
1)	Settlement Board	4 set	400 x 400 x 9	GEOTECH	758.40	-	Bogale MOC	03/25/201	1	a
2)	Pore Water Pressure	3 pcs	KPC-200KPA	Tokyo Sokki	3,255.45	-	Bogale MOC	03/25/201	1	a
3)	Water Level	1 pc	Type 2-50	Alfa Kougaku	760.40	-	Bogale MOC	03/25/201	1	a
4)	Inclination Gauge	1 set	KB-10GC	Tokyo Sokki	5,336.63	-	Bogale MOC	03/25/201	1	a
-1.	Guide Pipe	24 pcs	KBF-51-2 (2m)	Tokyo Sokki	1,877.28	-	Bogale MOC	03/25/201	1	a
-2.	Guide Pipe Socket	20 pcs	KBF-52	Tokyo Sokki	534.60	-	Bogale MOC	03/25/201	1	a
-3.	Guide Pipe Top Cap	4 pcs	KBF-54-1	Tokyo Sokki	102.96	-	Bogale MOC	03/25/201	1	a
-4.	Guide Pipe Bottom Cap	4 pcs	KBF-54-2	Tokyo Sokki	301.00	-	Bogale MOC	03/25/201	1	a
-5.	Tapping Screw	2 packs	KBF-58 (100pcs/pack)	Tokyo Sokki	35.64	-	Bogale MOC	03/25/201	1	a
3.	Data Logger	1 set	TC-32K	Tokyo Sokki	3,009.90	-	Bogale MOC	03/25/201	1	a
4.	Plastic Survey Stick	2 set	KS-120 (120pcs/set)	Tokyo Sokki	3,768.32	-	Bogale MOC	03/25/201	1	a

(*1) Condition

Rank	Statement
1	Good
2	Moderate
3	Repair
4	Unable to Use
5	Lost

(*2) Classification of the Frequency of Use of the each Equipment

Rank	Statement	Frequently
a	Used Frequently	Almost daily
b	Used Well	1-3 times per week
c	Not so much used	1-3 time per year
d	Not used	-

ANNEX 8

OVERSEAS ACTIVITIES COST

(as of February 28, 2015)

	JFY 2012									
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		TOTAL	
	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat
Miscellaneous	0.00	0	0.00	0	0.00	0	325.00	1,319,580	325.00	1,319,580
Rent/ Car Hiring	0.00	0	0.00	0	0.00	0	4,170.00	0	4,170.00	0
Communication Cost	0.00	0	0.00	0	0.00	0	50.00	20,000	50.00	20,000
Airfare	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Travel Allowance	0.00	0	0.00	0	0.00	0	895.00	0	895.00	0
Refreshment/ Conference Fee	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Fee and Honorarium	0.00	0	0.00	0	0.00	0	640.00	45,000	640.00	45,000
Commission Contract (Others)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
TOTAL	**0.00**	**0**	**0.00**	**0**	**0.00**	**0**	**6,080.00**	**1,384,580**	**6,080.00**	**1,384,580**

	JFY 2013									
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		TOTAL	
	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat
Miscellaneous	8,185.00	8,139,380	2,640.00	5,777,570	1,950.00	4,388,800	3.00	1,929,225	12,778.00	20,234,975
Rent/ Car Hiring	9,158.00	0	10,760.00	0	6,620.00	2,660,000	12,082.00	14,901,000	38,620.00	17,561,000
Communication Cost	100.00	1,210,250	0.00	1,167,600	0.00	613,550	0.00	954,550	100.00	3,945,950
Airfare	1,850.00	0	880.00	0	0.00	0	0.00	129,000	2,730.00	129,000
Travel Allowance	1,330.00	0	995.00	0	663.00	0	694.00	1,168,000	3,682.00	1,168,000
Refreshment/ Conference Fee	0.00	0	0.00	0	0.00	98,200	0.00	0	0.00	98,200
Fee and Honorarium	1,133.00	14,000	2,070.00	164,000	1,050.00	352,000	727.00	600,000	4,980.00	1,130,000
Commission Contract (Others)	0.00	0	0.00	1,411,000	0.00	0	0.00	0	0.00	1,411,000
TOTAL	**21,756.00**	**9,363,630**	**17,345.00**	**8,520,170**	**10,283.00**	**8,112,550**	**13,506.00**	**19,681,775**	**62,890.00**	**45,678,125**

	JFY 2014									
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter (as of Feb)		TOTAL	
	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat	US$	Kyat
Miscellaneous	696.00	705,600	2,605.00	1,067,950	3,619.00	2,014,370	386.00	952,490	7,306.00	4,740,410
Rent/ Car Hiring	5,395.00	5,889,000	9,448.00	6,334,000	12,873.00	6,930,000	3,032.00	462,500	30,748.00	19,615,500
Communication Cost	0.00	825,950	0.00	1,707,850	214.00	2,652,728	0.00	517,900	214.00	5,704,428
Airfare	2,507.00	150,000	2,667.00	142,000	4,461.00	303,700	802.00	0	10,437.00	595,700
Travel Allowance	515.00	0	945.00	8,000	1,689.00	217,665	373.00	86,449	3,522.00	312,114
Refreshment/ Conference Fee	0.00	300,000	0.00	0	0.00	0	0.00	323,550	0.00	623,550
Fee and Honorarium	400.00	600,000	400.00	1,833,000	500.00	2,789,000	0.00	854,275	1,300.00	6,076,275
Commission Contract (Others)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
TOTAL	**9,513.00**	**8,470,550**	**16,065.00**	**11,092,800**	**23,356.00**	**14,907,463**	**4,593.00**	**3,197,164**	**53,527.00**	**37,667,977**

LIST OF TRAINING COURSES IN THE PROJECT

ANNEX 9

(as of February 28, 2015)

1. Project Counterpart Training in Japan

No.	Name	Department	Position
		<JFY 2013>	
	(Title) Workshop on Enhancing Road Engineering		
	(Term) September 29 ~ October 12, 2013 (14 days)		
1	U Ohn Lwin	Building	Chief Engineer
2	U Win Lwin	Airfield	Superintending Engineer
3	U Aung Myo Oo	Pyapon District Office	Executive Engineer
4	Daw Htar Zin Thin Zaw	RRL (Road Research Laboratory)	Executive Engineer
5	U Than Naing	Airfield Special Construction Unit-2	Assistant Engineer
		<JFY 2014>	
	(Title) Workshop on Enhancing Road Engineering		
	(Term) September 28 ~ October 11, 2014 (14 days)		
1	U Sai Kyaw Moe	Road	Deputy Chief Engineer
2	Daw Kyi Kyi Thwe	MOC	Superintending Engineer
3	U Kyaw Tun Linn	Maubin District Office	Executive Engineer
4	Daw Su Mon Kyaw	Pyapon District Office	Assistant Engineer
5	U Nyi Nyi Kyaw	RRL (Road Research Laboratory)	Assistant Engineer

No.	Name	Department	Position
	(Title) Pre-Workshop between National Institute of Land and Infrastructure Management (NILIM) and Road Research Laboratory (RRL)		
	(Term) November 15 ~ 22, 2014 (8 days)		
1	Daw Khine Nyein Soe	RRL (Road Research Laboratory)	Senior Assistant Engineer
2	Daw Hnin Yu Aung	RRL (Road Research Laboratory)	Senior Assistant Engineer
3	Daw Nay Chi Oo	RRL (Road Research Laboratory)	Senior Assistant Engineer

No.	Name	Department	Position
(Title) The Training Program on Comprehensive Japanese Expressway Technologies related to Yangon Urban Expressway Project for Republic of the Union of Myanmar			
(Term) January 26 ~ February 4, 2015 (10 days)			
1	Mr. Aung Myint Oo	Planning (Road and Bridge), Publics Works, Ministry of Construction (MOC)	Deputy Chief Engineer
2	U Win Htay	Bridge Department, Publics Works, MOC	Deputy Superintending Engineer
3	U Kyaw Naing	Expressway Maintenance and Repair Unit, Public Works, MOC	Executive Engineer
4	U Nyi Nyi Aung	Expressway Maintenance and Repair Unit, Public Works, MOC	Assistant Engineer
5	U Yan Naung	Expressway Maintenance and Repair Unit, Public Works, MOC	Assistant Engineer
6	U Aung Ko Oo	Bridge Construction Special Unit No.3, Public Works, MOC	Assistant Engineer
7	U Thein Tun Oo	Road Planning Department, Public Works, MOC	Assistant Engineer
8	U Aye Ko	Road & Bridge Department, YCDC (Yangon City Development Committee)	Deputy Head
9	U Kyaw Min Oo	Road & Bridge Department, YCDC	Assistant Engineer
10	U Win Maung	Myanmar Engineering Society	Joint General Secretary

2. Seminar

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
1	June 9 ~ 16, 2013	The 1st Myanmar-Japan Joint Seminar ~ Road Engineering ~	<Myanmar Side> 1) U Win Tint (DMD, PW) 2) U Aung Myint (RRL Consultant) 3) Daw Mya Mya Win (DSE, RRL) 4) U Thet Zaw Win (EE, Road Design Sec) 5) U Htay Win (Associate Professor, Civil Dept., YIU) <Japanese Side> 1) Mr. Moriyasu Furuki	53 participants	* Current road construction and maintenance of all over in Myanmar * Current road construction and maintenance at Ayeyawady Region * Introduce RRL's work and ideas, challenges for road problems at Ayeyawady Region * Soft Soil Treatment * Review on Road design and soil stabilization researches * Soft Soil Treatment Practice in	USD 11,700.00 Kyat 3,722,590 = USD 4,015.74 (USD1.00 = Kyat927) <TOTAL> USD 15,715.74

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
			2) Dr. Shinri Sone 3) Mr. Kazuyuki Kubo 4) Mr. Hiroaki Miyatake 5) Prof. Kiyoshi Omine		Ariake Gulf * Pavement construction practices in tropical countries * Brief Explanation of Japanese Road Policy * Road Standards, Road Engineering , Research, History in Japan	
2	May 22, 2014	The 2nd Myanmar-Japan Joint Seminar ~ Road material and road improvement ~	<Myanmar Side> 1) U Aung Myo Oo <Japanese Side> 1) Dr. Shinri Sone 2) Dr. Hiroshi Watanabe	15 participants	* Road construction and Improvement Quality control and inspection * Road material and necessary technologies and standards * Causes, countermeasures of Concrete structures' deterioration	<TOTAL> USD 2,280.00

3. Workshop

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
1	May 27, 2013	Methodology of Project Cycle Management (PCM)	1) Mr. Koki Kaneda	50 participants	Presentation of approach of the PCM method and discussion of revising evaluation indicators in the Project Design Matrix (PDM).	USD 120.00 Kyat 176,100 = USD 201.49 (USD1.00 = Kyat874) <TOTAL> USD 321.49

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
2	July 25, 2013	Key points in case of applying chemical stabilization method in the PP-1	1) Dr. Hideki Yoneyama	9 participants in RRL	* Selection of additives (lime or cement?) * Determination of material mix ratio * Determination of target strength of stabilized material * Approach of cost reduction	<TOTAL> USD 0.00
3	Oct 4, 2013	How to use the stabilized material testing results in improved pavement design	1) Mr. Hirokazu Miyamoto	5 participants in RRL	* Evaluation of existing test result i) * How to use testing result in improved subgrade * Detail testing plan according to testing results so far.	<TOTAL> USD 0.00
4	Oct 29, 2014	Introduction on stabilized road improvement work	1) Mr. Hirokazu Miyamoto	7 participants in RRL	* Procedure of road stabilized road work * The role of mixing test in laboratory for stabilized road work * Quality control test	<TOTAL> USD 0.00
5	Dec 13, 2013	Implementation Program of Pilot Project-1	<Myanmar Side> 1) Daw Mya Mya Win 2) U Nyi Nyi Kyaw <Japanese Side> 1) Mr. Koki Kaneda 2) Mr. Hiroaki Kobayashi 3) Prof. Kiyoshi Omine	30 participants	* Pavement design approach * Operation method of the stabilizer * Quality control method of soil material * Construction procedure on site * Analysis method of ground behavior	<TOTAL> USD 0.00
6	May 28, 2014	Report about Pilot Project-1 ~ Conditions & Issues	<Myanmar Side> 1) U Kyaw Shein 2) U Aung Myao Oo 3) Daw Kyi Kyi Thwe <Japanese Side> 1) Prof. Kiyoshi Omine	29 participants	* Brief Presentation of the Pilot Project -1 in Ayeyarwady Region * Pilot Project-1 Reporting * High Embankment Behavior, Study in Delta Area * Importance of monitoring of high embankment on soft ground	USD 120.00 Kyat 360,000 = USD 380.15 (USD1.00 = Kyat947) <TOTAL>

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
						USD 500.15
7	June 6, 2014	Study about Analysis methods of high embankment on soft ground at Kywe Chan ye Kyaw Bridge approach road (1)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	11 participants	* Consolidation, Phenomenon and Theory * How to conduct consolidation test and how to summarize the results * Example of countermeasures * Slope stability * Slope failure, Phenomenon and Theory * How to calculate the safety factor of embankment * Critical embankment height * Drill: Stability chart by Tayler * Drill: Slip circular methods * Analysis methods of the observation equipment installed at site	<TOTAL> USD 0.00
8	June 12, 2014	Study about Analysis methods of high embankment on soft ground at Kywe Chan ye Kyaw Bridge approach road (2)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	10 participants	* Analysis of Soil Boring Data * Consolidation settlement * How to calculate the underground stress due to overburden load * Drill of underground stress calculation and settlement * How to estimate Consolidation settlement and its time * Drill of estimation of Consolidation settlement and its time	<TOTAL> USD 0.00
9	June 19, 2014	Study about Analysis methods of high embankment on soft ground at Kywe Chan ye Kyaw Bridge approach road	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	10 participants	* Consolidation settlement * Consolidation, Phenomenon and Theory * How to conduct consolidation test and	<TOTAL> USD 0.00

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
		(3)			how to summarize the results * How to calculate the underground stress due to overburden load * Drill of underground stress calculation and settlement * How to estimate Consolidation settlement and its time * Drill of estimation of Consolidation settlement and its time	
10	August 6, 2014	Study about Analysis methods of high embankment on soft ground at Kywe Chan ye Kyaw Bridge approach road (4)	1) Mr. Koki Kaneda	9 Participants	* Supplementary explanation about basic knowledge of soil * Questionnaire about basic knowledge * Explanation of calculation methods for stability * Coming time schedule	
11	August 27, 2014	Study about Analysis methods of high embankment on soft ground at Kywe Chan ye Kyaw Bridge approach road (5) (6)	1) Mr. Koki Kaneda	9 Participants	* Review of calculation methods for stability by Geo Studio * Group discussion about the understanding methods of original data * Group discussion about the correctness of converted or calculated data * Classification of soil striatum and definition of soil stratum characteristic data * No tests, but score by the presentation and comments number	
12	November 5, 2014	Summarization of the work shop process based on new	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	5 participants	* Manual Vol.1 Stability factor analysis * Manual Vol.2 Consolidation	

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
		manual (7)			settlement	
13	November 19, 2014	Preparation of Data sheets about Lab test in JIS format sheets by practical data (8)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	6 participants	* Kyawe chan yak yaw bridge approach slope's soil investigation results as a sample excise of data processing and arranging necessary graphs	
14	November 24, 2014	Preparation of Data sheets about Lab test in JIS format sheets by practical data (9)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	6 participants	* Explained and discussed about how to put data and draw in the format sheets of d-vt curve and d-long curve	
15	November 26, 2014	Preparation of Data sheets about Lab test in JIS format sheets by practical data (10)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	6 participants	* Calculating sheet and preparation of e-log p curve	
16	December 3, 2014	Explanation of Settelement Analysis method using textbook (11)	1) Mr. Koki Kaneda 2) Mr. Kuniaki Nishijima	9 participants	* Process of soil investing * Preparation of several curve for analysis * Consolidation test process * Preparation of characteristic graph for consolidation analysis * How to get Cv value from log Cv-log P vurve * Ground and loading condition * Calculation of effective stress * Calculation of settlement by e-log p curve and by Cc method * Calculation of settlement time * Settlement curve modification during construction * Countermeasures (example, preloading, sand pipe) *	

No.	Date	Title	Lecturer	No. of Participants	Content	Expenses by the Project
17	February 23, 2015	1) High Embankment Behavior Observation & Analysis 2) Stabilization work	3) U Aung Myo Oo 4) U Aung Chi 5) U Aung Soe oo 6) Daw K Khaing Nyein Soe 7) Mr. Koki Kaneda 8) Mr. Hiroaki Kobayashi	51 participants	* Installed equipment and Installing method * Observation method and current results * Necessary of observation and work specification countermeasure work * Explanation of PP-2 work plan	USD 300.00 + Kyat 323,550 = USD 320.03 (USD1.00 =Kyat 1,011) <TOTAL> USD 620.03

4. Training in the PP-1

No.	Date	Title	Trainer	No. of Participants	Content	Expenses by the Project
1	Feb 19, 2014	Intensive training of operation skill of machinery work	1) Mr. Yukio Kohsaka 2) U Nyi Nyi Win 3) U Tin Aung 4) U Hlaing Min Zaw 5) U Myint Than	13 participants	Classroom: * Role of Operator * Daily Operation and Inspection Report by Operators * Review of Operation & Maintenance Manual * Skill test Field training: * Construction of Road Stabilizer * Functions of Control equipment, Switches and Monitor * Work Operation (start the engine->stabilizing work->stop the engine) * To cope with Emergency	Kyat 15,600 = USD 16.12 (USD1.00 = Kyat968) <TOTAL> USD 16.12

2	Mar 13-14, 2014	Intensive training of control of stabilization material	1) Mr. Hiroaki Kobayashi 2) U Aung Myo Oo 3) Mr. Masataka Fujikuma 4) U Nyi Nyi Kyaw 5) Mr. Hirokazu Miyamoto	37 participants	Classroom: * Investigation & Design * Supervision of stabilization works * Quality control of stabilized materials * Analysis & Monitoring of ground behavior Field training: * Lime stabilization work of sub-grade * Cement stabilization work of sub-base course	Kyat 871,600 = USD 900.41 (USD1.00 = Kyat968 <TOTAL> USD 900.41
3	Jan 30, 2014	Training in field density test at PP-1 site	<Myanmar Side> 1) U Nyi Nyi Kyaw <Japanese Side> 1) Mr. Hirokazu Miyamoto	6 participants QC technician from RRL, Site engineer	Field pre- training * Field density test by sand replacement method * Confirmation the degree of compaction on existing subgrade	

Member List of "Soft Soil Treatment Manual" Editing Committee

	Name	Title	Role in TC
1	U Kyaw Linn	Managing Director	Chairman of JCC
2	U Win Tint	D M D (Work), PW	
3	U Khin Maung Kyaw	C E (Road), PW	
4	U Aung Myint Oo	D C E, Planning	Project Director
5	U Aung Myint	In-house Consultant, RRL	Adviser
6	Daw Hla Hla Thwe	S E, Road	Project Manager
7	U Myint Kyi	S E, Ayeyarwady Division	
8	Daw Mya Mya Win	D S E, RRL	Design
9	U Aung Myo Oo	D S E, Airfield 2	Implementation Program & Project Management
10	U Khin Zaw	D S E, Special Unit (4)	
11	U Zaw Naing	D S E, Special Unit (2)	
12	U Kyi Twin Oo	D S E, Special Unit (15)	
13	U Thet Zaw Win	E E, Phyapon District	Implementation Program & Project Management
14	Daw Htar Zin Thin Zaw	E E, RRL/Yangon	Material QC
15	U Kyaw Tun Lin	E E, Maubin District	
16	U Thet Zaw Win	E E, Pyapon District	
17	U Than Htoo Aung	E E, Latputta District	
18	U Toe Toe	E E, Myaung Mya District	
19	U Yan Naing Zaw	E E, Hintharda District	
20	U Tint Lwin	E E, Pathein District	
21	U Nay Lin Tun	AE (RRL)	
22	U Tint Lwin Oo	AE (RRL)	
23	U Nyi Nyi Kyaw	A E, RRL/Yangon	Soil Investigation (material)
24		SRL	
25		Yangon technological Univ	

MD	Managing Director
DMD	Deputy MD
CE	Chief Engineer
DCE	Deputy CE
SE	Superintending Engineer
DSE	Deputy SE
EE	Executive engineer
AE	Assistant Engineer
JE	Junior Engineer
TE	Township Engineer

Member List of JCC

1. Chairman			
U Kyaw Linn		Managing Director	PW
2. Members from Myanmar side			
1	U Win Tint	Deputy Managing Director	Work
2	U Win Pe	Deputy Managing Director	Planning
3	U Khin Maung Kyaw	Chief Engineer	Road Department
4	U Ohn Lwin	Chief Engineer	Road Department
5	U Thein Zaw	Chief Engineer	Airfield
6	U Khin Maung Thein	Chief Engineer	Building
7	U Saw Win Naing	Deputy Chief Engineer	Road Department
8	U Sai Kyaw Moe	Deputy Chief Engineer	Road Department
9	U Win Lwin	Deputy Chief Engineer	Bridge
10	U Khin Thet	Deputy Chief Engineer	Airfield
11	U San Wai	Deputy Chief Engineer	Airfield
12	U Myint Kyi	Superintending Engineer	Ayeyarwaddy Division
13	Daw Khin Than Win	Deputy Superintending Engineer	Road Department
3. Counterpart			
1	U Aung Myint Oo	Project Director Deputy Chief Engineer	Planning
2	Daw Hla Hla Thwe	Project Manager Superintending Engineer	Road Department
3	Daw Mya Mya Win	Assistant Project Manager Deputy Superintending Engineer	Road Research Laboratory
4	U Aung Myo Oo	Assistant Project Manager Executive Engineer	Phyapon District
5	U Thet Zaw Win	Assistant Project Manager Executive Engineer	Road Department
6	Daw Yin Yin Swe	Assistant Project Manager Executive Engineer	Soil Research Laboratory
7	Daw Htar Zin Thinn Zaw	Executive Engineer	Road Research Laboratory
8	U Nyi Nyi Zaw	Executive Engineer	Quantity Survey
9	Daw Zin Zin Htike	Executive Engineer	Quantity Survey
10	Daw Su Mon Kyaw	Township Engineer	Phyapon District
11	Daw Ei Ei Mon	Assistant	Road Department
12	U Aung Myint	Consultant	Road Research Laboratory

4. Other Attendants			
1	Daw Lwin Lwin Mi	Executive Engineer	Road Department
2	U Aung Kyaw Han	Executive Engineer	Road Department
3	U Myint Oo	Executive Engineer	Road Department
4	Daw Myint Myint Sein	Executive Engineer	Yangon Division

OTHER POINT DISCUSSED

The Myanmar side expressed their comment as following;
At the end of project the soft soil treatment manual will be discussed and accepted by Public Works. The technological knowledge and skill of PW engineers will also be improved in behavior of high embankment and road construction with stabilization.
PW expected to achieve new manual for geotechnical investigation, design, quality control, quality assurance, construction management and maintenance for the road constructions with stabilization. But PW didn't achieve it from the Project. Outcome of the Project didn't meet PW's expectations. We should evaluate the input and how big the output is achieved by PW.

The Japanese side explained their understanding as following:
In the course of the Project, the related needs such as geotechnical investigation, design, quality control and assurance, construction management and maintenance of road construction with stabilization has been arisen in spite of not being described in the PDM. The lessons derived from the experience was that mutual and close consultation between both sides were essential to discuss such matter both at the initial and mid-time stage of the cooperation project. And with such addressing, the design of the projects can be more flexible and practical when the situation changes significantly in the cooperation projects onward.

ANNEX 5

The indicators are stipulated in the Project Design Matrix (PDM).
Achievement level of the project activities will be examined by applying verifiable indicators at designated timing.

Indicators for PDM V1.0 was collected in 2013 as shown on Table 5.2 – 5.6 on following pages.

Table 5.1.1 Verifiable Indicators for PDM Version 1

Narrative Summary	Objectively Verifiable Indicators	Baseline Data
Overall Goal Roads in the delta areas of Ayeyarwady Region are improved. (To be examined 3 years after the Project)	1. The length (km) of road construction under the control of the PW is increased in the delta areas. 2. Reducing driving hour or travel time.	Annex 5 Table 5.2 Annex 5 Table 5.3
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced. (To examined at the completion of the Project)	1 Road length constructed by the technology introduced from Pilot Project. 2 Improved road conditions in delta area	Annex 5 Table 5.4
Outputs 1. Road technology standards and manuals for designing and construction works are improved.	1-1. The number of the road technology standards and manuals developed by the PW is increased.	Annex 5 Table 5.5
2. The practical skills and knowledge of the road technical staff are enhanced.	2-1. Number of trained engineers (Seminar, WS, OJT)	Annex 5 Table 5.6

However, all indicators was revised by the suggestion of Mid Term Evaluation Team, and the base line data were changed as shown below:

Table 5.1.2 Verifiable Indicators for PDM Version 2

Narrative Summary	Objectively Verifiable Indicators	Baseline Data
Overall Goal Roads in the delta areas of Ayeyarwady Region are improved. (To be examined 3 years after the Project)	1. The road improved by the stabilization technique is more than 10 km 2. Driving hour or travelling time is reduced 10% comparing before execution of project.	No work as the Baseline in the past Annex 5 Table 5.3
Project Purpose The capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region is enhanced. (To examined at the completion of the Project)	1. The enhancement of skill and knowledge of the engineer for road design and construction is confirmed by the hearing from more than 30 staff. 2 By the end of the project, road length constructed by the technology introduced from Pilot Project is extended longer than 2.6 km.	No baseline data, because this is a newly introduced technology
Outputs 1. Road technology standards and manuals for designing and construction works are improved.	1 New soft soil treatment manual is discussed and accepted by P.W. 2 More than 10 engineers are executing the work by using the manual.	No baseline data, because this is a newly introduced technology
2. The practical skills and knowledge of the road technical staff are enhanced.	1 Total number of trained staff of PW is more than 300 numbers. 2. 50% of participants evaluate training/seminars favorably.	No baseline data, because this is a newly introduced technology

ANNEX 5

Table 5.2 Length of Road Construction (Past Record and Future Plan)

No.	Name of Road	Km	Construction Group	2009 km	2010 km	2011 km	2012 km	2013 km
1	Pathein - Monywa	218	Districts, Special Construction Group + Company	223.69	223.69	218.86	219.27	217.86
2	Yangon - Pathein	99.6	B.O.T (Asia World)	149.26	149.26	100.58	100.58	100.58
3	Pathein - Ngwesaung	47.4	B.O.T (Asia World)	0.00	0.00	47.47	47.47	47.47
4	Ngathainggyaung - Gwa	35.6	RCSU (2)	45.87	45.87	35.81	35.81	35.81
5	Maubin - Kyaiklat	32.2	Maubin District + Pyapon District	32.39	32.39	32.39	32.39	32.39
6	Kyaiklat - Pyapon	17.6	Pyapon District	17.70	17.70	17.70	17.70	17.70
7	Pyapon - Bogale	30.8	Pyapon District	30.98	30.98	30.98	30.98	30.98
8	Kyeinpinse - Setkawt - Danubyu - Zalun	43.8	RCSU (4)	44.05	44.05	44.05	57.73	57.73
9	Hinthada - Duya - Dauntgyi - Zalun - Danubyu	33.2	B.O.T	53.11	53.11	53.11	19.71	19.71
10	Approach Road of Bo Myat Htun Bridge	6.4	B.O.T (Asia World)	0.00	0.00	6.44	6.44	6.44
11	Hinthada - Songon - Myan-aung	104.4	Companies	105.01	105.01	105.01	105.01	105.01
12	Myan-aung - Kyangin	7	Hinthada District	7.04	7.04	7.04	7.04	7.04
13	Kyangin - Phatye	13.8	Hinthada District	13.68	13.68	13.68	13.88	13.88
14	Danubyu - Thaunggyi	38.8	Maubin District + Pathein District	39.03	39.03	39.03	39.03	39.03
15	Hinthada - Athok - Kyaunggon	16.8	Hinthada District + Pathein District + B.O.T	16.90	16.90	16.90	16.90	16.90
16	Approach Road of Kebaung Bridge	4.4	Pathein District + B.O.T	4.43	4.43	4.43	4.43	4.43
17	Maubin - Sarmalauk	34.2	Maubin District + B.O.T (Asia World)	36.41	36.41	34.80	34.80	34.80
18	Twante - Maubin	24.2	Maubin District	21.12	21.12	24.34	24.34	24.34
19	Dedaye - Pyapon	25.2	Pyapon District	26.35	26.35	25.35	25.35	25.35
20	Labutta - Myaungmya - Einme - Kyaunggon - Kyonpyaw	74	Myaungmya District + Pathein District + RCSU (15) + RCSU (16)	171.79	171.79	171.19	146.65	163.14
	Total	907.4						

No.	Name of Road	Km	Construction Group	2009 km	2010 km	2011 km	2012 km	2013 km
21(1)	Maubin - Yelagale - Shwedaungmaw -Kyaikpi - Mawlamyinegyun	82.8	RCSU (4)	72.02	72.02	72.02	72.02	72.02
22(2)	Mawlamyinegyun - Hlaingbone- Thitpoak - Kwinpouk- Pyinzalu	115.8	RCSU (4)	108.43	108.43	116.47	116.47	116.47
23(3)	Labutta- Tingangyi – Pyinzalu	56.4	Labutta District	56.73	56.73	56.73	56.73	56.73
24(4)	Labutta- Thongwa- Oaktwin- Hteiksun	99.8	RCSU (2) + Labutta District	60.55	60.55	40.03	100.38	100.38
25(5)	Bogale-Kyeinchaung- Katonkani	66	RCSU (16)	66.38	66.38	66.38	66.38	66.38
26(6)	Bogale- Setsan- Htawpine- Ama	61.8	Maubin District	62.16	62.16	62.16	62.16	62.16
27(7)	Pyapon - Kyaonkadun - Dawyein - Ama	82.6	Pyapon District	48.68	48.68	83.08	83.08	83.08
28(8)	Kyaonkadun- Setsan	30.8	Pyapon District	30.78	30.78	30.78	30.78	30.78
29(9)	Pathein- Thalaikhwa- Mawtinsun	153.6	Pathein District + Labutta District	154.49	154.49	154.49	154.49	154.49
30(10)	Bogalae- Mawlamyinegyun- Wakema - Myaungmya	105.6	Myaungmya District + Pyapon District	0.00	0.00	0.00	98.77	98.77
31(11)	Pathein- Napudaw	33.6	Pathein District	33.80	33.80	33.80	32.59	32.59
	Total	888.8						

Table 5.3 Driving Hours or Travel Time in the Delta Area

No.	Name Of Road	Km	Construction Group	Driving Hour (hr:min)		Remark
				Rainy Season	Drying Season	
1	Pathein -Monywa	216.6	Districts+Special Construction	4:22	4:02	Group+Company(BOT) 52.8km
2	Yangon-Pathein	100.0	B.O.T (Asia World)	3:10	3:10	(152.8km)
3	Pathein - Ngwesaung	47.2	B.O.T (Asia World)	1:30	1:15	
4	Ngathainggyaung-Gwa	35.6	RCSU (2)	1:45	1:15	
5	Maubin-Kyalklat	32.2	Maubin District + Pyapon District	1:10	0:55	
6	Kyaiklat-Pyapon	17.6	Pyapon District	0:30	0:30	
7	Pyapon-Bogale	30.8	Pyapon District	0:35	0:35	
8	Kyeinpinse-Setkawt-Danubyu-Zalun	57.4	RCSU (4)	2:00	1:30	
9	Hinthada-Duya-Dauntgyi-Zalun-Danubyu	19.6	Hinthada District	0:25	0:25	
10	Approach Road of Nyaungdon Bridge	6.4	RCSU (4)	0:12	0:10	
11	Hinthada-Songon-Myanaung	104.4	Companies	2:45	2:30	
12	Myanaung-Kyangin	7.0	Hinthada District	0:10	0:10	
13	Kyangin-Phatye	13.8	Hinthada District	0:25	0:20	
14	Danubyu-Thaunggyi	38.8	Maubin District + Pathein District	1:30	1:00	
15	Hinthada-Athokg-Kyaunggon	16.8	Pathein Districts	0:57	0:40	
16	Approach Road of Kebaung Bridge	4.4	Pathein District	0:10	0:05	
17	Maubin-Sarmalauk	34.6	Maubin District+B.O.T (Asia World)	2:30	2:00	
18	Twante-Maubin	24.2	Maubin District	0:35	0:30	
19	Dedaye-Pyapon	25.2	Pyapon District	0:25	0:25	
20	Labutta-Myaungmya-Einme-Kyaunggon-Kyonpyaw	74.0	Myaungmya District +Pathein District + RCSU(15)+RCSU(16)	3:00	2:15	
21	Maubin-Yelagale -Shwedaungmaw-Kyaikpi-Mawlamyinegyun	71.6	RCSU(4)	3:30	2:00	
22	Mawlamyinegyun-Hlaingbone-Thitpoak-Kwinpouk-Pyinzalu	115.8	RCSU(4)	-	-	Connot drive because of earth toad
23	Labutta- Tingangyi-Pyinzalu	56.4	Labutta District + RCSU(15)	1:15	1:00	From Labatta to Tinganyyi
24	Labutta-KyaukPhyarlay-Thongwa-	99.8	RCSU(2)+Labutta District	-	-	Connot drive from M 0/0-M 20/7
	Oaktwin-Hteiksun			-	2:00	M 20/7-55/1
				0:40	0:20	M 30/0-40/0
				0:30	0:20	M 47/0-55/1
				0:30	0:15	M 6/3-7/2 (Old)
				0:30	0:20	M 0/0-4/7
25	Bogale -Kyeinchaung-Katonkani	66.0	AFSU (2)	-	1:30	In raining season, car can drive only up to M 10/2
26	Bogale-Seisan -Htawpine-Ama	61.8	AFSU (2)	-	-	Cannot drive because 5 nos of bridges are under construction
27	Pyapon-Kyaokadun-Dawnyein-Ama	82.6	Pyapon District	5:00	3:30	
28	Kyaonkadon-Satsan	30.6	Pyapon District	1:10	1:00	M (0/7-20/0)
29	Pathein-Thalaikhwa-Mawteinsun	153.6	Pathein District	4:40	3:30	
30	Bogalae-Mawlamyinegyun-Wakama-Myaungmya	98.2	Pyapon+Labutta+Myaungmay District	6:40	4:00	
31	Pathein-Napudaw	32.4	Pathein District	0:58	0:40	
	Total	**1143.8**				

Table 5.4 Road Condition by Road in Delta Area

			Good		Fair		Bad		Total
No.	Name of Road	Km	km	%	km	%	km	%	km
1	Pathein - Monywa	216.6	216.60	100%	-	-	-	-	216.60
2	Yangon - Pathein	99.6	99.60	100%	-	-	-	-	99.60
3	Pathein - Ngwesaung	47.2	40.40	86%	6.80	14%	-	-	47.20
4	Ngathainggyaung - Gwa	35.6	1.60	5%	13.80	39%	20.20	56%	35.60
5	Maubin - Kyaiklat	32.2	4.60	14%	18.20	57%	9.40	29%	32.20
6	Kyaiklat - Pyapon	17.6	-	-	17.60	100%	-	-	17.60
7	Pyapon - Bogale	30.8	30.80	100%	-	-	-	-	30.80
8	Kyeinpinse - Setkawt - Danubyu - Zalun	57.4	4.80	8%	6.40	11%	46.20	81%	57.40
9	Hinthada - Duya - Dauntgyi - Zalun - Danubyu	19.6	2.00	10%	15.80	81%	1.80	9%	19.60
10	Approach Road of Bo Myat Htun Bridge	6.4	6.40	100%	-	-	-	-	6.40
11	Hinthada - Songon - Myan-aung	104.4	37.60	36%	55.90	54%	10.90	10%	104.40
12	Myan-aung - Kyangin	7	3.80	54%	2.60	37%	0.60	9%	7.00
13	Kyangin - Phatye	13.8	1.80	13%	4.80	35%	7.20	52%	13.80
14	Danubyu - Thaunggyi	38.8	3.90	10%	9.40	24%	25.50	66%	38.80
15	Hinthada - Athok - Kyaunggon	16.8	6.00	36%	6.40	38%	4.40	26%	16.80
16	Approach Road of Kebaung Bridge	4.4	0.40	9%	0.40	9%	3.60	82%	4.40
17	Maubin - Sarmalauk	34.2	21.00	61%	13.20	39%	-	-	34.20
18	Twante - Maubin	24.2	24.20	100%	-	-	-	-	24.20
19	Dedaye - Pyapon	25.2	-	-	25.20	100%	-	-	25.20
20	Labutta - Myaungmya - Einme - Kyaunggon - Kyonpyaw	74	19.55	26%	49.45	67%	5.00	7%	74.00
	Total	**905.8**	**525.05**	**58%**	**245.95**	**27%**	**134.80**	**15%**	**905.80**

			Good		Fair		Bad		Total
No.	Name of Road	Km	km	%	km	%	km	%	km
21(1)	Maubin - Yelagale - Shwedaungmaw -Kyaikpi - Mawlamyinegyun	82.8	9.0	11%	65.8	79%	8.0	10%	82.80
22(2)	Mawlamyinegyun - Hlaingbone- Thitpoak - Kwinpouk- Pyinzalu	115.8	-	-	-	-	115.8	100%	115.8
23(3)	Labutta- Tingangyi – Pyinzalu	56.4	0.8	1%	-	-	55.6	99%	56.4
24(4)	Labutta- Kyaukphyarlay- Thongwa- Oaktwin- Hteiksun	99.8	16.6	17%	4.6	5%	78.6	78%	99.80
25(5)	Bogale-Kyeinchaung- Katonkani	66	-	-	-	-	66.0	100%	66.0
26(6)	Bogale- Setsan- Htawpine- Ama	61.8	-	-	-	-	61.8	100%	61.8
27(7)	Pyapon - Kyaonkadun - Dawyein - Ama	82.6	-	-	43.4	53%	39.2	47%	82.6
28(8)	Kyaonkadun- Setsan	30.6	-	-	7.2	24%	23.4	76%	30.6
29(9)	Pathein- Thalaikhwa- Mawtinsun	153.6	21.6	14%	132.0	86%	-	-	153.6
30(10)	Bogalae- Mawlamyinegyun- Wakema - Myaungmya	105.6	16.0	15%	47.4	45%	42.2	40%	105.60
31(11)	Pathein- Napudaw	32.4	29.6	91%	1.0	3%	1.8	6%	32.40
	Total	**887.4**	**93.6**	**11%**	**301.4**	**34%**	**492.4**	**55%**	**887.40**

Table 5.5 List of Existing Manuals and Standards

No.	Title
1.	Road Construction Specification (Public Works, Ministry of Construction)
2.	Road Maintenance Manual (Public Works, Ministry of Construction)
3.	Surface Dressing Manual (Public Works, Ministry of Construction)
4.	Pavement Surfacing; their properties and applications to Roads in Burma (Road Research and Development Project, United Nations Development Program)
5.	Axle Load Survey Demonstration (Road Research and Development Project, United Nations Development Program)
6.	Highway Construction Specifications (Road Research and Development Project, United Nations Development Program)
7.	General Specifications for Highway Bridge Construction in Burma (Road Research and Development Project, United Nations Development Program)
8.	Inventory of Construction Corporation Roads (Road Research and Development Project, United Nations Development Program)
9.	Road Roughness Surveys (Road Research and Development Project, United Nations Development Program)
10.	Design Standards for Highways (Ministry of Construction, Public Works)

Table 5.6 List of Training and Workshop (as of Dec/2013)

No.	Date	Theme	Number of attendance from PW
1.	Feb. 11, 2013	(at the time of Kick Off Meeting)	0
2.	May. 27, 2013	Project Cycle Management (PCM) workshop (The 1st Workshop at Yangon)	39
3.	Jun. 13 and 14, 2013	The 1st Seminar at Yangon (Introduction of advanced technology in Japan for road sector)	52
4.	December 13, 2013	Workshop prior to PP-1	40
5.			
6.			
7.			
8.			
9.			

Republic of the Union of Myanmar
Public Works, Ministry of Construction

Japan International Cooperation Agency

Reference Paper for Road Stabilization

April 2015

PW, MOC, JICA
The Project for Implement of Road Technology
in Disaster Affected Area in Myanmar

Abbreviations

Premium rate	Additional additive rate to the rate decided by Laboratory test considering the allowance for site mixture conditions
Additive rate	Mixture rate including premium rate

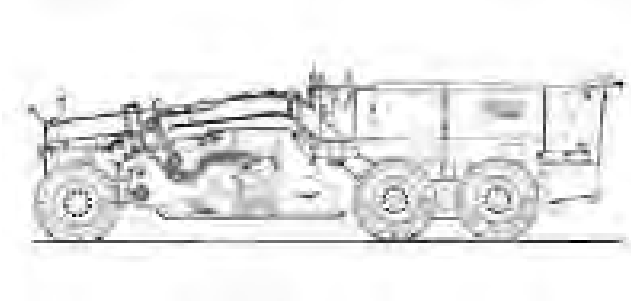
Table of contents

Stabilizer Equipment

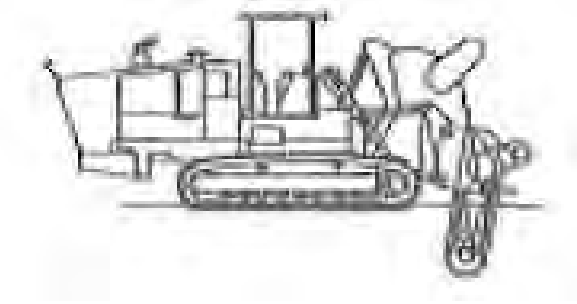
Stabilization is the work to improve the site soil mainly by mixing. One of the features of stabilization work is to be mechanical work. It needs minimum backhoe. Many kinds of specific equipment were developed to execute the work efficiently. Followings are example of equipment to be used in stabilization work.

Subgrade Stabilizer

Mud Stabilizer



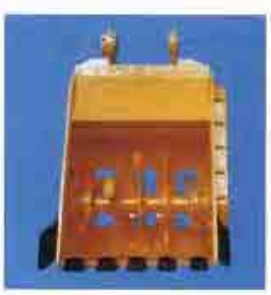
Base course Stabilizer



Subgrade stabilizer

Movable Soil Plant

Movable Soil Plant



Bucket Type Stabilizer

Lime/Cement Spreader

1. Outline of Stabilization

Stabilization is a kind of soft ground treatment. Stabilization methods should be adopted when the cost is economical comparing other methods.

1.1. in what case Road Stabilization is required?

Road stabilization could be adopted in case of Table 1-1:

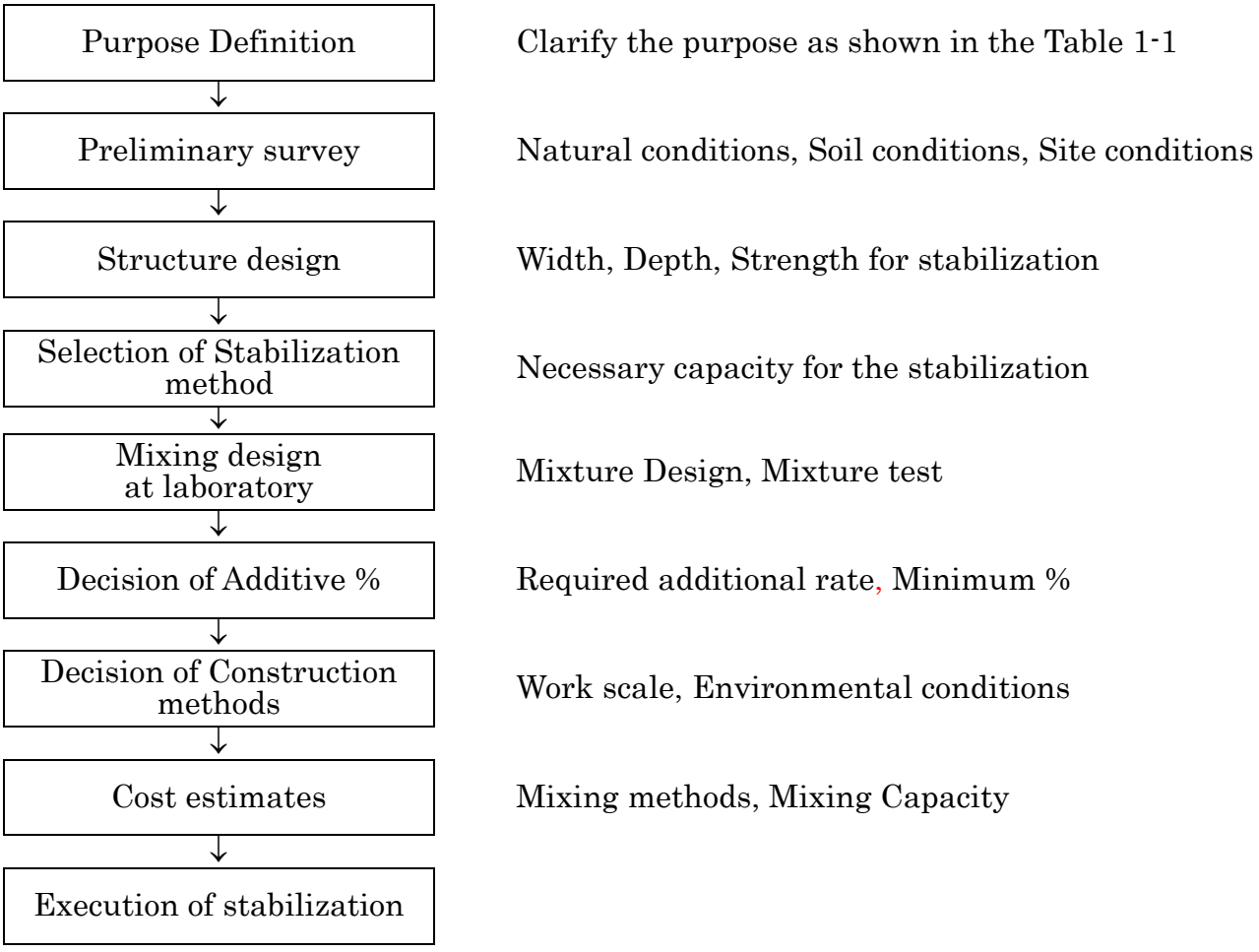
Table 1-1 Purpose of Stability Work

a) to ensure the traffic for the construction equipment
b) to improve the strength or bearing capacity of road-bed, subgrade, base-course and structure foundations
c) to reduce the compressibility of soil to be used refilling or backfilling
d) to re-use the construction generated soil by improving
e) others

1.2. Process for Road stabilization

Road stabilization process is shown in bellow: Fig1-1

Fig 1-1 Procedures for Stabilization Work



1.3. Preliminary survey

Three kinds of survey are expected

Fig 1-2 Necessary items for Preliminary Survey

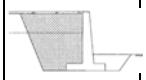
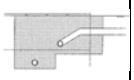
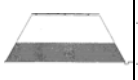
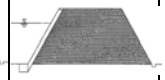
Natural condition	Topographical, geological, weather, environmental conditions
↓	
Soil condition	Pat survey report, if available Should follow the testing standards of the execution agency Physical test except water contents should be done, if necessary
↓	
Site condition	Construction site's earth ground, obstacles, temporary roads Procurement methods (route, package or bulk) Period, Work volume, seasons Surrounding conditions

1.4 Classification of Site Soil or generated soil from the site

Site soil or Generated soil from the site is classified as follows in Japan:

This manual will treat for 3rd class and 4th class soil, and not described others

Table 1-2 Generated Soil and Applicable Place

		Cone index	Backfill 	Re-fill 	Sub-grade 	Road-bed 	Dike 	Land develop-ment
1st class	Stone soil, Sandy soil		◎	◎	◎	◎	◎	◎
2nd class	Stone soil, Sandy soil	>800	◎	◎	◎	◎	◎	◎
3rd class	Sandy soil Clay soil Organic soil	>400	○	◎	○	◎	◎	◎
4th class	Sandy soil Clay soil	>200	○	○	○	○	○	○
Mud	Sandy soil Clay soil	200>	○ △ ×	△ △ ×	△ △ ×	○ △ △	○ △ ×	○ △ △

◎: usable without treatment
○: usable by applying stabilization
△: needs cost and time for the improvement
×: not appropriate to use generally

1.5. Kinds of Road stabilization

Road stabilization will be categorized into 2 kinds

Table 1-3 Kinds of Road Stabilization

1) Mechanical stabilization	✓ Mixing with good material such as sand or gravel soil ✓ Freezing of soil ✓ Dehydration such as Vacuum etc
2) Chemical stabilization	✓ Lime stabilization ✓ Cement stabilization ✓ Stabilization by artificial solidification materials ✓ Mixing of above solidification materials

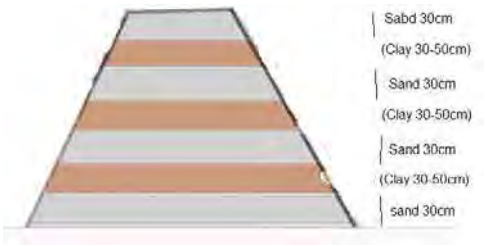
Note1: Mixing of above methods is effective according to the site soil conditions

Note2: Mixing by blast furnace slag has a effect of mechanical stabilization and chemical stabilization due to its CaO components.

1.5.1. Mechanical stabilization

This method is applied to improve the soil properties or drain the water inside of clayey layer and mainly for road-bed (embankment) improvement.

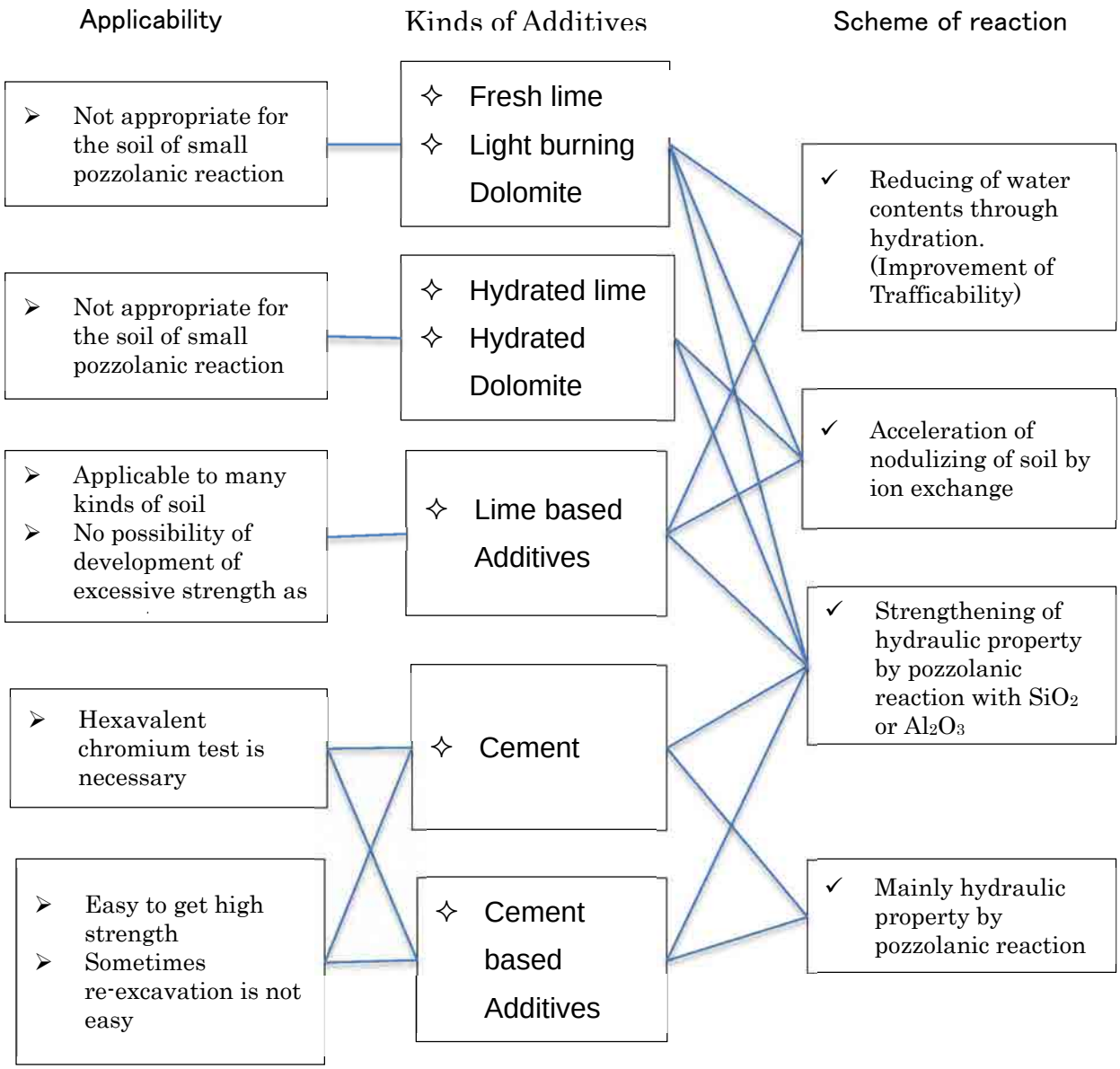
Table 1-4 Kinds of Mechanical Stabilization

Mechanical stabilization	Mixing	mixing sand (30% or more) without solidification additives
	Alternation of strata	

1.5.2 Chemical Stabilization

There are many kinds of chemical additives. They are categorized as shown in Figure below:

Fig 1 Comparison of Chemical Additives



This manual will describes only Lime and Cement.

Figure 2 Applicability of additives for Subgrade according to Soil Properties

					Issues on using as subgrade			Stabilization Additives				Remarks
					Increase CBR	Traffic ability	Stability	Cement	Hydrated Lime	Fresh lime	Others	
Course Soil Course parts> 50%	Gravel Soil G>S	FP<15%	Gravel S<15%	G				Δ	◎			
			Sand Gravel S>15%	GS	Δ			Δ	◎			
		FP>15%	Gravel with fine parts	GF	X			◎	◎			
	Sandy Soil S<G	FP<15%	Sand	S	Δ	Δ	Δ		Δ			
			Gravel sand	SG			Δ		Δ			
		FP>15%	Sand with fine parts	SF	X	X	Δ	◎	◎			
Fine Soil Fine parts>50%	Cohesive Soil		Silt	M	X	X			◎	○		Disturbed Fine Soil is not appropriate as Subgrade
			Clay	C	X	X			◎	○		
	Organic soil			O	Difficult to use as subgrade materials							
	Volcanic Clay			V	X	X			○	◎		
High Organic soil				Pt	Difficult to use as subgrade materials							

Remarks

Issues on using as subgrade			Effectiveness as stabilizing additives			
X	Δ		◎	○	Δ	
Has issues	Maybe issues		Highly	Good	Not always	

1.5.3 Lime stabilization

Lime stabilization has following effects:

Table 1-5 Purpose of Lime stabilization

a) reducing of water contents ratio
b) reducing of plastic index
c) improving trafficability
d) improving compaction degree
e) increasing strength value

There are many kinds of Limes to be used as shown bellow. It should be selected considering the cost, availability and effect by the laboratory test

Table 1-6 Kinds of Lime to be used for lime stabilization

Lime stabilization	Fresh lime	✓ Burning lime stone with 900℃ or more ✓ Powder type or particle type
	Hydrated lime-dry	✓ Reacted fresh lime with water ✓ Powder type
	Hydrated lime-wet	✓ Added 20-25% water to Hydrated lime
	Light burning Dolomite	✓ Burning dolomite with 900C or more ✓ Powder type or particle type
	Hydrated Dolomite	✓ Reacted fresh lime with water ✓ Powder type
	Solidification lime	✓ Added talc, slag powder, alumina, fly ash

1.5.4. Cement stabilization

Cement stabilization is generally effective for sandy soil.

Table 1-7 Kinds of Cement for stabilization

Cement stabilization	Portland cement	✓ Available in almost area ✓ Strength will be developed in short time comparing other additives
	Furnace cement	✓ Low cost comparing with portal cement ✓ Strength development is slow comparing with portal cement

Table 1-8 Applicability of Cement Stabilization

	Kinds of soil		Cone index	Fc	Water contents	
3rd class	Sandy soil	SF	>400	25–50%	30–50%	
	Silt Soil Clay soil	M C			<40%	
	Volcanic soil	V			–	
4th class	Sandy soil	SF	>200	25–50%	–	
	Silt Soil Clay soil	M C			40–80%	
	Volcanic soil	V			–	
	Organic soil	O			40–80%	

Notice 1: Followings should be taken care in case of cement stabilization

a) Possibility of reflection crack to the surface layer
b) Possibility of hexavalent chromium

Notice 2: Followings are important on the execution of Cement stabilization

a) Mixed materials should be compacted immediately
(should not store temporally in case of Soil Mixing Plant methods
b) Compaction degree should be more than 90%
(one layer thickness should be less than 20-30 cm)

2. Stabilization methods

2.1. Mixing methods

There are many kinds of methods for the stabilization.

This manual target treatment volume is around 1000m3 or less per one project.

Table 2-1 Recommendable Mixing Methods by Works

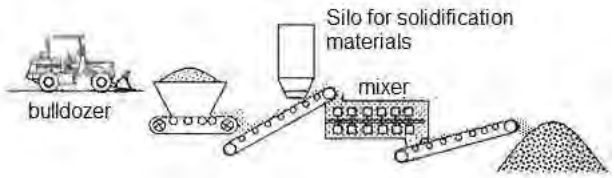
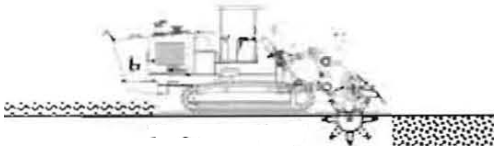
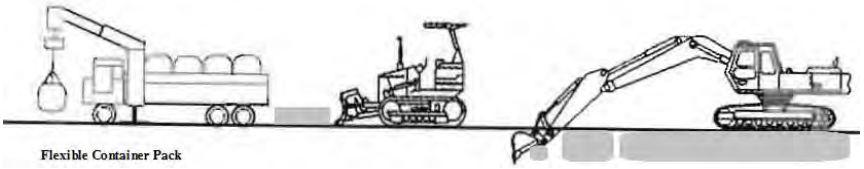
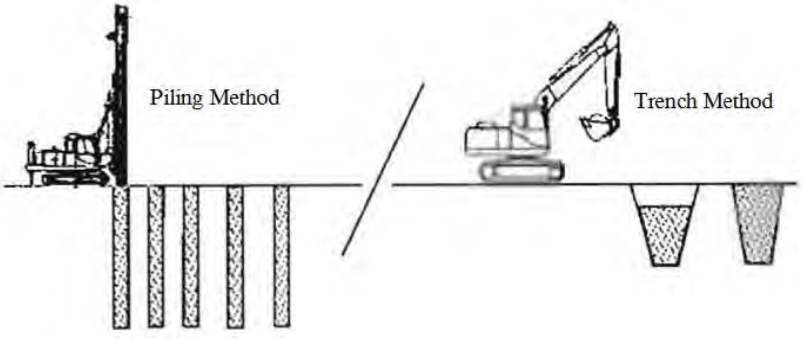
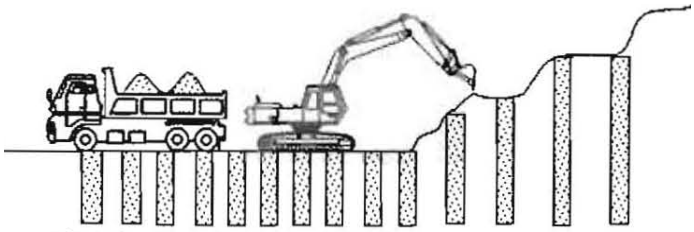
	Soil plant mixing		In-situ mixing			Borrow pit mixing
			Mixing on road		Shallow mixing	
			Depth 1m or less		Depth 1~3m	
Mixing methods	Fixed soil plant	Movable soil plant	Stabilizer	Back-hoe	Stabilizer Bach-hoe Movable plant	Bach-hoe Bulldozer Stabilizer Movable plant
Work scale	Large (30,000m3 or more)	Middle or Small	Large, Middle, Small	Small (300m3 or less)	Large, Middle, Small	Large, Middle, Small
Smoking	None	Less	Possible by methods and kinds of mixture			
Mixing degree	◎	◎	○	○	○	○
Embankment	◎	◎	○	○		◎
Subgrade	◎	◎	◎	○		△
Base-course	◎	○	○	△		
Gravel soil	◎	◎	○			
Sandy soil	◎	◎	◎	○	○	○
Clay	○	○	◎	○	◎	◎
Production Capacity (m3/h)	○	○	(100~300)	(20~40)	Stabilizer (Max 100) Backhoe (10~30) Movable plant (40~150)	(Variable)

◎: usable without treatment
○: usable by applying stabilization
△: needs cost and time for the improvement

2.2. Construction process

There are various kinds of mixing methods for stabilization as shown below:

Table 2-2 Mixing Methods for Stabilization

Plant mix	Fixed soil plant	
	Movable soil plant	
In-situ mixing plant	Mixing on road	
	Shallow mixing	
Borrow pit mixing		 

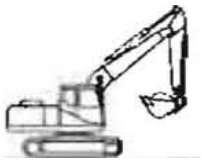
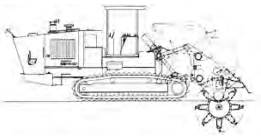
2.3. Construction equipment

Necessary equipment are shown in Table 2-3, and comparison of mixing equipment is summarized in Table 2-4.

Table 2-3 Necessary equipment for stabilization

	Scarify & shaping	Spreading	Crushing & mixing	Target Soil	Placing	Compaction
Plant mix	Bulldozer (Back-hoe) (Grader)	Man-power Track crane Dump truck (Dozer shovel) Spreader	Fixed soil plant Movable soil plant	Clay Sandy-soil Gravel-soil Base-course	Bulldozer Motor-grader	Tire-roller Macadam-roller Vibration-roller Tamper-plate
Mixing on road			Stabilizer (Max depth 100cm)			
Shallow mixing			Back-hoe (Max depth 100cm)	Clay Sandy soil Gravel soil		
			Stabilizer (Max depth 120cm)			
			Back-hoe (Max depth 150cm)			
			Movable soil plant			
Borrow pit mixing			Stabilizer (Max depth 120cm)	Clay Sandy soil	No work at mixing yard	No work at mixing yard
			Back-hoe (Max depth 150cm)			
			Movable soil plant	Clay Sandy soil Gravel soil	Back-hoe for loading	

Table 2-4 Mixing Equipment Comparisons

	Backhoe	Rotary built-in Backhoe	Stabilizer for base-course	Stabilizer for subgrade
Outline				
Mix depth[1]	60-70cm (0.7m3 bucket)	60-70cm (0.7m3 bucket)	43cm	100cm
Capacity	25~50m3/h			70~120m3
✓ Feature	✓ General purpose machine ✓ Applicable for removal of big obstacle	✓ Mixing degree is good	✓	✓ Qc>300kN/m2 ✓ Qc>5kN/m2 is possible in case of soft ground crawler type

[1] Mixing Depth is recommended to be Maximum around 30cm in spite of possible mixing depth of each equipment in order to ensure the sufficient compaction.

3. Road-bed (embankment) stabilization

3.1. Purpose

Road-bed (embankment) stabilization will be adopted in case of following case:

Table 3-1 Purpose of Stabilization for Road-bed

a) to improve trafficability for the construction equipment
b) to reduce the compressibility of soil to be used refilling or backfilling
c) to improve the stability of embankment

Note1: Required additional rate for additives % is not considered in case of the improving of trafficability. Because above required value including safety allowance.

3.2. Mixture design

Mixture design of Road bed is done by Cone-Index or Unconfined strength.

Table 3-2 Necessary Design strength of Roadbed Stabilization

Purpose	Indicator	Design strength
trafficability	Cone index	Qc=400kN/m2
compressibility	Unconsolidated strength	Same value with backfill material
stability		Decided by the designer

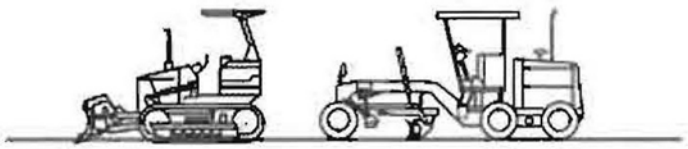
Table 3-3 Mixture Design Methods

Preparation of specimen	Material	Passed one of sieve of 4.75mm (9.5mm for improved soil)
	Mold	D 100mm V 1000cm3
	Rammer	W 2.5kg
	Compaction	3 layer compaction 25 times from H 30cm
Measurement	Cone penetrometer	Area of bottom 3.24cm2 Top angle 30˚C
	Penetration speed	1 cm/s
	Methods	Penetrate to specimen with mold
Calculation	Penetration resistance	Average of value at 5cm, 7.5cm and 10 cm depth
	Cone index Qc (kN/m2)	Average value should be divide by 3.24cm2

3.3. Construction process

Construction process for Road-bed is shown in below:

Shaping of ground

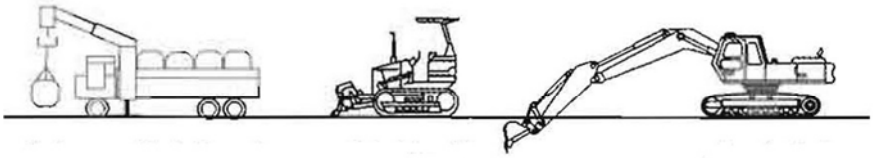


⇩

Spreading lime

⇩

Mixing



⇩

Leaves for Curing

⇩

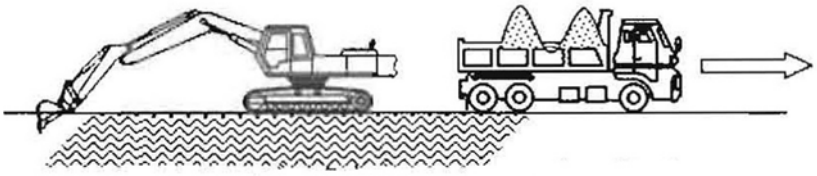
Excavation/Loading

⇩

Transportation

⇩

Placing/Leveling

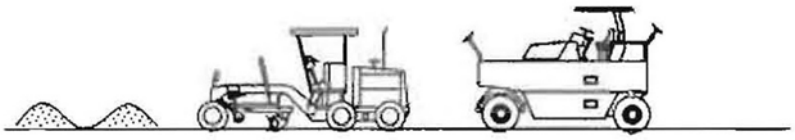


⇩

Compaction

⇩

Curing

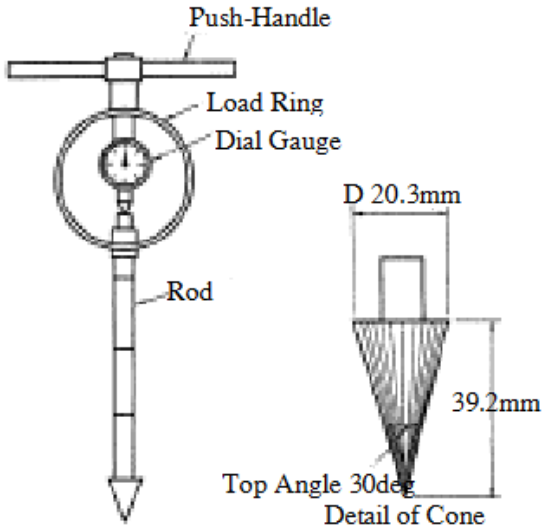


3.4. Quality control

Quality Control on Road-bed construction is shown in below:

Table 3-4 Q/C method

Item and Method				Test Frequency
Base test	Soil test		Water contents etc	Representative materials
	Mixture test			
Site quality control	Used quantity	Bag	Used bag number	Each section
		Soil plant	Weight on receipt	1 time/day
	Site density			1 time/1000m2
	Cone index			1 time/day or 1 time/1000m2



Cone-Penetro-meter

4. Subgrade stabilization

4.1 Purpose

Subgrade stabilization is most popular methods in case of following case:

Table 4-1 Purpose of Stabilization for subgrade

a) if subgrade CBR<3
b) to improve subgrade bearing strength where finished height is limited
c) if subgrade bearing strength is not constant
d) if the total cost become small by subgrade stabilization

4.2 Mixture design

Mixture design of subgrade is by CBR test.

Design CBR is determined by following three step:

Table 4-2 Mixture Design methods for subgrade stabilization

CBRm at each point	Each layer of each point CBR should be checked by laboratory data	Composite CBR of the place should be calculated
↓		
CBR of the section	Decide the section where the pavement thickness should be same	CBR of the section should be calculated from average and standard deviation
↓		
Design CBR	Decide from CBR of the section	Round down after the decimal point

CBR test should be followed by AASHTO T193

Required additional rate will be around 15-50% as shown in Table 4-4.

Minimum mixture rate should be 30kg/m3 considering mixing condition and workability

Mixing test indicator is by CBR test

Table 4-3 CBR Test method

Preparation of specimen	Material	Passed one of sieve of 37.5mm
	Mold	D 150mm V 2209cm3
	Rammer	W 4.5kg
	Compaction	3 layer compaction 67 times compaction from H 45cm
Curing		6 days air curing plus 4 days submerged curing
		20±3 cent degree
Measurement	Penetration piston	D 50mm
	Penetration speed	1 mm/min
	Methods	Penetrate to specimen with mold Prepare graph from the load at 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10.0, 12.5mm
Calculation	CBR (%)	Read out the penetration load at 2.5mm
		Adopt load at 5.0mm if the load at 5mm is bigger than 2.5mm

Mixing ratio

Mixing ratio of the additives should be decided at Laboratory trial test based on necessary design CBR. It is normally 2~20 % for lime and for cement.

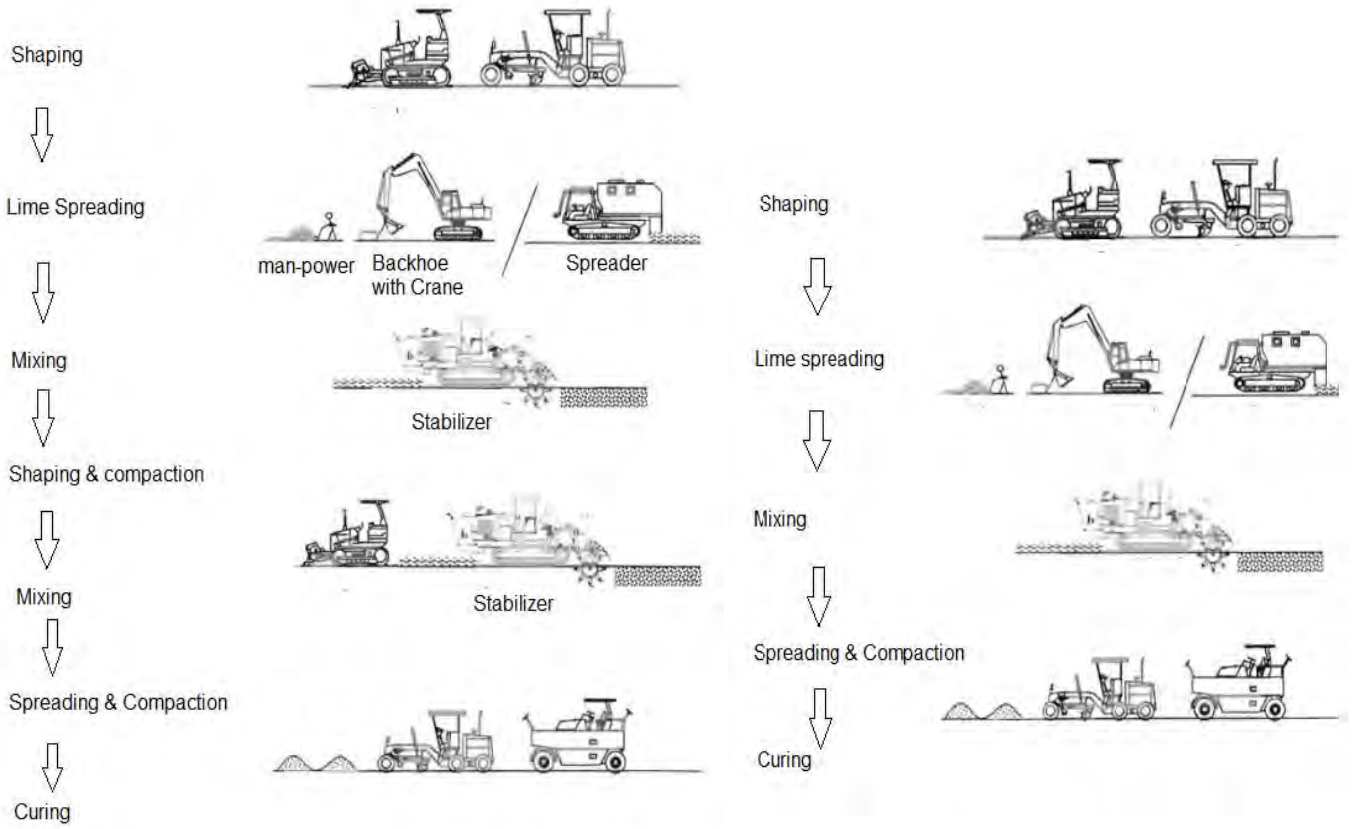
And required additional rate for the additive should be considered by the site conditions as shown in bellow:

Table 4-4 Required additional rate

Thickness	%
50cm or less	15~20%
More than 50 cm (sandy soil)	20~40%
More than 50 cm (clayey soil)	30~50%

4.3 Construction process

There are two kinds of Construction process according to the additive materials for the stabilization to use particle one or powder one. In case of using particles, mixing will be done two times normally.



Particle shape additives powder type additives

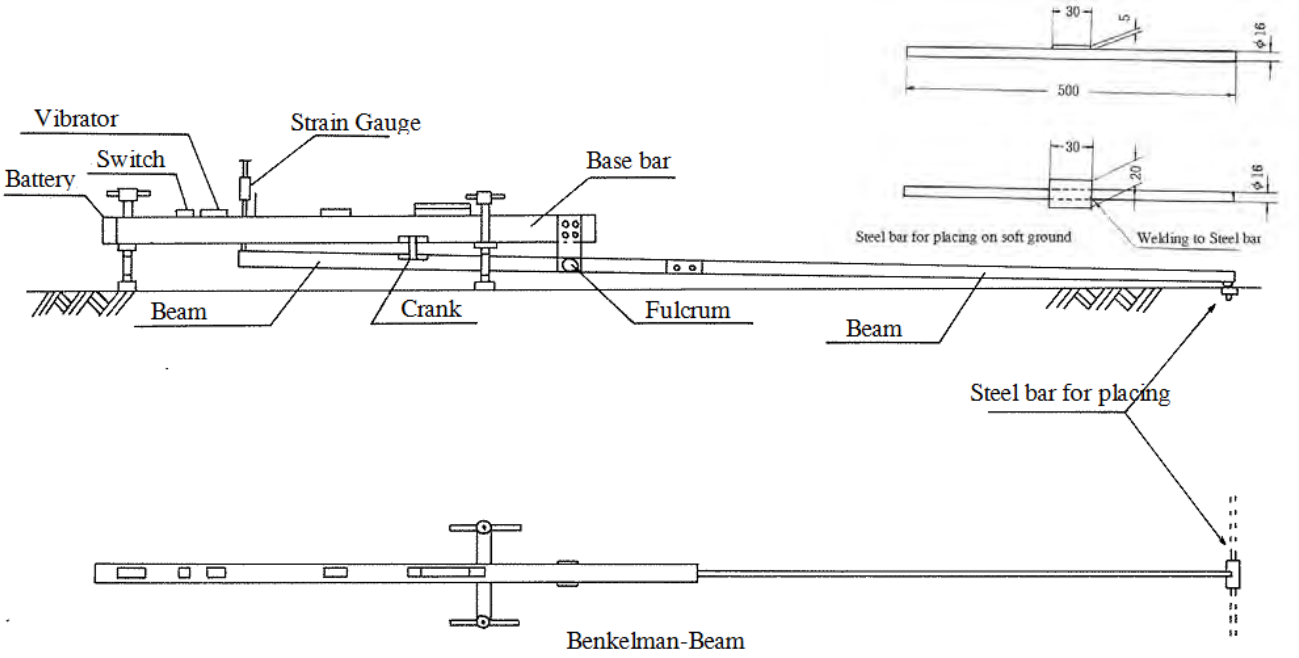
On spreading the additives, it is necessary to use them equally or evenly. Following photo shows the example of using of bag type additives.

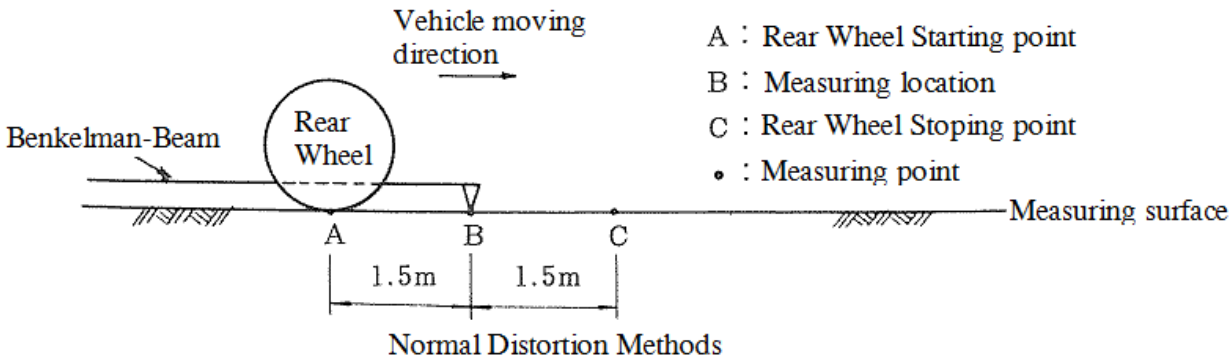
4.4. Quality control

Quality control is done by the method shown in Table 4-5.

Table 4-5 Q/C Methods

	Item and Method			Test Frequency
Base test	Soil test	Water contents etc		Representative materials
	Mixture test			
Site quality control	Used quantity	Bag	Used bag number	Each section
		Soil plant	Weight on receipt	1 time/day
	Site density			1 time/1000m2
	Proof rolling			All area Any time on demand





Normal Distortion Methods

5. Base course stabilization

5.1 Purpose

Base-course Stabilization will be adopted in case of following case:

Table 5-1 Purpose of stabilization for base-course

a) if local materials near the site is out of quality specification
b) recycling of site generated material
c) to reduce the total pavement thickness
d) if the total cost of stabilization methods become economical

5.2 Mixture design

Table 5-2 Necessary Quality for base-course

	Unconfined compression strength (curing 10 days) Mpa	
	Subbase-course	Base-course
Asphalt pavement	0.7	0.98
Cement concrete pavement	0.5	0.98

Table 5-3 Desirable aggregate quality to be used for stabilization

		Materials quality	
		Subbase-course	Base-course
Sieve passing %	53mm	-	100
	37.5mm	-	95~100
	19mm	-	50~100
	2.36mm	-	20~60
	0.075mm	-	2~20
95% modified CBR (%)		More than 10	More than 20
Ip		6~18	6~18
Max size (mm)		Less than 50	Less than 40

1 Mpa=1000KN/m2=1/9.8kgf/mm2

Mixing test indicator is by unconfined compression test (JIS ??)

Table 5-4 Mixture Design Procedures

Preparation of specimen	Material	Passed one of sieve of 26.5mm
	Mold	D 100mm V 1000 cm3
	Rammer	W 2.5kg
	Compaction	3 layer compaction 25 times compaction from H 30 cm
Curing		9 days air curing plus 1 days submerged curing
		20±3 cent degree
Measurement	Penetration piston	D 50mm
	Penetration speed	1 %/min
	Methods	Penetrate to specimen with mold Prepare graph from the stress and strain
Calculation	unconfined compression test Qu(kN/m2)	Maximum stress is Qu within the rage up to stress of 15% Stress at Qu is called as breaking stress

Mixture ratio

As shown in Fig 5-1, additive % should be decided based on necessary unconfined compression strength.

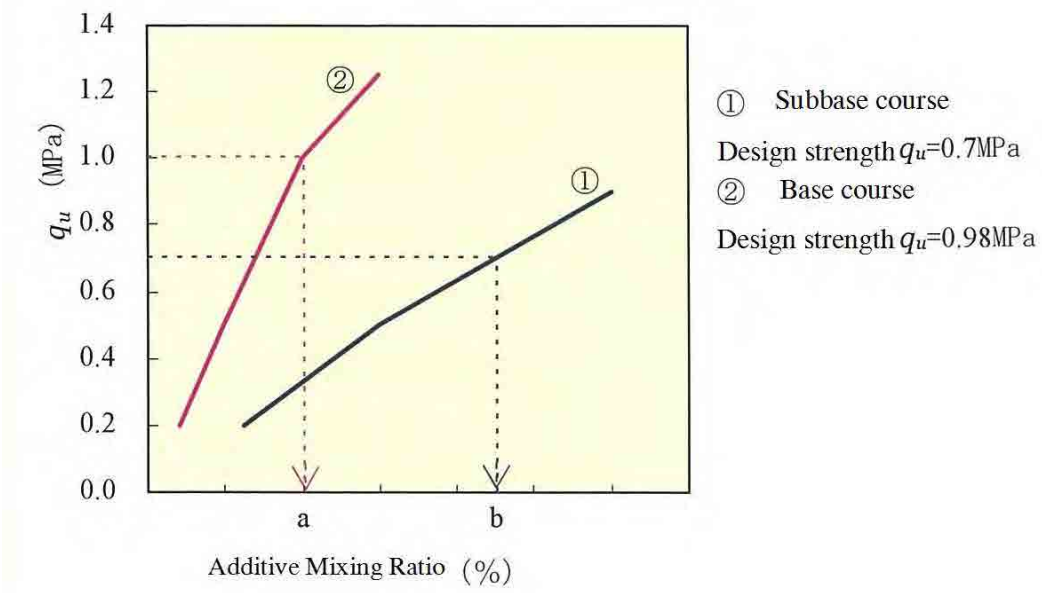
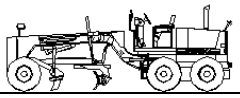
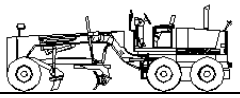
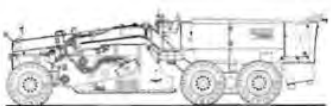
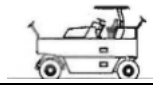
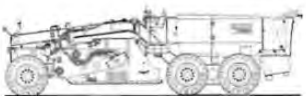
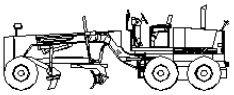
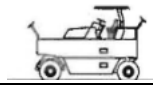
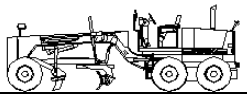


Figure 5-1 Methods to seek % of additives

5.3 Construction process

Table 5-5 Construction Process for Base Course

Stage	Explanation	equipment
Preparation	Plow existing layer & Water spray	
	Placing Additional materials	
Pacing & Mixing of mixture materials	Placing lime or cement	
	Mixing up to designed depth	
	Preliminary compaction	
	Re-mixing after 4~12 hours	
Compaction	Shaping by grader: One layer 15~30cm for subbase; One layer 10~20cm for base-course	
	Light Compaction by tire roller	
	Shaping by grader	
	Compaction by macadam roller and tire roller	 
Curing	May open to traffic immediately after the work	
	As-emulsion may sprayed, if necessary	
Traverse joint	End of base-course of the Previous day should be disturbed and connect to new materials	
Longitudinal joint	Form should be used and placed opposite side materials in early occasion to avoid the crack	

5.4. Quality control

Table 5-4 Q/C methods

Item and Method				Test Frequency
Base test	Soil test	Water contents etc.		Representative materials
		Grading		
		PI		
	Mixture test			
Site quality control	Used quantity	Bag	Used bag number	Each section
		Soil plant	Weight on receipt	1 time/day
	Site density			1 time/1000m2
	Grading			1 time/day
	Proof rolling + Benkelman-Beam			All area Any time on demand

6. Stabilization for structure foundation (not described in this manual)

7. Stabilization of Site generated soil

7.1. Purpose

Stabilized site-generated soil will be used following case:

Table 7-1 Purpose of Stabilization for Site generated Soil

a) re-filling for under-ground facility work
b) road embankment
c) backfilling of structures
d) construction of dike
e) land development

Table 7-2 Applicability for the location

	Cone index (kN/m2)	Backfill	Re-fill	Subgrade	Road bed	Dike	Land development
1st grades	Similar to sand or rock	◎	◎	◎	◎	◎	◎
2nd grade	>800	◎	◎	◎	◎	◎	◎
3rd grade	>400	○	◎	○	◎	◎	◎
4th grade	>200	○	○	○	○	○	○
Mud	200>	△	○	△	○	○	○

◎: usable without treatment
○: usable by applying stabilization
△: needs cost and time for the improvement

7.2. Mixture design

Table 7-3 Desirable quality of stabilization for site generated soil

	Re-fill	Backfill	Subgrade	Road bed	Dike	Land development
Max size	50㎜	100㎜			150mm	100mm
Grading	Fc<25%	Fc<25%				
Consistency		PI<10				
Strength	CBR	CBR				
Compaction	Dc>90%	Dc>90~95%		Dc>90%		Dc>85%
1 layer	20~30cm	20cm		30cm		30~50cm

Fc: Fine particle contents

Appendix

Appendix 1 Standard Additive Quantity (Silt) (for reference)

			Dike Road-bed	Refill Backfill	Subgrade					Remarks
Target strength	Qc(kN/m2)		400	800	900	1350	1800	2700	4550	Qc=227xCBR
	CBR(%)		1.8	3.5	4	6	8	12	20	
	Qu(kN/m2)		18	35	40	60	80	120	200	Qu=10xCBR
	Original soil	Qc in Lab	Mixing ratio of Cement (% for γd)							
Water contents w (%)	W<40		Non	3	3	5	6	7	9	Almost belongs to 4th class soil
	40<W<42	300~400	1	3	4	5	6	8	9	
	42<W<44		1	4	4	6	7	8	10	
	44<W<46	200~300	2	4	5	6	7	8	10	
	46<W<48	150~200	2	5	6	7	8	9	11	Almost belongs to Mud
	48<W<50	100~150	3	6	7	8	9	10	11	
	50<W<52	<100	3	6	7	9	9	10	12	
	52<W<54		4	7	7	9	9	10	12	
	54<W<56		4	7	8	9	9	10	12	
	56<W<58		5	8	8	9	9	11	13	
	58<W<60		5	8	8	9	10	11	13	
	60<W<62		6	8	8	9	10	11	14	
	62<W<64		6	8	9	9	10	12	15	
	64<W<66		7	9	9	10	11	12	15	
	66<W<68		8	9	9	10	11	13	16	
	70<W		8	9	9	11	12	14	18	
	40<W<42		-	-	-	-	-	-	-	

Appendix 2 Standard Additive Quantity (Clay) (for reference)

			Dike Road-bed	Refill Backfill	Subgrade					Remarks
Target strength	Qc(kN/m2)		400	800	600	850	1150	1750	2900	Qc=145xCBR
	CBR(%)		2.8	5.5	4	6	8	12	20	
	Qu(kN/m2)		28	55	40	60	80	120	200	Qu=10xCBR
	Original soil	Qc in Lab	Mixing ratio of Cement (% for γd)							
Water contents w (%)	W<40	200~300	1	2	1	2	3	5	7	Almost belongs to 4th class soil
	40<W<42		1	2	2	3	4	6	7	
	42<W<44		1	3	2	3	4	6	8	
	44<W<46	150~200	2	3	2	4	5	7	9	
	46<W<48		2	4	3	5	6	8	10	
	48<W<50	100~150	3	6	4	6	8	9	11	
	50<W<52		3	6	4	7	8	9	12	
	52<W<54		3	7	5	7	8	10	12	
	54<W<56	<100	3	7	5	8	8	10	13	Almost belongs to Mud
	56<W<58		4	8	6	8	9	11	13	
	58<W<60		4	8	6	8	9	11	14	
	60<W<62		5	8	7	9	10	12	15	
	62<W<64		5	9	7	10	11	13	16	
	64<W<65		5	10	8	10	11	13	16	
	65<W		-	-	-	-	-	-	-	

Appendix 3 Standard Additive Quantity (Volcanic Soil) (for reference)

			Dike Road-bed	Refill Backfill	Subgrade					Remarks
Target strength	Qc(kN/m2)		400	800	500	750	1000	1500	2500	Qc=124xCBR
	CBR(%)		3.2	6.5	4	6	8	12	20	
	Qu(kN/m2)		32	65	40	60	80	120	200	Qu=10xCBR
	Original soil	Qc in Lab	Mixing ratio of Cement (% for γd)							
Water contents w (%)	W<50	200~300	1	3	2	3	5	7	9	Almost belongs to 4th class soil
	50<W<52		2	4	2	3	5	7	9	
	52<W<54		2	4	2	4	5	7	10	
	54<W<56	150~200	2	5	3	4	6	8	11	Almost belongs to Mud
	56<W<58		2	5	3	5	7	9	12	
	58<W<60	100~150	3	6	3	6	7	9	13	
	60<W<62		3	7	4	6	8	10	14	
	62<W<64	<100	4	8	5	7	9	11	16	
	64<W<66		4	9	5	8	10	12	17	
	66<W<68		5	9	6	9	10	12	17	
	68<W<70		5	9	6	9	10	13	17	
	70<W<72		6	10	7	9	11	13	17	
	72<W<74		6	10	8	10	11	14	18	
	74<W<76		7	11	8	10	12	14	18	
	76<W<78		8	11	9	11	12	15	18	
	78<W<80		9	12	9	11	13	15	19	
	80<W<82		9	12	10	12	13	16	19	
	82<W<84		10	13	11	12	14	16	20	
	84<W<86		11	13	11	13	14	17	21	
	86<W<88		11	14	12	13	15	17	21	
	88<W<90		12	14	12	14	15	18	22	
	90<W		-	-	-	-	-	-	-	

Example of Cost Estimation for Road Stabilization

April 2015

The Project for Implement of Road Technology

in Disaster Affected Area in Myanmar

Preface

This is an example of cost estimation for Road Soil Stabilization Work.
Cost estimation about Road Stabilization Works is not described in PW cost estimation hand -book.
Most of Works for Road Stabilization needs equipment, such as stabilizer etc. However the rental cost of such expensive equipment is not shown in PW's hand -book. Therefore, the cost estimation method is shown based on Japanese Standard Cost estimation methods for reference.
PW's cost estimation methods is shown in appendix of this books for the conventional works.

Abbreviations & Definition of Words

Premium rate	Additional additive rate to the rate decided by Laboratory test considering the allowance for site mixture conditions
Additive rate	Mixture rate including premium rate

Table of Contents

1. Flow of the stabilization

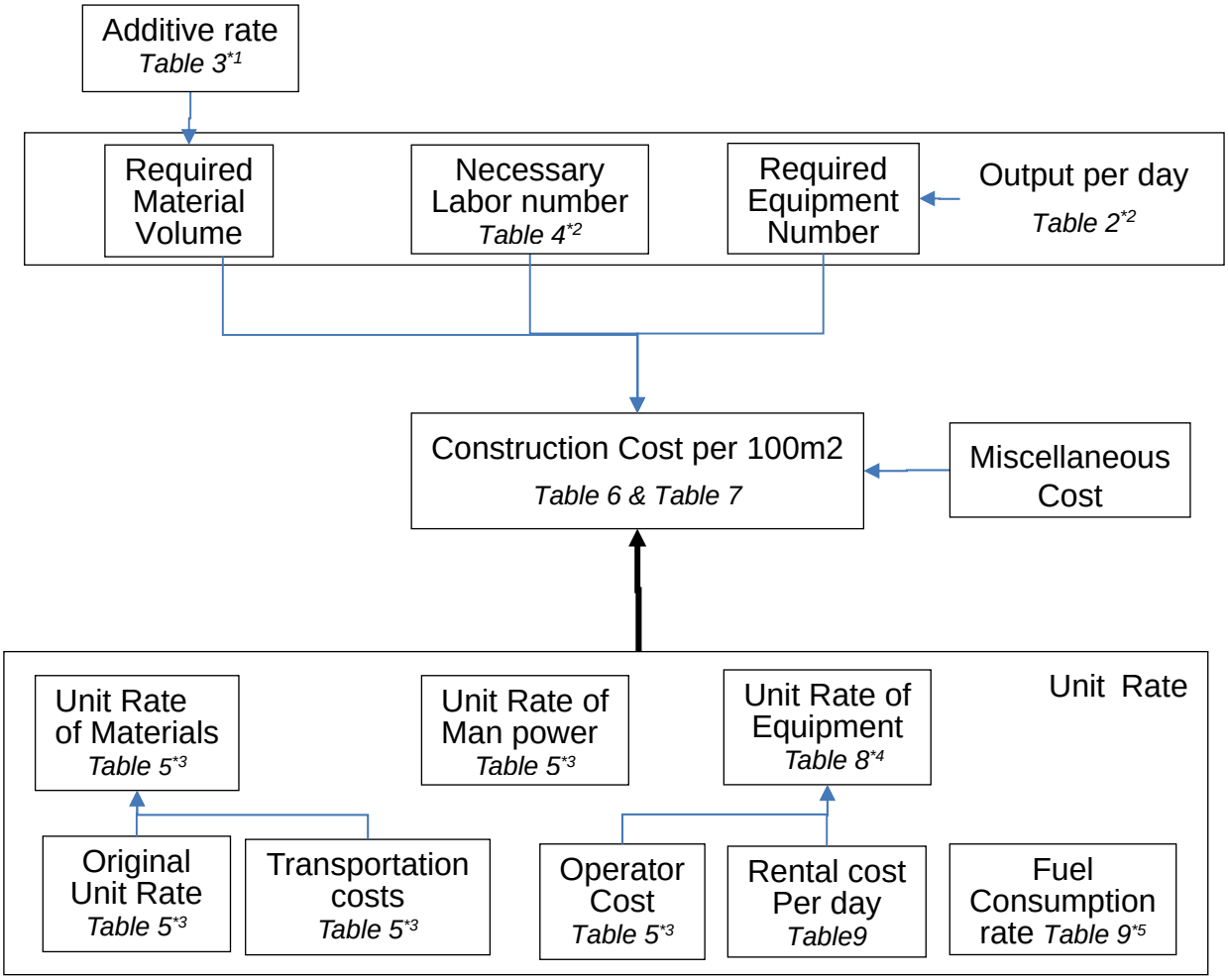
Flow of stabilization is normally as shown in Table 1.
Preparation work cost is variable according to the distance to site location and site conditions. This example of cost estimation will not cover the cost for mobilization and de-mobilization of equipment.

Table 1 Flow of Stabilization work

Work item	Sub Items	Necessary Equipment
Preparation	Mobilization of Equipment	Trailer truck
	Hauling of Materials to site	
	Clearing & Grubbing or removal of big stone, if necessary	Grader, Bulldozer
	Scratching up of surface	Bulldozer, Grader
	Shaping of ground	Grader
↓		
Spreading of Additives	Bag, Flexible Container	man-power Truck-crane,
↓		
Mixing	One time for powder type Two times for granular type	Road stabilizer Backhoe
↓		
Shaping		Grader
↓		
Compaction		Tire roller, Macadam roller, Vibration Roller
↓		
Curing (for cement)		
↓		
Demobilization		Trailer truck

Construction cost could be calculated by following Procedures

Figure 1 Cost Estimation Procedure



Stabilization Cost p2

*1: Table 3 shows example at Pilot Project

*2: Table 2 & 4 shows estimation by JICA Team

*3: Table 5 shows unit rate from Myanmar Standards

*4: Table 8 shows unit rate from Myanmar Standards

*5: Table 9 shows unit rate from Myanmar Standards

Note: Red text of each "Table" should be input by each user, and black text parts will be calculated automatically.

2. Daily Output of Stabilization work

Stabilization work is depending on the equipment capacity. Table 2 shows the standard daily output (by Japanese manual). This should be confirmed and revised through the trial work and/or actual site work in Myanmar.

Table 2-1 Daily Output of stabilizing by back hoe D(m)= 0.4

	Unit	By Backhoe 0.45m3	By Stabilizer b:2.65m,	By Soil plant 10–50m3/hour
Subgrade <1m	m2/d	180		
Structure foundation <1m	m2/d	127		
Structure foundation>1m	m2/d	74		

Table 2-2 Daily Output of stabilizing by crawler type stabilizer D(m)= 0.4

	Unit	By Backhoe 0.45m3	By Stabilizer b:1.6m,	By Soil plant 10–50m3/hour
One time mixing	m2/d		252	
			(A1*)	
Two times mixing	m2/d		126	
			(A2*)	

A1= $\frac{b \times V \times E}{N} = \frac{(1.6-0.2) \times 300 \times 0.6}{1}$ 252 A2= $\frac{b \times V \times E}{N} = \frac{(1.6-0.2) \times 300 \times 0.6}{2}$ 126

Here: V (working speed) is assumed to be 300m/hr as shown in Table 2-6.

Table 2-3 Daily Output at Mixing yard by base-course stabilizer (tire type) D(0.3

	Unit	By Backhoe 0.45m3	By Stabilizer b:2.65m,	By Soil plant 10–50m3/hour
One time mixing	m2/d		1000	
			(A1*)	
Two times mixing	m2/d		500	
Two times mixing	m2/d		0	

A1= $\frac{b \times V \times E}{N} = \frac{(2.65-0.2) \times 700 \times 0.6}{1}$ 1029 A2= $\frac{b \times V \times E}{N} = \frac{(2.65-0.2) \times 700 \times 0.6}{2}$ 514.5

Here: V (working speed) is assumed to be 700m/hr as shown in Table 2-6.

Table 2-4 Daily Output by base-course stabilizer (tire type) D(m)= 0.2

	Unit	By Backhoe 0.45m3	By Stabilizer b:2.65m,	By Soil plant 10–50m3/hour
One time mixing	m2/d		1400	
			(A1*)	
Two times mixing	m2/d		700	
			(A2*)	

A1= $\frac{b \times V \times E}{N} = \frac{(2.65-0.2) \times 1000 \times 0.6}{1}$ 1470 A2= $\frac{b \times V \times E}{N} = \frac{(2.65-0.2) \times 1000 \times 0.6}{2}$ 735

Here: V (working speed) is assumed to be 1000m/hr as shown in Table 2-5.

Stabilization cost>2output

Table 2-5 Daily Output by soil plant mixing D(m)= 0.2

	Unit	By Backhoe	By Stabilizer b:2.65m,	By Soil plant 10—50m3/hour
Base course min (10m3/h)	m3/d			54
	m2/d			270
Ditto max (30m3/h)	m3/d			162
	m2/d			810

10m3/h*6h/d*0.9=54m3/d
54m3/d/d0.2=270m2/d

30m3/h*6h*0.9=162m3/d
162/0.2=810m2/d

Stabilization cost>2output

Mixing Speed of Stabilizer is shown bellow

Table 2-6 Mixing Speed of Stabilizer (m/hr)

Mixing depth	20cm	30cm	40cm	60cm	remarks
Crawler Type stabilizer	350	330	300	200	including secondary mixing
Tire Type stabilizer	1000	700	600	400	Estimated from PM550S Manual

Stabilization cost>2mixingspeed

3. Example of Additive mixing ratio

Mixing ratio of the additives are variable according to the soil conditions.
Following are example of trial mixing results at Road Research Laboratory for Pilot Project 1 and Pilot Project 2.

Premium rate baseco 1.15
Premium rate subgra 1.2

Table 3-1 Pilot Project 1 Additive mixing ratio

		Site soil	Sand	Gravel	Cement	Lime	CBR	Qu
Base Course	Granular	0%	-	100%	-	-	100%	-
Subbase	Cement stabilization	70%	30%	0%	6.8% 7.8%	-	-	0.75-1.5Mpa
Subgrade	Lime stabilization	100%	0%	0%	-	3.6% 4.3%	20%	-

Premium rate baseco 1.15
Premium rate subgra 1.2

Table 3-2 Pilot Project 2 Additive mixing ratio

		Site soil	Sand	Gravel	Cement	Lime	CBR	Qu
Base Course	Granular	0%	-	100%	-	-	80%	-
Subbase	Cement stabilization	50%	50%	0%	4.6% 5.3%	-	-	1.5Mpa
~~Subgrade~~	~~Lime stabilization~~	~~100%~~	~~0%~~	~~0%~~	-	~~%~~	~~20%~~	-

( ) shows including premium rate

Stabilization cost>3Additives

4. Necessary Labor number

Japanese Standard Cost estimation book shows as follows:

Table 4-1 Necessary Man-power (Japan)

Item	Spec	Unit	Numbers	Rate	Amount	
Supervisor		m-d	1x100/D	(100)		
Common labor		m-d	3x100/D	(50)		
Operator		m-d	1x100/D			per one equipment

Here D means the capacity of work in a day.
However labor numbers are revised as follows considering the actual site status.

Table 4-2 Necessary Man-power (Myanmar)

Item	Spec	Unit	Numbers	Rate	Amount	
Supervisor		m-d	1x100/D	6		
Common labor		m-d	10x100/D	4.5		
Operator		m-d	1x100/D			per one equipment

Stabilization cost>4manpower

5. Unit Rate

Unit rate is shown in shown in Material Rate (issued by PW, ID, CDC) as shown bellow (Pyapon 2014-2015 Fiscal year)

hearing means survey results in 2004

Table 5 Unit Rate (Myanmar)

Materials(No came from	Myanmar Unit	Rate(Ky)	Converted SI Unit	Converted Rate (US$)	
001 Rock	Sudrine	70,000	m3	24.7	
005River gravel	Sudrine	135,000	m3	47.7	
007River sand	Sudrine	26,000	m3	9.2	
016Crush stone2"-4"	Sudrine	165,000	m3	58.3	
017Crush stone1"-2"	Sudrine	194,000	m3	68.5	
019Chipping	Sudrine	209,000	m3	73.8	
046Cement (50kg Bug)	Bag	8,000	Ton	160	
051 Lime powder (8galon bag)	Bag(98kg)	3,700	Ton	38	¥=2.7
052 Lime (15kg bag)	Bag	1,200	Ton	80	hearing
016asphalt	Gallon	4,200	Ton	924	
Loading/Unloading					
601cement (50kg Bug)	Bag	220	Ton	4.4	
602 Lime (15kg bag)	Bag				
604RiverSand	Sudrine	3,500	m3	1.2	
605Crush Stone	Sudrine	4,600	m3	1.6	
608Crushstone	Sudrine	5,200	m3	1.8	
Transportation					
713River Gravel	Sudrine	8,300	m3	2.9	
Soil/Earth	Sudrine	8,300	m3	2.9	
723Asphalt	Ton	6,500	Ton	6.5	
7311Diesel	Times	32,000			
733Asphalt by water	Ton	5,700	Ton	5.7	
Equip Rental Fee					
There is no description on the book except small equipment; therefore Japanese standard unit price per day was used tentatively (Table?)					
Fuel					
151Diesel Oil	Gallon	4,400	Litter	1.0	
Man Power					
Operator		6,000		6.0	
Supervisor		6,000		6.0	
labour		4,500		4.5	

Sudrine	=100*0.3048^3m3=(m3)	2.8317
Gallon	=(lit)	4.546

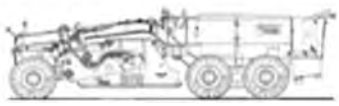
Stabilization cost>5rate

6. Cost Comparison by the Construction Methods

Bellow is the comparison of stabilization cost by different equipment.

Final 3 are conventional aggregate layer construction by Japanese work efficiency using Myanmar Unit rate

Table 6 Summary of Construction Cost

	method	m2 per day	$/100m2	$/m3	Reference
Subgrade 40cm Lime	by backhoe	180	694	17	Table 7-1
			Material		$397
			man-power		$28
			Equipment		$235
			overhead		$33
	by stabilizer crawler type	252	674	17	Table 7-2
			Material		$397
			man-power		$29
			Equipment		$215
			overhead		$32
Subbase 20cm Cement	stabilizer at mixing yard	1000	1008	34	Table 7-3
			Material		$788
			man-power		$7
			Equipment		$165
			overhead		$48
	by stabilizer tire type	1400	648	32	Table 7-4
			Material		$525
			man-power		$5
			Equipment		$86
			overhead		$31
	by movable plant	540	661	33	Table 7-5
			Material		$417
			man-power		$14
			Equipment		$198
			overhead		$31
Stabilized Base Course d=150	Cement	1400	961	64	Table 7-9
			Material		$602
			man-power		$1
			Equipment		$21
			overhead		$43
Subgrade depth=200	Conventional	500	286	14	Table 7-6
			Material		$220
			man-power		$4
			Equipment		$48
			overhead		$14
Aggregate SubBased=200	Conventional	1100	574	29	Table 7-7
			Material		$455
			man-power		$2
			Equipment		$27
			overhead		$27
Aggregate Base Course d=150	Conventional	1100	1122	75	Table 7-8
			Material		$1,040
			man-power		$2
			Equipment		$27
			overhead		$53

Stabilization cost>6summary

Bellow is the comparison of unit rate. Shadowed one is the stabilization work. We can know that stabilization cost in PP1 looks a little expensive, but normally it is rather cheap method.

Subgrade	PW basic methods	ADB	Japan standard Methods	PP1budget (modified)	Stabilization
		Soil & sand	Soil	Lime stabilization	Lime stabilization
Output area					180-250m2/day
Thickness (inch)		16	8	16	16
Total cost $			286	56035	
$/m3		18	14	27	17
$/m2		4.5	2.9	6.3	6.9

Subbase	PW basic methods	ADB	Japan standard	PP1 budget (stabi)	Stabilization
	Laterite	Shingle / soil	Laterite/sand	Cement stabilization	
Output area					500-1400 m3/day
(Volume)	100sud				
Thickness (inch)	6"	8	8	8	8
Total cost $	9,048		574	60134	
$/m3	32	44	29	40	32
$/m2	4.8	9.0	5.7	8.0	6.5

Base course	PW basic methods	ADB	Japan standard	PP1budget	Stabilization
	Aggregate	Crushed rock	Aggregate	Aggregate	
Output area					
(Volume)	100sud				
Thickness (inch)	6"	6	6	7	6"
Total cost $	14,653		1122	97323	
$/m3	52	102	75	80	64
$/m2	7.8	15.0	11.2	14.0	9.6
Reference	Analysis of Rates for Road works 9 & 10		StabilizationCost Table 7.6 & 7.7 & 7.8	PP1Cost (Version2) Improved Estimate	StabilizationCost Table 7.1 & 7.4 & 7.9

Stabilization Cost.>11comparison

7. Breakdown of Unit Rate of Stabilization Work

Table 7-1 Unit rate for subgrade by backhoe (per 100m2) Ouptput per day is 180m2/day

Name	Spec	Unit	Quantity	Rate	Amount	Remarks
Additives	Lime	ton	3.1	123.3	383.6	4.3%*100*0.4*1.8
diito transportation			3.1	4.4	13.7	
Supervisor	1	m-d	0.6	6.0	3.3	1x100/D
Common labor	10	m-d	5.6	4.5	25.0	10x100/D
Backhoe		day	0.6	125.1	69.5	Table 8-2
Motor grader		day	0.6	121.0	67.2	Table 8-7
Tire roller		day	0.6	61.2	34.0	Table 8-9
Macadam roller		day	0.6	116.0	64.4	Table 8-8
Overhead	5%				33.0	
		total			693.8	17.3
					$/100m2	$/m3

c= 0.0432
t= 0.4
D= 180

4.3% of Additive ratio is based on 3.6% x 1.20 as shown in Table 2.2.3 of Pilot Project 1 Report prepared on Aug, 2014

Table 7-2 Unit rate for subgrade by crawler type stabilizer (per 100m2) Output per day is 252m2

Name	Spec	Unit	Quantity	Rate	Amount	Remarks
Additives	Lime	ton	3.1	123.3	383.6	4.3%*100*0.4*1.8
diito transportation			3.1	4.4	13.7	
Supervisor	1	m-d	0.4	6.0	2.4	1x100/D
Common labor	10	m-d	4.0	4.5	17.9	10x100/D
Ditto for Removal of big stone	5	m-d	2.0	4.5	8.9	5x100/D
Stabilizer		day	0.4	244.3	97.0	Table 8-11
Motor grader		day	0.4	121.0	48.0	Table 8-7
Tire roller		day	0.4	61.2	24.3	Table 8-9
Macadam roller		day	0.4	116.0	46.0	Table 8-8
Overhead	5%				32.1	
		total			673.9	16.8
					$/100m2	$/m3

c= 0.0432
t= 0.4
D= 252

Table 7-3 Unit rate for subbase by mixing at mixing yard (per 100m2) Output per day is 1000m2

Name	Spec	Unit	Quantity	Rate	Amount	Remarks
Additives	Cement	ton	4.2	160.0	675.6	7.8%*100*0.3*1.8
diito transportation			4.2	4.4	18.6	
Sand	river	m3	9.0	9.2	82.6	30%*100*0.3
diito transportation			9.0	1.2	11.1	
Supervisor	1	m-d	0.1	6.0	0.6	1x100/D
Common labor (site) Removal of big stone	10	m-d	1.0	4.5	4.5	10x100/D
Common labor (plant)	5	m-d	0.5	4.5	2.3	5x100/D
Stabilizer		day	0.1	910.4	91.0	Table 8-12
Motor grader		day	0.1	121.0	12.1	Table 8-7
Wheel Dozer		day	0.1	96.9	9.7	Table 8-3
Dump truck		day	0.3	115.1	34.5	Table 8-4
Tire roller		day	0.1	61.2	6.1	Table 8-9
Macadam roller		day	0.1	116.0	11.6	Table 8-8
Overhead	5%				48.0	
		total			1008.4	33.6
					$/100m2	$/m3

c= 7.8 %
t= 0.3
D= 1000

Table 7-4 Unit rate for subbase by stabilizer tire type (per 100m2) Output per day is 1400m2

Name	Spec	Unit	Quantity	Rate	**Amount**	Remarks
Additives	Cement	ton	2.8	160.0	450.4	7.8%*100*0.2*1.8
diito transportation			2.8	4.4	12.4	
Sand	river	m3	6.0	9.2	55.1	30%*100*0.2
diito transportation			6.0	1.2	7.4	
Supervisor	1	m-d	0.1	6.0	0.4	1x100/D
Common labor Removal of big stone	10	m-d	0.7	4.5	3.2	10x100/D
Common labor	5	m-d	0.4	4.5	1.6	5x100/D
Stabilizer		day	0.1	910.4	65.0	Table 8-12
Motor grader		day	0.1	121.0	8.6	Table 8-7
Tire roller		day	0.1	61.2	4.4	Table 8-9
Macadam roller		day	0.1	116.0	8.3	Table 8-8
Overhead	5%				30.8	
		total			647.7	32.4
					$/100m2	$/m3

c= 7.8%
t= 0.2
D= 1400

Table 7-5 Unit rate by stabilizer movable plant (per 100m2) depth=200 Output per day is 540m2 (194ton/day)

Name	Spec	Unit	Quantity	Rate	Amount	Remarks
Additives	Cement	ton	1.9	160.0	304.7	5.3%*100*o.2*1.8
diito transportation			1.9	4.4	8.4	
Sand	river	m3	10.0	9.2	91.8	100*0.2*50%
diito transportation			10.0	1.2	12.4	
Supervisor	1	m-d	0.2	6.0	1.1	1x100/D
Common labor (site)	10	m-d	1.9	4.5	8.3	10x100/D
Common labor (plant)	5	M-d	0.9	4.5	4.2	5x100/D
Soil plant		day	0.2	444.9	82.4	Table 8-13
Wheel loader		day	0.2	96.9	17.9	Table 8-3
Dump Truck		day	0.4	115.1	42.6	Table 8-4
Motor grader		day	0.2	121.0	22.4	Table 8-7
Tire roller		day	0.2	61.2	11.3	Table 8-9
Macadam roller		day	0.2	116.0	21.5	Table 8-8
Overhead	5%				31.5	
		total			660.5	33.0
					$/100m2	$/m3

c= 5.3%
t= 0.2
D= 540

5.3% of Additive ratio and 50% of sand ratio are based on Cement Stabilized Soil Testing data prepared on Feb 13, 201 (4.6% x 1.15=5.3%)

Table 7-9 Unit rate of Stabilized Base Course (per 100m2) d=150 Output/day is 1400m2

Name	Spec	Unit	Quantity	Rate	Amount	Remarks
Grad adjust Aggregate	CBR80	m3	16.5	36.5	602.2	
Additives	Cement	ton	1.4	160.0	229.0	5.3%*100*o.15*1.8
Supervisor	1	m-d	0.1	6.0	0.4	1x100/D
Common labor (site)	2.4	m-d	0.2	4.5	0.8	0.24*10
Motor grader		day	0.1	121.0	8.6	Table 8-7
Tire roller		day	0.1	61.2	4.4	Table 8-9
Macadam roller		day	0.1	116.0	8.3	Table 8-8
Stabilizer		day	0.1	910.4	65.0	Table 8-12
Overhead	5%				42.7	
		Total			961.4	64.1
					$/100m2	$/m3

t= 0.15
D= 1400
94

Stabilization cost>7workunit rate

Table 7-6 Unit rate of Subgradee (per 100m2) depth=200 Output per day is 500m2 P2-18

Name	Spec	Unit	Quantity	Rate	Amount	Remarks		
Soil	CBR10	m3	24.0	9.2	220.4		t=	0.2
Supervisor	1	m-d	0.2	6.0	1.2	1x100/D	D=	1100
Common labor (site)	3	m-d	0.6	4.5	2.7	3		
BulDozer		day	0.2	125.3	25.1	Table 8-1		
Tire roller		day	0.2	116.0	23.2	Table 8-9		
Overhead	5%				13.6			
		Total			286.1	14.3	11.7	
					$/100m2	$/m3		

Table 7-7 Unit rate of Aggregate SubBase (per 100m2) d=200 Output per day is 1100m2 P11-9

Name	Spec	Unit	Quantity	Rate	Amount	Remarks		
Laterite 70%	CBR30	m3	16.1	28.3	454.9		t=	0.2
sand 30%		m3	6.9	9.2	63.4			
Supervisor	1	m-d	0.1	6.0	0.5	1x100/D	D=	1100
Common labor (site)	2.4	m-d	0.2	4.5	1.0	0.24*10		
Motor grader		day	0.1	121.0	11.0	Table 8-7		
Tire roller		day	0.1	61.2	5.6	Table 8-9		
Macadam roller		day	0.1	116.0	10.5	Table 8-8		
Overhead	5%				27.3			
		Total			574.2	28.7	55.8	
					$/100m2	$/m3		

Table 7-8 Unit rate of Aggregate Base Course (per 100m2) d=150 Output/day is 1100m2 P11-10

Name	Spec	Unit	Quantity	Rate	Amount	Remarks		
Grad adjust Aggregate	CBR80	m3	16.5	63.0	1040.1		t=	0.15
Supervisor	1	m-d	0.1	6.0	0.5	1x100/D	D=	1100
Common labor (site)	2.4	m-d	0.2	4.5	1.0	0.24*10		
Motor grader		day	0.1	121.0	11.0	Table 8-7		
Tire roller		day	0.1	61.2	5.6	Table 8-9		
Macadam roller		day	0.1	116.0	10.5	Table 8-8		
Overhead	5%				53.4			
		Total			1122.2	74.8	94	
					$/100m2	$/m3		

Stabilization cost>7workunit rate

8. Operating Cost of Equipment per day (US$)

Rental fee of heavy equipment is one of the important factors for the cost estimation. Therefore the rental fee was calculate as shown in Table 8 based on Table 9, because, PW's equipment has no charges to the site.

Table 8-1 Bulldozer Operating Cost (per day) 9t

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Bulldozer		d	1	84.2	84	450h/y÷160d/y=2.8h/d
Fuel	Diesel	lit	33.0	1.0	32	11.7lit/hx2.8
Miscellaneous		%	10		3	
	Total				125	

Table 8-2 Backhoe Operating Cost (per day) C0.5m3

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Backhoe		d	1	72.0	72	750h/y÷190d/y=4.0h/d
Fuel	Diesel	lit	44.2	1.0	43	11lit/hx4
Miscellaneous		%	10		4	
	Total				125	$300/day by hearing

Table 8-3 Wheel loader Operating Cost (per day) C1.0m3

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Wheel loader		d	1	64.0	64	570h/y÷190d/y=3.0h/d
Fuel	Diesel	lit	25.245	1.0	24	8.4lit/hx3
Miscellaneous		%	10		2	
	Total				97	

Table 8-4 Dump truck Operating Cost (per day) w8ton

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Dump truck		d	1	64.0	64	900h/y÷190d/y=4.7h/d
Fuel	Diesel	lit	42.4	1.0	41	9litx4.7=42
Miscellaneous		%	10		4	
	Total				115	$130/day by hearing

Table 8-5 Truck Operating Cost (per day) 4-4.5t

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Truck		d	1	28.0	28	660h/y÷160d/y=4.1h/d
Fuel	Diesel	lit	28.3	1.0	27	6.9lit/hx4.1
Miscellaneous		%	10		3	
	Total				64	

Table 8-6 Trailer truck Operating Cost (per day) 32t

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Trailer truck		d	1	143.2	143	660h/y÷200d/y=3.3h/d
Fuel	Diesel	lit	58.2	1.0	56	18lit/hx3.3
Miscellaneous		%	10		6	
	Total				211	

Stabilization cost>8equipmentrate

Table 8-7 Motor Grader Operating Cost (per day) w3.1m

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Motor Grader		d	1	80.0	80	430h/y÷120d/y=3.6h/d
Fuel	Diesel	lit	32.9	1.0	32	9.2*3.6=33
Miscellaneous		%	10		3	
	Total				121	$258/day by hearing

Table 8-8 Macadam Roller Operating Cost (per day) w13-14t

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Macadam Roller		d	1	88.0	88	410h/y÷120d/y=3.4h/d
Fuel	Diesel	lit	20.7	1.0	20	6*3.4=20.4
Miscellaneous		%	10		2	
	Total				116	$170/day by hearing

Table 8-9 Tire Roller Operating Cost (per day) No.0802021 w8-20t

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Tire Roller		d	1	32.0	32	430h/y÷140d/y=3.1h/d
Fuel	Diesel	lit	21.8	1.0	21	3.1*7.1=22
Miscellaneous		%	10		2	
	Total				61	

Table 8-10 Vibration Roller Operating Cost (per day) No.0804021 w12ton

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Vibration Roller		d	1	40.0	40	340h/y÷110d/y=3.1h/d
Fuel	Diesel	lit	41.3	1.0	40	13*3.1=40
Miscellaneous		%	10		4	
	Total				90	

Table 8-11 Crawler type Stabilizer Operating Cost (per day) D0.6m w1.6m

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Stabilizer		d	1	**179.3**	179	230h/y÷70d/y=3.3h/d
Fuel	Diesel	lit	55.4	1.0	54	3.3*17=56
Miscellaneous		%	10		5	
	Total				244	

Table 8-12 Tire type Stabilizer Operating Cost (per day) D0.5m w2.4m

	Spec	Unit	Quantity	Rate	Amount	Remarks
Operator		m-d	1	6.0	6	
Stabilizer		d	1	**717.2**	717	230h/y÷70d/y=3.3h/d
Fuel	Diesel	lit	175.8	1.0	170	54*3.3=178
Miscellaneous		%	10		17	
	Total				910	

Table 8-13 Movable soil plant Operating Cost (per day) w20ton

	Spec	Unit	Quantity	Rate	Amount	Remarks
		m-d	1	6.0	6	
soil plant		d	1	**358.6**	359	
Generator	90kw	d	1	**51.0**	51	310h/y÷80d/y=3.9h/d
Fuel	Diesel	lit	27.5	1.0	27	7.1*3.9=27.7
Miscellaneous		%	10		3	
	Total				445	

Stabilization cost>8equipmentrate

9. Maintenance Cost of Equipment per hour (US$)

Table 9 Machineries and vehicles maintenance cost

25% increased on basic pay (per hour)

		per hour 2010	per hour 2015	type	(fuel rate/h)
1	Dozer Large	6740	15000	1A,1B	
	Dozer Medium	5260	10520	1C	5.5
	Dozer Small	1940	6000	1D	
3	Grader	2400	10000	1F	3.75
5	FE Loader/Shovel	3140	8000	1G	3
7	Road Roller	720	11000	2B	1.75
8	Tyre Roller	700	4000	2B 443,450,451,	2
	Tyre Roller	700	4000	507-512,CIP 2B1 6YPR 01,02UNDP 007/ JG 88-010,JG 88	
6	High speed Compactor	4500	10000	2BT	
11	Vibrating Roller	2500	5000	All	2.25
	3-Wheel roller	720	4000		1.75
	Tandem Roller	2000	6740		2.25
54	Water Bowzer	1800	4000		1
45	Asphalt plant	25000	25000	2R042,045,052,055	120
	bitumen burner TK2000				20
48	Bitumen Decanter	2300	3500	up to 2000 litre	24.3
	Bitumen Decanter	5400	7000	above 2000 litre	
22	Decanter			All 2D	
49	Asphalt paver	9000	12000		5
50	Bitumen Distributor	7200	7500		10
62	Water pump	260	260		0.5
53	Tipper	1450	2500	up to 5 tons	1
	Stabilizer Buldozer type		22412.5		
	SAKAI PM550		89650		
	Soil Mixing Plant		44825		
	Dump Truck (10 Wheel)	7500	8000		1
	Tipper	1450	2500	6-8 tons vehicles	1
	Tipper	3000	4000	Vehicles numbers	
52	Truck	1200	2000	up to 5 tons	0.4
	Truck	2650	3500	6 ton & above	
40	Electric generating sets	2000	2500	up to 75KVA	
	Electric generating sets	3000	4500	75-150KVA	
	Electric generating sets	4800	6000	Above 150KVA	
2	Scraper			1K	
4	Excavator	10000	16000	till 1FO46	
		9000	9000	1FO47 & up	
9	Hyster Grid Roller			2B 448,449,513,	
10	Power Tiller			Baby Roller	
12	Power Hammer				
13	Plate compactor				

Dear Sirs

Questionnaires

We. JICA TCP team, are appreciating your participation to this Workshop.

This TCP (Technical Cooperation Project) for Improvement of Road Technology in Disaster-affected Areas in Myanmar has following Purpose:

- Improvement of Road technology standards and manuals for designing and construction works.
- Enhancement of the practical skills and knowledge of the road technical staff.
- Enhancement of the capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region.

Now you are kindly requested to answer to following questioners:

1. TCP team has carried out following kinds of Seminar, Workshops and Trainings. Please put the mark on the right side as follows: ・: I have participated and got good knowledge for you future works △ : I have participated, but could not get good knowledge ✔ : I have not participated these kinds of Seminar, Workshop, Training	
1. Seminar at Nay Pyi Taw (Jun 13-14, 2013) about TCP outline	
2. Seminar at Nay Pyi Taw (May 22, 2014) about PP1 planning	
3. Workshop at CTC (May 27, 2013) about PCM Workshop	
4. OJT about Soil mix testing work	
5. Training in Japan (Sep 30 to Oct 11, 2013)	
6. Workshop at CTC (Dec 13, 2013) about Stabilization, Soft Ground Behavior	
7. OJT through Construction Supervision Work of PP-1	
8. Workshop at CTC (Mar 28, 2014) about high embankment analysis	
9. OJT for installation of equipment for high-embankment behavior observation work	
10. Training in Japan (Sep 28, to Oct 10, 2014)	
11. Training in Japan (Nov 2014)	
12. Training in Japan (Jan24~Feb 5) by HIDA[1]	
13. Workshop at BRL (Jun 3~Dec 10, 2014) about data analysis for stability and settlement	
14. Workshop at Bogale (Feb 23,2015) for Site Reconnaissance of high embankment work	
15. Workshop at Bogale (Apr 29, 2015) for Pilot Project 2---Today	
16. OJT for Construction Management (Apr~Mar 2015)—not yet	
17. Seminar at Nay Pyi Taw (Jun 18, 2015) about TCP summarization —not yet	

[1] The Overseas Human Resources and Industry Development Association

This is the question for the person who participated to some of above Seminar or Workshop or Training 2. Have you gotten some improvement or progress on your technical or engineering knowledge for the road design and construction through this TCP. Please select one from the followings:	
I received a good knowledge	
I received some reference	
I received some knowledge, but not so much	
Almost nothing	

3. TCP team has prepared and delivered following kinds of Manual or reference books. Please put the mark on the right side as follows: ・ : I have used these reference books on the execution of your project(s) △ : I have just read or looked ✔ : I have not received	
1. Soft Ground Treatment Manual (Draft)	
2. Text Book for Practical Training about Checking Methods for Stability & Settlement of High Embankment on Soft Ground	
3. Comments about Geometric Design and safety facilities of Expressway	
4. Training text at HIDA about Expressway	

Please fill your name and title

Name	
Title and/or position	
Phone Number	
Email Address	

Thanks your Cooperation

Following Verifiable Indicators are requested in PDM

		First enquête results in Apr 2015	Second enquête results in Jun 2015
Project Purpose			
● Enhancement of the capacity of the Public Works (PW) for road construction adaptive to the delta areas of Ayeyarwady Region.	confirmation from more than 30 staff about the effect for enhancement	>asked to 50 staff, and they answered as follows: >17 staff received good knowledge >24 staff received some knowledge >other 9 staff were negative >Threfore it might be said that 41 staff's knowledge was enhanced	
	road length by stabilization is more than 2.6km	comolete length is 2.4km up to the end of PROJECT	
Output 1			
● Improvement of Road technology standards and manuals for designing and construction works.	New Soil treatment Manual is disscussed and accepted	? times discussed and accepted on ??	
	More than 10 engineers using the Manual	>TCP team has delivered 4 kinds of Manual/Books >19% of staff received such manual >However only 7 persons answered they are using >threfore output1 is not achived yet	
Output 2			
● Enhancement of the practical skills and knowledge of the road technical staff.	Total number of trained staff is more than 300	more than 400 staff has participated to TCP traing/seminar	
	50% of participants evaluate training/seminar	>12 % of staff answered that he/she participated some of training/seminar >1% staff participated but could not get good kowledget >72 % of staff has not participated any training/seminar >thus more than 90% participants evaluate favourably	

Analysis Results of Questionnares for PDM Indicators

Answer Total 50

1. TCP team has carried out following kinds of Seminar, Workshops and Trainings. Please put the mark on the right side as follows: ○: I have participated and got good knowledge for you future works △ : I have participated, but could not get good knowledge ✓: I have not participated these kinds of Seminar, Workshop, Training		Output 2					
		○:	△ :	✔:	non	total	=○／(○+△)
1. Seminar at Nay Pyi Taw (Jun 13-14, 2013) about TCP outline		1	2	40	7	50	33%
2. Seminar at Nay Pyi Taw (May 22, 2014) about PP1 planning		2		41	7	50	100%
3. Workshop at CTC (May 27, 2013) about PCM Workshop		4	1	38	7	50	80%
4. OJT about Soil mix testing work		1		43	6	50	100%
5. Training in Japan (Sep 30 to Oct 11, 2013)		2		41	7	50	100%
6. Workshop at CTC (Dec 13, 2013) about Stabilization, Soft Ground Behavior		6	1	36	7	50	86%
7. OJT through Construction Supervision Work of PP-1		9		35	6	50	100%
8. Workshop at CTC (Mar 28, 2014) about high embankment analysis		4	1	38	7	50	80%
9. OJT for installation of equipment for high-embankment behavior observation work		4		40	6	50	100%
10. Training in Japan (Sep 28, to Oct 10, 2014)				43	7	50	
11. Training in Japan (Nov 2014)		3		40	7	50	100%
12. Training in Japan (Jan24~Feb 5) by HIDA[1]				43	7	50	
13. Workshop at BRL (Jun 3~Dec 10, 2014) about data analysis for stability and settlement		9		34	7	50	100%
14. Workshop at Bogale (Feb 23,2015) for Site Reconnaissance of high embankment work		21		15	14	50	100%
15. Workshop at Bogale (Apr 29, 2015) for Pilot Project 2---Today		27	1	14	8	50	96%
16. OJT for Construction Management (Apr~Mar 2015)—not yet							
17. Seminar at Nay Pyi Taw (Jun 18, 2015) about TCP summarization —not yet							
	Total	93	6	541	110	750	
		12%	1%	72%	15%	100%	

Almost of participants on Apr 29, 2015 has not participated to the early stage seminar, and could not get answer.
Therefore TCP team has utilized the answer for the questionare, which was delivered to around 35 participants on the Seminar of Jun 14,2013. Summary of average answer were as folows:
1 Easiness for understanding = Comparatively easy
2. Interesting degree of contents = interesing

Indicatot 2.2 Output 2:
50% of participants evaluate training/seminar favorably

Results: Almost of participants for each training/ seminar answered to be favoravle (got good knowledge) as shwn in right summary Table.

This is the question for the person who participated to some of above Seminar or Workshop or Training 2. Have you gotten some improvement or progress on your technical or engineering knowledge for the road design and construction through this TCP. Please select one from the followings:		Project Purpose				
I received a good knowledge		17				
I received some reference			24			
I received some knowledge, but not so much				6		
Almost nothing					3	50

Indicator 1 for Project Purpose:
The enhancement of Skill and knowledge of the Engineer for road design and construction is confermed by the hearing from moretha 30 staff.

Questionare was delivered to around 50 participants on the Workshop, held on Apr 29 2015. And gtot answers from 36 engineers.
The Workshop is the first occasion for almost 70% of Engineers to participate to TCP trainings.
Alomost of the engineer participated to TCP training evaluated

3. TCP team has prepared and delivered following kinds of Manual or reference books. Please put the mark on the right side as follows: ○ : I have used these reference books on the execution of your project(s) △ : I have just read or looked ✓: I have not received		Output 1					
		○:	△ :	✔:	no answer		
1. Soft Ground Treatment Manual (Draft)		2	9	31	8	50	18%
2. Text Book for Practical Training about Checking Methods for Stability & Settlement of High Embankment on Soft Ground		5	13	25	7	50	28%
3. Comments about Geometric Design and safety facilities of Expressway			4	38	8	50	0%
4. Training text at HIDA about Expressway			3	39	8	50	0%
		7	29	133	31	200	
		4%	15%	67%	16%		

Indicator 1-2 for Output 1:
More than 10 engineers are executing the work by using the manuals

This achievement ratio is not good
Only 3 engineers used the manuals.

Annex 8 Monitoring Item (Draft)

Project monitoring is necessary not only during project execution period but also after the completion of project for the post evaluation process.
Following monitoring items are proposed in this TCP for reference.

Item	Target	Remarks
1.Acievement ratio of each output	It should be evaluated from decided numeric indicator in PDM	
2. Achievement ratio of project purpose	It should be studied from the consciousness of the relevant personnel for the achievement of project purpose.	
3. Achievement ratio of overall goal		
4. Actual results of input for project	Input M/M Facilities Materials & Equipment Necessary expenses	
5. Progress of activities	Comparison between plan & actual Affected factors (Plus & Minus) Response on the occurrence of problems	
6. Process for the necessary decisions		Issues on the decision should be checked
7. Organization for Project management	Information sharing in project team (including C/P) Prompt correspondence status against the correction of the plan by JICA and PW	
8. Monitoring status	Monthly periodical Monitoring status Feedback against project activities	Reflection to PO and PDM
9. Changing of Pre-conditions	Changing has occurred or not? Influence of the changing Correspondence against the changing	
10. Executing organization	Is there issues on the execution? What is the cause? Is it affected to the execution organization? Improvement status in Quality-control	Improved degree should be confirmed by skill-test before and after training of quality control
11. Role of relevant personnel for Project	Assignment of the staff were adequate or not? Assignment ratio of the staff were adequate? Explanations to the staff about the major role is enough? Roles were clear or not?	
12. Cooperation with relevant agencies	Frequency of the joint meeting Participation to the trial work from each agencies	