添付12：ツイスター工法プロモーションビデオ

JDC Twister Technology Promotional Video

Please refer to the attached pictures and link for your reference ☞ http://twister-grp.com/

☝ Click for Twister Promotional Video

Please enjoy the Twister promotional video 👇

Collaboration Program with JICA-MOC for Disseminating Construction Soil Improving Method (Twister Method)

Demonstration Session/ Workshop [6 Jun – 7 Jun 2019]

JDC CORPORATION
YANGON BRANCH

S/N	NAME	POSITION	DEPARTMENT	REMARKS
1	U Hla Tun Oo	Deputy Director General, DDG	Head Office	Higher Position of Ministry of Construction
2	U Khin Zaw	Chief Engineer, CE	Head Office	
3	U Yan Naing Zaw	Chief Engineer, CE	Ayeyarwady Division	
4	Daw Htar Zin Thin Zaw	Chief Engineer, CE	RRL	
5	Daw Zin Zin Htike	Deputy Director, DD	Road/ Port Design Department	
6	U Htoon Htoon Naing	Deputy Director, DD	Special Road Construction Unit 14	
7	U Win Kyaw Aung	Deputy Director, DD	Special Road Construction Unit 20	
8	U Than Myine Htoo	Deputy Director, DD	Special Road Construction Unit 21	

S/N	ATTENDEE	POS.	DEPARTMENT	S/N	ATTENDEE	POS.	DEPARTMENT
1	U Thein Zaw OO	AE	Special Road Construction Unit 14	13	U Ye Min Taung	SAE	Maubin District
2	U Win Naing	AE	Pyapon District	14	U Tay Zar Lin	SAE	Pathein District
3	U Myo Thet Zaw	AE	Hinthada District	15	U Zarni Htet	SAE	Labutta District
4	U Kyaw Kyaw Min Kyi	AE	Mechanical Department	16	U Kaung Myat Lin	SAE	Hintada District
5	U Nyut Oo	AE	Quality Control	17	U Zaw Min Tun	SAE	Mechanical Department
6	U Soe Thiha	AE	RRL	18	U Tin Htut Naing	SAE	Mechanical Department
7	Daw Aye Myint Zu	SSAE	Special Road Construction Unit 21	19	U Zaw Tun Naing	SAE	Quality Control
8	U Zaw Zaw Hlaing	SSAE	Mechanical Department	20	U Thein Than Aung	JE	Special Road Construction Unit 14
9	U Win Naing	SAE	Special Road Construction Unit 14	21	U Su Thiha Aung	JE	Quality Control
10	U Hla Min Than	SAE	Special Road Construction Unit 20	22	U Kyaw Moe	Operator	Special Road Construction Unit 14
11	U Thein Zaw Tun	SAE	Bogalay Division	23	U Thet Zaw	Mechanic	Special Road Construction Unit 14
12	U Hlaing Min Zaw	SAE	Pyapon District				

Collaboration Program with JICA-MOC for Disseminating

Construction Soil Improving Method (Twister Method)

JDC CORPORATION
YANGON BRANCH

DEMONSTRATION SESSION / WORKSHOP

Day- 1 (06th Jun 2019)	Day- 2 (07th Jun 2019)
① Briefing on Project Outline	① Twister Plant Operation and Control Explanation
i. Project objective & purpose ii. Twister plant introduction & operation briefing iii. Mix design specifications	i. Explanation on control mechanism and relevant switches ii. Briefing on operation sequences
② Plant Operation Demonstration	② Demonstration on Plant Operation
i. Briefing and description on operation ii. Explanation of all equipment parts iii. Guidance on plant operation mechanism	i. Briefing on different equipment parts ii. Explanation on workflow and workers' duty
③ Presentation of Project History	③ Twister Maintenance Briefing
i. Presentation on project milestone & history ii. Implementation plan iii. Quality control and specifications	i. Briefing the importance of maintenance work before/ during/ after operation ii. Details of maintenance work on different parts of the plant
④ Presentation of Promotional Video	④ Road Construction Site Visit
i. Display Twister promotional video ii. Explanation of relevant successful projects	i. Quality inspection to the constructed road ii. Discussion of road specifications iii. Briefing on road monitoring work
⑤ Q&A Session & Appreciation Session	⑤ Q&A Session
i. Difference and comparison between Twister plant with other conventional stabilizer. ii. Quality control on design specifications and improved soil. iii. Production cost and operation rate.	i. Propose to review the road specifications for the next trial project ii. Suggestion for different mix design options to achieve more economical mix design for future road construction

Collaboration Program with JICA-MOC for Disseminating

Construction Soil Improving Method (Twister Method)

JDC CORPORATION
YANGON BRANCH

Photos of the Day: 6th June 2019






Collaboration Program with JICA-MOC for Disseminating

Construction Soil Improving Method (Twister Method)

JDC CORPORATION
YANGON BRANCH

Photos of the Day: 6th June 2019

Collaboration Program with JICA-MOC for Disseminating

Construction Soil Improving Method (Twister Method)

JDC CORPORATION
YANGON BRANCH

Photos of the Day: 7th June 2019

1. During rainy season, the site office is open to students in the village affected by the Project

2. Maintenance of common access to the village

3. Situation of borrow-pit to get local soil

4. Situation of sand stock yard

5. Maintenance of common place in the village

Collaboration Program among JICA/ MOC/ JDC for Disseminating Construction Soil Improving Method (Twister Method)

JDC CORPORATION
YANGON BRANCH

Official Handing Over Ceremony [14 November 2019]

Event Attendees List:

S/N	NAME	POSITION	DEPARTMENT	REMARKS
1	U Ohn Lwin	Director General, DG	Head Office	Higher Position of Ministry of Construction
2	U Aung Myint Oo	Deputy Director General, DDG	Head Office (Planning)	
3	U Kyi Zaw Myint	Deputy Director General, DDG	Head Office (Planning-2)	
4	U Shwe Zin	Chief Engineer, CE (Civil)	DOH	
5	U Kyaw Kyaw	Chief Engineer, CE (Civil)	DOH	
6	U Myint Han	Chief Engineer, CE (Civil)	DOH	
7	U Than Myint	Chief Engineer, CE (Civil)	DOH	
8	U Thaung Tun	Chief Engineer, CE (Mechanical)	DOH	
9	Dr. Hlaing Moe	Director (Mechanical)	DOH	
10	U Kyaw Moe Htut	Director (Civil)	DOH	
11	Daw Yin Yin Aye	Director	DOH	
12	U Tin Maung Kyi	Assistant Director, AD (Mechanical)	DOH	
13	U Nay Moe Naing	Assistant Director, AD (Mechanical)	DOH	
14	Daw Tin Tin Naing	Assistant Director, AD (Mechanical)	DOH	

JDC CORPORATION
YANGON BRANCH

Official Handing Over Ceremony

Agenda of the Ceremony:

Time	Agenda
10:00 – 10:05	Announcement of Opening Ceremony
10:05 – 10:20	Presentation of the Collaboration Program Milestone
10:20 – 10:30	i. Handing Over of the Twister Handbook to Department of Highways ii. Awarding of the Letter of Appreciation for Donations to JDC Corporation
10:30 – 10:45	Words of Thanks by U Ohn Lwin, Director General (DG) of Department of Highways, Ministry of Construction
10:45 – 11:00	Announcement of Closing Ceremony
11:00 – 11:15	MOC-JDC Photography Session
11:15 – 11:40	Refreshment & Conversation Session

JDC CORPORATION
YANGON BRANCH

Official Handing Over Ceremony

Photos of the Day: 14th November 2019






JDC CORPORATION
YANGON BRANCH

Official Handing Over Ceremony

Photos of the Day: 14th November 2019

JDC CORPORATION
YANGON BRANCH

Official Handing Over Ceremony

Photos of the Day: 14th November 2019

MINISTRY OF CONSTRUCTION
DEPARTMENT OF HIGHWAYS

LETTER OF APPRECIATION FOR DONATIONS
To
JDC Corporation

(November 14, 2019)

On Behalf of the Department of Highways, Ministry of Construction, I would like to thank the JDC Corporation for their generous donation of KOKUDO KAIHATSU TM-1500 Rotary Crushing & Mixing Machine (Twister Method). We are very pleased for the advantages of Japanese Technologies on Construction Soil Improving Method (Twister Method) in Myanmar as per results of Pilot Project under the Collaboration Program. Your significant support of these efforts is greatly appreciated.

Ohn Lwin

Director General

ACTIVE. CREATIVE. EVOLUTION. BUILDING TOMORROW.

JDC CORPORATION
YANGON BRANCH

Workshop Summary

PURPOSE	Summarized on:- 1. Workshop 2 event 2. Distribution and review of project report, especially cost effectiveness 3. Video presentation 4. Discussion on Q&A session 5. Photos of the day
DATE / TIME	20th February 2020, Thursday (1000 - 1210)
LOCATION	Mechanical Section Department, 8 Mile Yangon
ATTENDEES	Refer to the following list

No.	NAME	POSITION	DEPARTMENT
		Ministry of Construction	
1	U Taung Myint Tun	Chief Engineer, CE	Civil Department
2	U Yan Naing Zaw	Director	Ayeyarwady Division
3	U Kyaw Naing	Director	Civil Department
4	Dr. Hlaing Moe	Director	Mechanical Department
5	Daw Htar Zin Thin Zaw	Director	RRL
6	U Htoon Htoon Naing	Deputy Director, DD	Special Road Unit 14
7	U Than Myaing Htoo	Deputy Director, DD	Special Road Unit 21
8	U Kyaw Zaw	Assistant Director, AD	Pyapon District
9	U Kyaw Than Htay	Assistant Director, AD	Yangon North District - Civil
10	U Nyi Nyi Aung	Assistant Director, AD	Pathein District - Civil
11	U Myat Khine Soe	Assistant Director, AD	Maubin District – Civil
12	U Tin Maung Kyi	Assistant Director, AD	Mechanical Department
13	U Aung Kyaw	Assistant Director, AD	Mechanical Department
14	U Zaw Zaw Hlaing	SSAE	Mechanical Department
15	Daw Mi Mi Yee Mon	Staff Officer	Twantay District – Civil
16	U Kyaw Kyaw Min Kyi	Staff Officer	Mechanical Department
17	U Moe Si Thu Win	Staff Officer	Mechanical Department
		JDC Corporation	
1	Ryoji Yamashita	Chief Representative	-
2	Thant Zaw Ngwe	Office Manager	-
3	Ng Kin Mun	Engineer	-
4	Linn Htet Aung	Engineer	-

Workshop Flow Chart:

Project Outline Introduction

- ✓ project location and purpose
- ✓ design mix applied
- ✓ Twister plant layout explanation

Project Schedule Briefing

- ✓ project plan illustration
- ✓ completion of Twister plant workflow
- ✓ phase 1 - phase 6

Post Monitoring Work - QC

- ✓ orientation and method for post monitoring work
- ✓ comparison of Before and After
- ✓ latest road condition

Review / Analysis of Cost Effectiveness

- ✓ review of cost with design mix
- ✓ proposal for future road extension
- ✓ findings

Video Presentation

- ✓ project procedure/ milestone
- ✓ latest road condition

Q & A Session

As discussed in Q&A Session:-

[1] - CE urged to use simple design mix in order to reduce the project cost

- JDC strongly recommended to CE to consider more simple design mix which can reduce the overall types of material involved in the design and construction stage.
- CE agreed with JDC's point and urged the RRL's Director Daw Htar Zin to consider simpler design mix for future project.
- RRL explained that a high design mix specification was decided due to MOC's lack of understanding on the newly introduced Twister technology. Besides, RRL also commented that cement is not necessary to be applied in Base course design.
- RRL stated that more time is needed to study the past project result in sequence to work out more economical and simple design mix for future project.

[2] - Material procurement and loss of material

- JDC highlighted the delay of material procurement which eventually delayed the production progress of Twister plant's due to insufficient material on site. Furthermore, there was loss of material delivered to site. CE questioned DD on the stated issue.
- DD explained that the soft crushed rocks had to be procured and delivered from the supplier at Myaungmya area, where far from the Twister site and thus it caused the delay in material procurement. Meanwhile, the delay in material delivery also caused by the low bridges' capacity and aged-condition which is critical for heavy truck to pass through.
- RRL said that most suppliers were not able to supply the crushed rock according to the size distribution chart. This is because they don't have the facility to prepare the required mixture.

[3] - Usage of hard rock in Twister machine and Japan operation experience

- Assistant Director questioned on the usage of hard rock in Twister machine and its past operation experience in Japan. JDC mentioned the Twister machine is capable to crush and mix a wide range of material, from cohesive soil to soft rock in order to produce a mass volume of improved soil. Besides, crushing and mixing of hard rock

is workable for Twister machine but it will involves frequent maintenance especially replacement of impact chain, which will increase the operation cost.

- JDC highlighted on Twister's higher productivity and better product quality but further studies are required to compare with the other conventional method in term of cost and quality in details.

[4] - Budget for future road extension project

- CE mentioned that the current budget is not available for road extension project as informed by head office since the Yangon-Pathein Road upgrading work is MOC's first priority project at the present time.
- CE also mentioned that they are trying to secure the budget for the road extension project for next year.

[5] - Twister promotional video

- Mechanical section Assistant Director and SSAE was requested a copy of Twister promotional video.
- JDC has sent the Twister promotional video link to SSAE afterwards.

[6] - *Pictures on the Day*




Japan International Cooperation Agency

JDC CORPORATION
YANGON BRANCH

WORKSHOP 2

Project Report / Proposal for Future Road Extension

Table of Contents Page No.

Collaboration Program with JICA-MOC for Disseminating Construction Soil Improving Method (Twister Method)

1. OVERVIEW

- Owner : JICA (Consignment Contract)
- Contract Period : 30th November 2018 - 31st August 2020
- Program Purpose : Demonstration to Myanmar government and local / foreign companies on the most effective soil improvement technology "Twister Method".
- Demonstration Details

① Demonstration Content : Utilization of "Twister Method" effectively to produce the improved local soil as the material for subgrade, sub-base and base course in road construction.

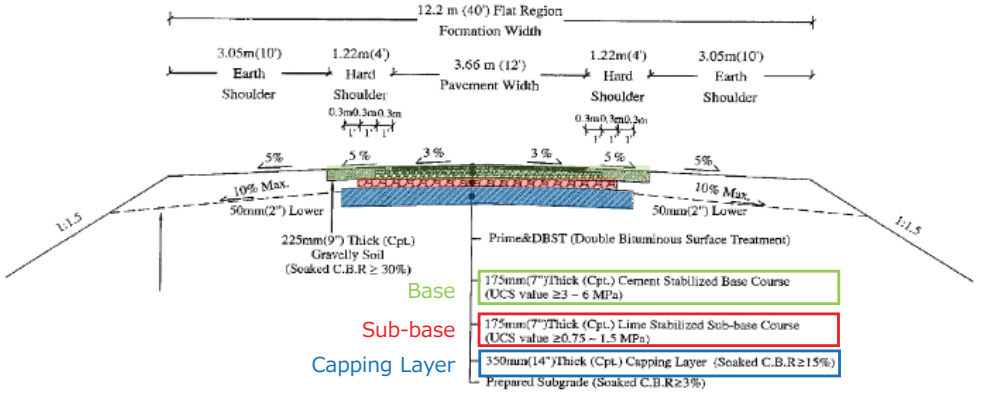
② Construction Location : 400m length around 24km point of Road S_{16}-49 (Bogalay – KyeinChaung – KaDonKaNi), approximately 200km away to Southwest from Yangon.

③ Material Quantity : ❶ Subgrade= 400m (length) × 5.46m (width) × 350mm (thk.)= 765m³

❷ Sub-Base= 400m (length) × 4.86m (width) × 175mm (thk.)= 340m³

❸ Base = 400m (length) × 4.26m (width) × 175mm (thk.)= 298m³

Total Improved Soil Quantity = 765m³ + 340m³ + 298m³ =1,403m³

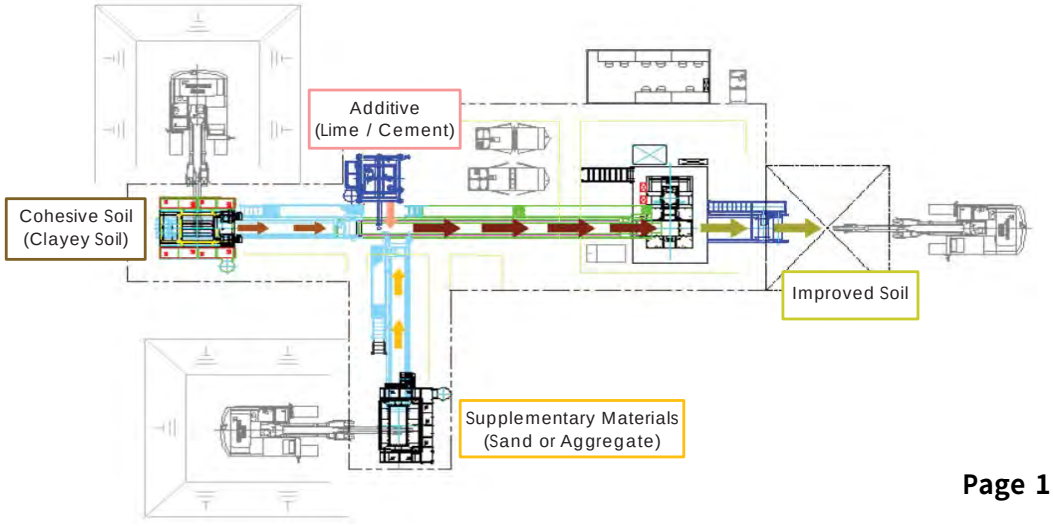


④ Material Mixture Proportion

Material / Course	Cohesive Soil	River Sand	River Shingle	Lime
Capping Layer	60 %	40 %	-	6.9 %
Sub-Base	15 %	15 %	70 %	6.9 %

Material / Course	C/R (1"x2") (25mm x 50mm)	C/R (3/4") (19mm)	C/R (1/2") (13mm)	C/R (3/8") (9.5mm)	Dust	Cement
Base	25 %	20 %	15 %	10 %	30 %	4.6 %

⑤ Plant Layout



Topic 1 Project Procedure

i. Project Flow Chart

Project Milestone/ Procedure

The Project's milestone involved with respective start and finish date to be tabularized below:

No.	Phase	Start Date	End Date
1	Construction of plant yard	28 December 2018	5 March 2019
2	Transportation & Delivery	6 March 2019	8 March 2019
3	Installation/ Assembly	9 March 2019	23 March 2019
4	Commissioning	25 March 2019	28 March 2019
5	Trial Test for design mix	29 March 2019	6 April 2019
6	Actual Road Construction	23 April 2019	18 May 2019

Procedure Flow Chart:

Phase 1
Construction of Twister Plant Yard
(28 Dec. 2018 - 5 Mar. 2019)

↓

Phase 2
Transportation & Delivery of Twister Plant
(6 Mar. 2019 - 8 Mar. 2019)

↓

Phase 3
Installation / Assembly of Twister Plant
(9 Mar. 2019 - 23 Mar. 2019)

↓

Phase 4
Commissioning
(25 Mar. 2019 - 28 Mar. 2019)

↓

Phase 5
Trial Test for Deisgn Mix
(29 Mar. 2019 - 6 Apr. 2019)

↓

Phase 6
Actual Road Constuction
(23 Apr. 2019 - 18 May. 2019)

Project Procedure – *Phase 1 Construction of Twister Plant Yard*

① *Site before occupation* *(19th Dec. 2018)*






② *Earthwork for plant yard begin* *(2nd Jan. 2019)*



③ *Earthwork for embankment* *(8th Jan. 2019)*






④ *Earthwork for embankment* *(15th Jan. 2019)*




⑤ *Completion of embankment* *(14th Feb. 2019)*



⑥ *Commencement of foundation works for plant equipment* *(20th Feb. 2019)*



⑦ *Completion of foundation works* *(27th Feb. 2019)*



⑧ *Site ready for equipment delivery* *(5th Mar. 2019)*



① *Delivery of equipment* *(6th – 8th Mar. 2019)*









① *Twister installation work* *(9th – 23th Mar. 2019)*









① *Calibration of Machine* *(25th – 28th Mar. 2019)*










Project Procedure – *Phase 5 Trial Test for Design Mix*

① *Capping Layer* *(29th Mar. 2019)*



② *Sub-Base Course* *(1st Apr. 2019)*



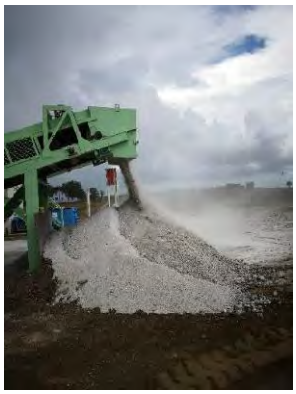
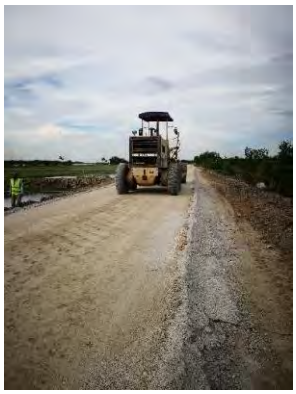
③ *Base Course* *(5th – 6th Apr. 2019)*




Project Procedure – *Phase 6 Actual Road Construction*

① *Capping Layer – Soil (60%) : Sand (40%) : Lime (6.9%)* *(23rd - 29th Apr. 2019)*


②*Sub-Base Course – Soil (15%) : Sand (15%) : River Shingle (70%) : Lime (6.9%)* *(30th Apr. – 6th May 2019)*


③ *Base Course – C/R 1”x2” (25%) : C/R 3/4” (20%) : C/R 1/2” (15%) : C/R 3/8” (10%) : Dust (30%) : Cement(4.6%)*

(7th - 12th May 2019)



Project Procedure – *Phase 6 Actual Road Construction*

④ *DBST Double Bituminous Surface Treatment Work* *(15th - 18th May 2019)*





⑤ *DBST Road Construction Completion*

Topic 2 Post Monitoring Work

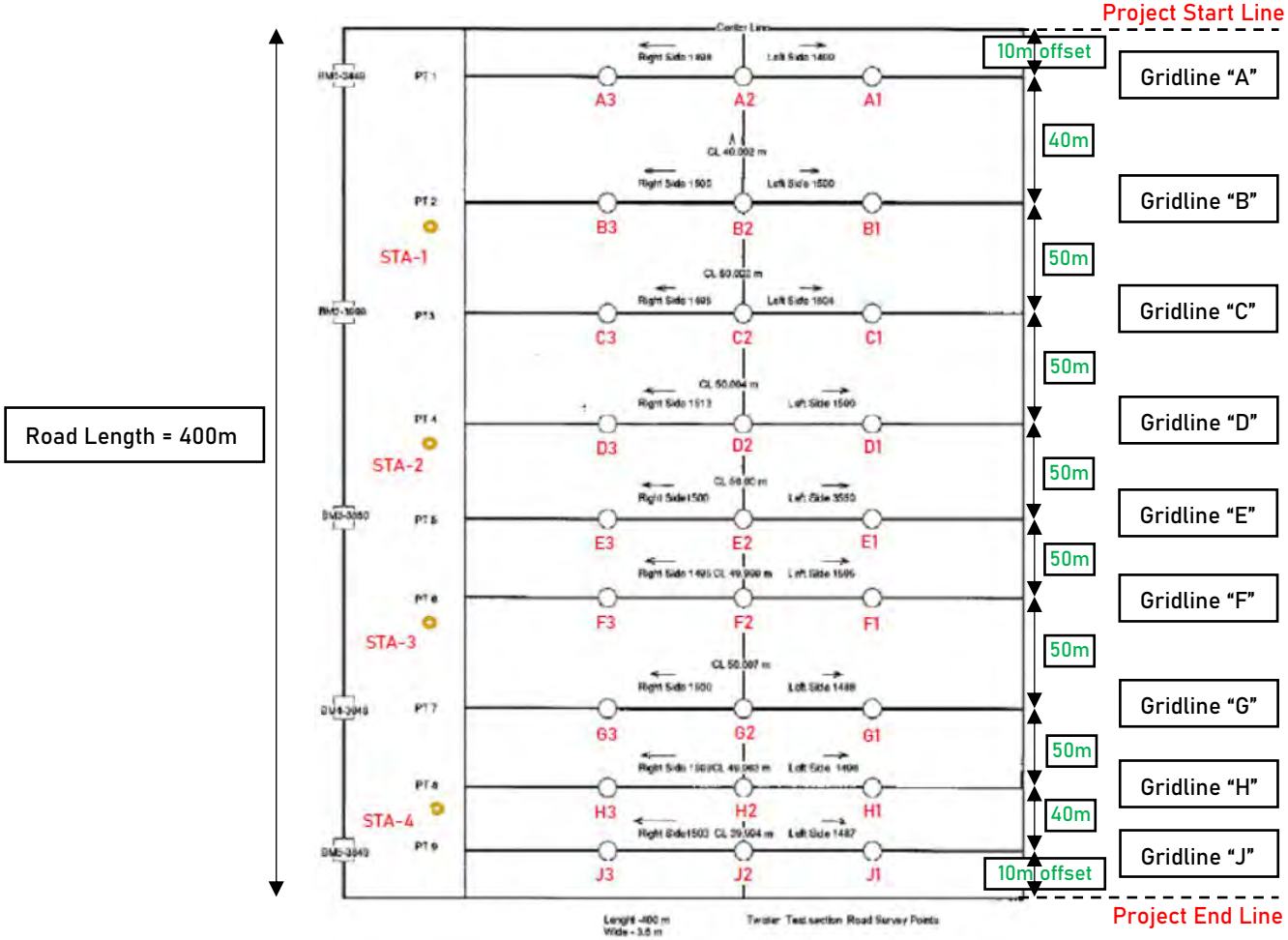
i. Configuration of Post Monitoring

ii. Comparison of Before & After

iii. Latest Road Condition (Dec' 2019)

Post Monitoring

The construction of 2-furlongs road under Twister Technology was completed on 18 May 2019 and has been monitored throughout collaboration program. The road was divided into portions with 50m apart from each gridline, and 3 control points were setup on each gridline as shown. The differential settlement and tilting of the constructed road were measured and recorded for further research purpose.



Post-Monitoring

Before collaboration program begin...	*Criteria*	*After Twister Technology applied...*
	18th Sep. 2018	Photo Taken On	18th Sep. 2019	
	Bad	Water Permeability	Good	
	Numerous / Muddy	Water Stagnant	Nil	
	Numerous	Potholes / Crack	Nil / Crack Free	
	Hard / Dangerous	Ease of Accessibility	Easy / Safe	

SITE ROAD CONDITION ~ 18-19 Sep. 2019 (During Rainy Season)

The Bogalay lies on 7m above sea level. This township has a tropical climate and significant 100.0 inch of precipitation falls annually.

⑧

⑦

⑥

⑤

Latest Road Condition – *12 December 2019*


CH 0


CH 50


CH 150


CH 250


CH 350


CH 400

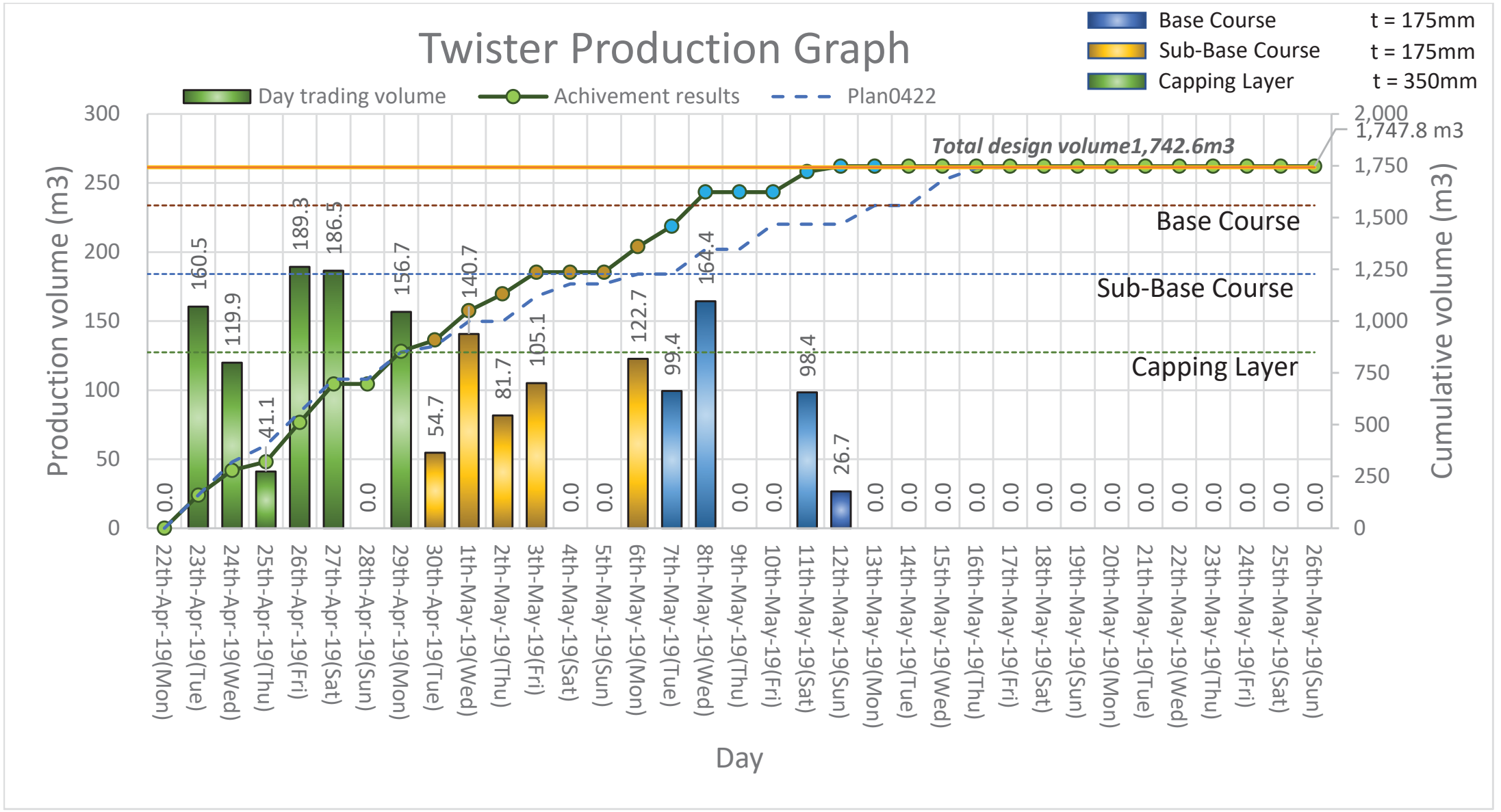
Current Road Condition after Twister 400m road section:

Topic 3 Analysis of Cost Effectiveness

i. Review of Cost with Design Mix

ii. Evaluation of Technical Requirements / Findings

iii. Proposal for future road extension


Twister Production Graph
Base Course t = 175mm
Sub-Base Course t = 175mm
Capping Layer t = 350mm
Day trading volume
Achivement results
Plan0422
Total design volume1,742.6m3
1,747.8 m3
Base Course
Sub-Base Course
Capping Layer
Production volume (m3)
Cumulative volume (m3)
300
250
200
150
100
50
0
2,000
1,750
1,500
1,250
1,000
750
500
250
0
0'0
160.5
119.9
41.1
189.3
186.5
0'0
156.7
54.7
140.7
81.7
105.1
0'0
0'0
122.7
99.4
164.4
0'0
0'0
98.4
26.7
0'0
0'0
0'0
0'0
0'0
0'0
0'0
0'0
0'0
0'0
0'0
0'0
22th-Apr-19(Mon)
23th-Apr-19(Tue)
24th-Apr-19(Wed)
25th-Apr-19(Thu)
26th-Apr-19(Fri)
27th-Apr-19(Sat)
28th-Apr-19(Sun)
29th-Apr-19(Mon)
30th-Apr-19(Tue)
1th-May-19(Wed)
2th-May-19(Thu)
3th-May-19(Fri)
4th-May-19(Sat)
5th-May-19(Sun)
6th-May-19(Mon)
7th-May-19(Tue)
8th-May-19(Wed)
9th-May-19(Thu)
10th-May-19(Fri)
11th-May-19(Sat)
12th-May-19(Sun)
13th-May-19(Mon)
14th-May-19(Tue)
15th-May-19(Wed)
16th-May-19(Thu)
17th-May-19(Fri)
18th-May-19(Sat)
19th-May-19(Sun)
20th-May-19(Mon)
21th-May-19(Tue)
22th-May-19(Wed)
23th-May-19(Thu)
24th-May-19(Fri)
25th-May-19(Sat)
26th-May-19(Sun)
Day

Capping Layer

Actual Work (130m³/day) (45% Capacity 300m³/day)

Twister Method	Capping Layer (THK 350mm)(56,353 Cost/m³)			
C-60%,S-40%,Lime- 6.9%	**853.8 m³**	Quantity m³	Rate	Price (MMK)
6 Days	Soil m³	874	1,500	1,311,000
Material	Sand m³	458	6,000	2,748,000
Design Volume 764.4 Cum	Lime (Bags)	7,637	2,280	17,412,360
	768.42/764.4=1		Total	21,471,360
	Actual 768.42 Cum	**Material Unit Rate/m³**		**27,942**
	Design 764.4 Cum	**Material Unit Rate/m³**		**28,089**
Machainary Cost	Excavator (day)	12	250,000	3,000,000
	Wheel loader (day)	5	300,000	1,500,000
	Motor Grader (day)	6	300,000	1,800,000
	Smooth Roller (day)	6	300,000	1,800,000
	Sheepfoot Roller (day)	6	300,000	1,800,000
	Tire Roller (day)	6	300,000	1,800,000
	Dump Truck (day)	23	150,000	3,450,000
				15,150,000
Fuel Cost	Diesel (Lit)	2,023	1,130	2,285,990
		7,326	1,057	7,743,582
				10,029,572
Labour Cost	Worker (day)	39	6,000	234,000
	Operator (day)	6	7,000	42,000
	Excavator (day)	12	7,000	84,000
	Motor Grader (day)	6	7,000	42,000
	Smooth Roller (day)	6	7,000	42,000
	Sheepfoot Roller (day)	6	7,000	42,000
	Tire Roller (day)	6	7,000	42,000
	Dump Truck (day)	23	7,000	161,000
	Wheel loader (day)	5	7,000	35,000
				724,000
		Total		25,903,572
	Actual 768.42 Cum	**Production unit Rate/m³**		**33,710**
	Design 764.4 Cum	**Production unit Rate/m³**		**33,887**
		Total		**47,374,932**
		Actual 768.42Cum		**61,652**
	Total	**Design 764.4 Cum**		**61,977**

Case 1 (240m³/day) (80% Capacity)

80% capacity	Capping Layer (THK 350mm)(45,334 Cost/m³)				Actual Vs Case 1
C-60%,S-40%,Lime- 6.9%	**853.8 m³**	Quantity m³	Rate	Price (MMK)	
(4 days)	Soil m³	874	1,500	1,311,000	
Material	Sand m³	458	6,000	2,748,000	
Design Volume 764.4 Cum	Lime (Bags)	7,637	2,280	17,412,360	
	768.42/764.4=1		Total	21,471,360	
	Actual 768.42 Cum	**Material Unit Rate/m³**		**27,942**	
	Design 764.4 Cum	**Material Unit Rate/m³**		**28,089**	
Machainary Cost (Base 300m³/day)	Excavator (day)	8	250,000	2,000,000	
	Wheel loader (day)	4	300,000	1,200,000	
	Motor Grader (day)	4	300,000	1,200,000	
	Smooth Roller (day)	4	300,000	1,200,000	
	Sheepfoot Roller (day)	4	300,000	1,200,000	
	Tire Roller (day)	4	300,000	1,200,000	
	Dump Truck (day)	16	150,000	2,400,000	
				10,400,000	
Fuel cost	Diesel (Lit)	1,348	1,130	1,523,240	
		4,883	1,057	5,161,331	
				6,684,571	
Labour	Worker (day)	26	6,000	156,000	
	Operator (day)	4	7,000	28,000	
	Excavator (day)	8	7,000	56,000	
	Motor Grader (day)	4	7,000	28,000	
	Smooth Roller (day)	4	7,000	28,000	
	Sheepfoot Roller (day)	4	7,000	28,000	
	Tire Roller (day)	4	7,000	28,000	
	Dump Truck (day)	15	7,000	105,000	
	Wheel loader (day)	3	7,000	21,000	
				478,000	
		Total		17,562,571	
	Actual 768.42 Cum	**Production unit Rate/m³**		22,855	**32 percent**
	Design 764.4 Cum	**Production unit Rate/m³**		**22,976**	
		Total		**39,033,931**	
		Actual 768.42Cum		**50,798**	
	Total	**Design 764.4 Cum**		**51,065**	**18 percent**

Case2 Twister Method Applied PP2 Mix Design 80% Capacity

80% capacity	Capping Layer (THK 350mm)(45,334 Cost/m³)				Case1 Vs Case2
Soil 50%, Sand 50%	**853.8 m³**	Quantity m³	Rate	Price (MMK)	
Material	Soil m³	728	1,500	1,092,000	
Design Volume 764.4 Cum	Sand m³	573	6,000	3,438,000	
(4 days)	Lime (Bags)	0	2,280	-	
	768.42/764.4=1		Total	4,530,000	
	Actual 768.42 Cum	**Material Unit Rate/m³**		**5,895**	**79 Percent**
	Design 764.4 Cum	**Material Unit Rate/m³**		**5,926**	
Machainary Cost	Excavator (day)	8	250,000	2,000,000	
(Base 300m³/day	Wheel loader (day)	4	300,000	1,200,000	
	Motor Grader (day)	4	300,000	1,200,000	
	Smooth Roller (day)	4	300,000	1,200,000	
	Sheepfoot Roller (day)	4	300,000	1,200,000	
	Tire Roller (day)	4	300,000	1,200,000	
	Dump Truck (day)	16	150,000	2,400,000	
				10,400,000	
Fuel cost	Diesel (Lit)	1,348	1,130	1,523,240	
		4,883	1,057	5,161,331	
				6,684,571	
Labour	Worker (day)	26	6,000	156,000	
	Operator (day)	4	7,000	28,000	
	Excavator (day)	8	7,000	56,000	
	Motor Grader (day)	4	7,000	28,000	
	Smooth Roller (day)	4	7,000	28,000	
	Sheepfoot Roller (day)	4	7,000	28,000	
	Tire Roller (day)	4	7,000	28,000	
	Dump Truck (day)	15	7,000	105,000	
	Wheel loader (day)	3	7,000	21,000	
				478,000	
		Total		17,562,571	
	Actual 768.42 Cum	**Production unit Rate/m³**		22,855	
	Design 764.4 Cum	**Production unit Rate/m³**		**22,976**	
		Total		**22,092,571**	
		Actual 768.42Cum		**28,751**	**43 Percent**
	Total	**Design 764.4 Cum**		**28,902**	

Thechnical & Quality Control Part

Mix Design	Requirement	Test	DOC
Soil 60%, Sand 40%	OMC (w) =14.4%		
lime 6.9%	MDD = 1.92 g/cm³	Density test	Achieved DOC
	DOC ≥ 95%		
Capping Layer	socked CBR ≥ 15%		
	≥ 10 Roller passes		

Thechnical & Quality Control Part

Mix Design	Requirement	Test	DOC
Soil 60%, Sand 40%	OMC (w) =14.4%		
lime 6.9%	MDD = 1.92 g/cm³	Density test	Achieved DOC
	DOC ≥ 95%		
Capping Layer	socked CBR ≥ 15%		
	≥ 10 Roller passes		

Thechnical & Quality Control Part

Mix Design	Requirement	Test	DOC
Soil 50%, Sand 50%			
	CBR ≥ 15%		
PP2 Project	Dry Dendity 1.69 g/cm³	Density test	unspecified
	Moiture content 6%		
	Doc 93%		

Sub Base Course

Actual Work (90m^3/day) (30% Capacity)

Twister Metohd	Sub Base (THK 175mm)(91,793 Cost/m^3)			
C-15%,Rs-70%,Lime-6.9%	**504.6 m^3**	Quantity m^3	Rate	Price (MMK)
Sand 15%	Soil m^3	138	1,500	207,000
5 Days	Sand m^3	108	6,000	648,000
Material	Lime (Bags)	4803	2,280	10,950,840
Design Volume 340 Cum	Rs m^3	435	41,000	17,835,000
	454.14/340=1.34	Total		29,640,840
	Actual 454.14 Cum	**Material Unit Rate/m^3**		**65,268**
	Design 340 Cum	**Material Unit Rate/m^3**		**87,179**
Machainary Cost	Excavator (day)	10	250,000	2,500,000
	Wheel loader (day)	5	300,000	1,500,000
	Motor Grader (day)	5	300,000	1,500,000
	Smooth Roller (day)	5	300,000	1,500,000
	Sheepfoot Roller (day)	5	300,000	1,500,000
	Tire Roller (day)	5	300,000	1,500,000
	Dump Truck (day)	11	150,000	1,650,000
				11,650,000
Fuel Cost	Diesel (Lit)	1,685	1,130	1,904,050
		6,104	1,057	6,451,928
				8,355,978
Labour Cost	Worker (day)	35	6,000	210,000
	Operator (day)	5	7,000	35,000
	Excavator (day)	10	7,000	70,000
	Wheel loader (day)	5	7,000	35,000
	Motor Grader (day)	5	7,000	35,000
	Smooth Roller (day)	5	7,000	35,000
	Sheepfoot Roller (day)	5	7,000	35,000
	Tire Roller (day)	5	7,000	35,000
	Dump Truck (day)	11	7,000	77,000
				567,000
		Total		20,572,978
	Actual 454.14 Cum	**Production unit Rate/m^3**		**45,301**
	Design 340 Cum	**Production unit Rate/m^3**		**60,509**
		Total		**50,213,818**
		Actual 454.14Cum		**110,569**
	Total	**Design 340 Cum**		**147,688**

Thechnical & Quality Control Part

Mix Design	Requirement	Test	UCS
soil 15%, Sand 15%, Rs 70%, Lime 6.9% Sub Base Course	OMC = 6.7% MDD = 2.15 g/cm^3 CBR ≥ 30% UCS ≥ 0.75-1.5 Mpa Doc ≥ 98% ≥ 10 Roller passes	UCS Density test	0.85 Mpa 12 Test Points Achieved DOC

Case 1 (240m^3/day) (80% Capacity)

80% Capacity	Sub Base (THK 175mm)(64,537 Cost/m^3)				**Actual Vs Case 1**
C-15%,Rs-70%,Lime-6.9%	**506.4 m^3**	Quantity m^3	Rate	Price (MMK)	
Sand 15%	Soil m^3	138	1,500	207,000	
2 Days	Sand m^3	108	6,000	648,000	
Material	Lime (Bags)	4803	2,280	10,950,840	
Design Volume 340 Cum	Rs m^3	435	41,000	17,835,000	
	454.14/340=1.34	Total		29,640,840	
	Actual 454.14 Cum	**Material Unit Rate/m^3**		**65,268**	
	Design 340 Cum	**Material Unit Rate/m^3**		**87,179**	
Machainary Cost	Excavator (day)	4	250,000	1,000,000	
	Wheel loader (day)	2	300,000	600,000	
	Motor Grader (day)	2	300,000	600,000	
	Smooth Roller (day)	2	300,000	600,000	
	Sheepfoot Roller (day)	2	300,000	600,000	
	Tire Roller (day)	2	300,000	600,000	
	Dump Truck (day)	5	150,000	750,000	
				4,750,000	
Fuel Cost	Diesel (Lit)	674	1,130	761,620	
		2,442	1,057	2,581,194	
				3,342,814	
Labour cost	Worker (day)	14	6,000	84,000	
	Operator (day)	2	7,000	14,000	
	Excavator (day)	4	7,000	28,000	
	Wheel loader (day)	2	7,000	14,000	
	Motor Grader (day)	2	7,000	14,000	
	Smooth Roller (day)	2	7,000	14,000	
	Sheepfoot Roller (day)	2	7,000	14,000	
	Tire Roller (day)	2	7,000	14,000	
	Dump Truck (day)	5	7,000	35,000	
				231,000	
		Total		8,323,814	
	Actual 454.14 Cum	**Production unit Rate/m^3**		**18,329**	**60 percent**
	Design 340 Cum	**Production unit Rate/m^3**		**24,482**	
		Total		**37,964,654**	
		Actual 454.14Cum		**83,597**	**24 percent**
	Total	**Design 340 Cum**		**111,661**	

Thechnical & Quality Control Part

Mix Design	Requirement	Test	UCS
soil 15%, Sand 15%, Rs 70%, Lime 6.9% Sub Base Course	OMC = 6.7% MDD = 2.15 g/cm^3 CBR ≥ 30% UCS ≥ 0.75-1.5 Mpa Doc ≥ 98% ≥ 10 Roller passes	UCS Density test	0.85 Mpa 12 Test Points Achieved DOC

Case2 Twister Method Applied PP2 Mix Design 80% Capacity

80% Capacity	Sub Base (THK 175mm)(64,537 Cost/m^3)				**Case1 Vs Case2**
soil 50%,sand 50%,ce 6.4-6.9%	**506.4 m^3**	Quantity m^3	Rate	Price (MMK)	
Material	Soil m^3	460	1,500	690,000	
2 Days	Sand m^3	360	6,000	2,160,000	
	Cement	4524	2,280	10,314,720	
Design Volume 340 Cum	Rs m^3		41,000	-	
	454.14/340=1.34	Total		13,164,720	
	Actual 454.14 Cum	**Material Unit Rate/m^3**		**28,988**	**56 Percent**
	Design 340 Cum	**Material Unit Rate/m^3**		**38,720**	
Machainary Cost	Excavator (day)	4	250,000	1,000,000	
	Wheel loader (day)	2	300,000	600,000	
	Motor Grader (day)	2	300,000	600,000	
	Smooth Roller (day)	2	300,000	600,000	
	Sheepfoot Roller (day)	2	300,000	600,000	
	Tire Roller (day)	2	300,000	600,000	
	Dump Truck (day)	5	150,000	750,000	
				4,750,000	
Fuel Cost	Diesel (Lit)	674	1,130	761,620	
		2,442	1,057	2,581,194	
				3,342,814	
Labour cost	Worker (day)	14	6,000	84,000	
	Operator (day)	2	7,000	14,000	
	Excavator (day)	4	7,000	28,000	
	Wheel loader (day)	2	7,000	14,000	
	Motor Grader (day)	2	7,000	14,000	
	Smooth Roller (day)	2	7,000	14,000	
	Sheepfoot Roller (day)	2	7,000	14,000	
	Tire Roller (day)	2	7,000	14,000	
	Dump Truck (day)	5	7,000	35,000	
				231,000	
		Total		8,323,814	
	Actual 454.14 Cum	**Production unit Rate/m^3**		**18,329**	
	Design 340 Cum	**Production unit Rate/m^3**		**24,482**	
		Total		**21,488,534**	
		Actual 454.14Cum		**47,317**	**43 Percent**
	Total	**Design 340 Cum**		**63,202**	

Thechnical & Quality Control Part

Mix Design	Requirement	Test	UCS
soil 50%,sand 50%,ce 6.4-6.9%	DD 1.63 kg/cm^3 moisture content 11% DOC 95%	UCS Density test	≥ 1.125 Mpa

Base Course

Actual Work (87m^3/day) (29% Capacity)

Twister Method	Base Course (Thk 175mm)(99,916 Cost/m^3)			
C/R(1''x2'')25%,C/R(3/4'')20%	**388.6 m^3**	Quantity m^3	Rate	Price (MMK)
C/R(1/2'')15%,C/R(3/8'')10%	C/R (1''x2'')	132	50,000	6,600,000
Dust 30%,Cement 4.6%	C/R (3/4'')	104	50,000	5,200,000
4 Days	C/R (1/2'')	78	50,000	3,900,000
Material	C/R (3/8'')	51	50,000	2,550,000
	Dust	152	40,000	6,080,000
Design Volume 298 Cum	Cement (Bag)	763	7,500	5,722,500
	349.74/298=1.17	Total		30,052,500
	Actual 349.74 Cum	**Material Unit Rate/m3**		**85,928**
	Design298 Cum	**Material Unit Rate/m3**		**100,847**
Machainary Cost	Excavator (day)	8	250,000	2,000,000
	Wheel loader (day)	4	300,000	1,200,000
	Motor Grader (day)	4	300,000	1,200,000
	Smooth Roller (day)	4	300,000	1,200,000
	Sheepfoot Roller (day)	1	300,000	300,000
	Tire Roller (day)	4	300,000	1,200,000
	Dump Truck (day)	11	150,000	1,650,000
				8,750,000
Fuel Cost	Diesel (Lit)	1,358	1,130	1,534,540
		4,884	1,057	5,162,388
				6,696,928
Labour Cost	worker (day)	24	6,000	144,000
	Operator (day)	4	7,000	28,000
	Excavator (day)	8	7,000	56,000
	Wheel loader (day)	4	7,000	28,000
	Motor Grader (day)	4	7,000	28,000
	Smooth Roller (day)	4	7,000	28,000
	Sheepfoot Roller (day)	1	7,000	7,000
	Tire Roller (day)	4	7,000	28,000
	Dump Truck (day)	11	7,000	77,000
				424,000
		Total		15,870,928
	Actual 349.74 Cum	**Material Unit Rate/m3**		45,379
	Design298 Cum	**Material Unit Rate/m3**		**53,258**
		Total		**45,923,428**
	Total	**Actual349.74Cum**		**131,307**
		Design 298 Cum		**154,105**

Actual Vs Case 1

47 Percent

16 percent

Case 1 (240m^3/day) (80% Capacity)

80% Capacity	Base Course (Thk 175mm)(78,241 Cost/m^3)			
C/R(1''x2'')25%,C/R(3/4'')20%	**388.6 m^3**	Quantity m^3	Rate	Price (MMK)
C/R(1/2'')15%,C/R(3/8'')10%	C/R (1''x2'')	132	50,000	6,600,000
Dust 30%,Cement 4.6%	C/R (3/4'')	104	50,000	5,200,000
2 Days	C/R (1/2'')	78	50,000	3,900,000
Material	C/R (3/8'')	51	50,000	2,550,000
	Dust	152	40,000	6,080,000
Design Volume 298 Cum	Cement (Bag)	763	7,500	5,722,500
	349.74/298=1.17	Total		30,052,500
	Actual 349.74 Cum	**Material Unit Rate/m3**		**85,928**
	Design298 Cum	**Material Unit Rate/m3**		**100,847**
Machainary Cost	Excavator (day)	4	250,000	1,000,000
	Wheel loader (day)	2	300,000	600,000
	Motor Grader (day)	2	300,000	600,000
	Smooth Roller (day)	2	300,000	600,000
	Sheepfoot Roller (day)	2	300,000	600,000
	Tire Roller (day)	2	300,000	600,000
	Dump Truck (day)	6	150,000	900,000
				4,900,000
Fuel Cost	Diesel (Lit)	674	1,130	761,620
		2,442	1,057	2,581,194
				3,342,814
Labour Cost	worker (day)	12	6,000	72,000
	Operator (day)	2	7,000	14,000
	Excavator (day)	4	7,000	28,000
	Wheel loader (day)	2	7,000	14,000
	Motor Grader (day)	2	7,000	14,000
	Smooth Roller (day)	2	7,000	14,000
	Sheepfoot Roller (day)	2	7,000	14,000
	Tire Roller (day)	2	7,000	14,000
	Dump Truck (day)	6	7,000	42,000
				226,000
		Total		8,468,814
	Actual 349.74Cum	**Material Unit Rate/m3**		**24,215**
	Design298 Cum	**Material Unit Rate/m3**		**28,419**
		Total		**38,521,314**
	Total	**Actual349.74Cum**		**110,143**
		Design 298 Cum		**129,266**

Thechnical & Quality Control Part

Mix Design	Requirement	Test	UCS
C/R(1''x2'')25%,C/R(3/4'')20%	OMC = 4.8%		
C/R(1/2'')15%,C/R(3/8'')10%	MDD = 2.31 g/cm^3	UCS	0.78Mpa
Dust 30%,Cement 4.6%	CBR ≥ 30%	Density test	1.7Mpa
	UCS ≥ 3-6 Mpa		1.97Mpa
Base Course	Doc ≥ 98%		
	≥ 10 Roller passes		

Thechnical & Quality Control Part

Mix Design	Requirement	Test	UCS
C/R(1''x2'')25%,C/R(3/4'')20%	OMC = 4.8%		
C/R(1/2'')15%,C/R(3/8'')10%	MDD = 2.31 g/cm^3	UCS	0.78Mpa
Dust 30%,Cement 4.6%	CBR ≥ 30%	Density test	1.7Mpa
	UCS ≥ 3-6 Mpa		1.97Mpa
Base Course	Doc ≥ 98%		
	≥ 10 Roller passes		

Analysis of Cost Effectiveness

Finding

1. Low productivity
   - Not in time procurement, especially additives such as lime/cement and aggregates.
   - Premixing by excavators due to many types of main materials used for sub base / base course, Twister here is for 2 main materials and 1 additive. To enhance the productivity, simplified design mix is better.

2. Hight wastage/loss of material
   - Further study is necessary to find reasons

3. High Design requirements for rural roads at this junction

4. (1) to (3) result in high cost.

Proposal

In order to establish economical/practical design requirement of especially subgrade/capping layer and sub base for rural roads, a few patterns of design mixes should be tried in next extension project.

Revised Implementation Program Schedule

Item	Work Item / Activity	Year
		2018: Nov, Dec 2019: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec 2020: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec 2021: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug
0	**JICA Program** Collaboration program for disseminating construction soil improving method (Twister Method) Current Contract Period: 8th June 2018 - 26th February 2021 ※Expected Revised Contract to be extended until 31st August 2021	30th Nov. 2018 - 26th Feb. 2021 Expected Extension till 31st Aug. 2021
1	**Twister Plant Preparation** - Site Preparation, Equipment Delivery & Assembly	30th Nov. 2018 - 28th Mar. 2019
2	**Twister Plant Operation** - Trial Test & Road Construction	29th Mar. - 18th May 2019
3	**Workshop 1** - Demonstration session of project milestone in Bogalay - Description of Twister plant operation and maintenance (Completed: 6th - 7th June 2019)	6th - 7th Jun. 2019
4	**Official Handing Over Ceremony** Attendees: MOC/ DOH Location: Ministry of Construction Head Office, Nay Pyi Taw (Completed: 14th November 2019)	14th Nov. 2019
5	**Workshop 2** Discussion and analysis on project result, review and proposal on alternative & economic pavement design (Completede: 20th February 2020)	20th Feb. 2020
6	**COVID-19** prevention measures implied by Government to prevent the spread of virus: ban of mass gathering , social distancing , workplace precautionary measures	COVID-19 Pandemic & Travel Restriction Measures
7	**Overhaul of Twister Plant** Maintain the functionality of the whole plant by overhauling. Repair and replace certain damaged mechanical parts of the plant (Est. Schedule: within 1st December 2020 - 31st January 2021)	within 1st Dec. 2020 - 31st Jan. 2021 (as earliest as possible)
8	**Determination & notification** regarding the continuance of the project based on overall situation (By End of January 2021)	Determination & Notification: End of Jan. 2021
9	**Workshop 3** Training session on Twister plant operation & maintenance lesson to deepen the knowledge (Est. Date: Early February 2021) - approximately 1 week	Workshop 3: Proposed 2nd - 10th Feb. 2021
10	**Workshop 4** Discussion & disclosure of project result and final conclusion (Est. Date: Early April 2021)	Workshop 4: Proposed 9th Apr. 2021
11	**JICA Report Submission** - Draft Report: 31st May 2021 - Final Report: 30th July 2021	31st May. 2021 - 30th Jul. 2021
12	Techincal Assistance by JDC without Finance Compensation	

Remarks:

- Technical assistance/ support to be provided by JDC without finance compensation from MOC during collaboration program period. However, relevant party should liable for the costs and damages caused by their negligence or inattention of operation guidelines.

Indicator: Completed; Outstanding Activities; Ongoing

Pre-Workshop Task - Major Overhaul of Twister Plant

Pre-Workshop Task Details :

Purpose — Due to discontinuity of Twister plant's full operation for more than 1 year, it is necessary and essentially to maintain the functionality and capacity of the plant for near future use. Thus, JDC is obliged to ensure the Twister plant's long-run performance and achieve its purposes. In addition, overhauling can prevent critical equipment failure, increase the system performance and yet extend the life span of the plant.

Activity : ① Inspect the tear and wear condition of the plant components

: ② Overhaul the Twister plant as per recommended

Location : Twister Plant, Road S_{16}-49, Bogalay

Attendees : ① JDC's Yangon technical team (Mr. Yamashita, Mr. Kin Mun, Mr. Linn, Mr. Zaw)

: ② ANC Fortune Winner Co., Ltd. specialist for control system integrator

: ③ MOC appointed Operation & Maintenance Team for Twister plant

Revised Date	**December 14, 2020**	**December 15, 2020**	**December 16, 2020**
Day	**Monday**	**Tuesday**	**Wednesday**
Activity Description	**❶ Inspection & Troubleshooting**		
	① The plant will be thoroughly inspected. ② Perform the troubleshooting on different part of the plant.		
	❷ Overhaul		
	① Repair or replace certain damaged part of the plant. ② Correct alignment of belt conveyors and lubrication where appropriate. ③ Final adjustments are performed on mechanical equipment to align to operational specifications.		
	Required Preparation : ① Material : manuals for plant overhaul ② Manpower : MOC - electrician (1 pax) & general workers (≈ 2 pax)		

(※Date to be confirmed at MOC convenience)

Workshop 3 - Twister Technology Staff Training and Skill Development

Workshop Details :

Purpose : ① ***Establisment of MOC's Twister Operation and Maintenance Team*** or Technical transfer and staff training in order to deepen the understanding of Twister operation workflow and production of improved material

Activity : ① Twister plant's system commissioning

: ② Twister operation tutorial and training session for MOC team

Location : Twister Plant, Road S_{16}-49, Bogalay

Attendees : ① JICA Advisor (Mr. Masanori Sunada)

: ② JDC's Yangon technical team (Mr. Yamashita, Mr. Kin Mun, Mr. Linn, Mr. Zaw)

: ③ ANC Fortune Winner Co., Ltd. specialist for control system integrator

: ④ MOC high position personnels & engineers from different Special Construction Unit

: ⑤ MOC appointed Operation & Maintenance Team for Twister plant

Revised Date	February 2, 2021	February 3, 2021	February 4, 2021	February 5, 2021	February 8, 2021	February 9, 2021	February 10, 2021
Day	Tuesday	Wednesday	Thursday	Friday	Monday	Tuesday	Wednesday
Activity Description	***Activity 1***			***Activity 2***			
	❶ System Commissioning			**Plant Commissioning & Training Session 1**			**Buffer Day**
	① Validate the performance and ensure the functionality of the system ② Preparation of hand tools for replacement work: cordless screwdriver set, open-end spanner set, hex-key set, safety gloves etc.			① Review of production workflow ② Plant commissioning with basic test on site, operation and maintenance ③ Full Twister operation done by MOC Team ④ Tutorial materials preparation: user manual, operation control sheet, projector, presentation slides etc.			① Training session 2 (optional), subject to Training Session 1 outcome
	❷Integrated Analysis for Quality Control ① Pavement sampling for compressive strength analysis and DCP test conducted by Fukken						
	Required Preparation : ① Material : documents and manuals for system commissioning ② Manpower : MOC electrician (1 pax), general workers (≈ 2 pax)			**Required Preparation :** ① Material : soil, sand and lime for 50m^3 improved soil production ② Manpower : general workers (≈ 4 pax) ③ Machinery : Excavator (2 nos), Dump truck (1 nos)			