TO CR of JICA Timor-Leste OFFICE

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Version of the Sheet: Ver.5（Term: March, 2016 - March, 2019）

Name: Hisashi MUTO

Title: Team Leader/ Road Maintenance1

Submission Date: 16th July, 2018

< I. Summary (all achievements are as of 31st March, 2018) >

1. Progress

1-1 Progress of Inputs

1-1-1 Japanese side

< Short-term experts dispatched to Timor-Leste>

NO	Name	Title	Dispatched Period to Timor-Leste	Changes or delay
1	Hisashi MUTO	Team Leader/ Road Maintenance 1	(1st) 8th Mar - 10th Apr, 2016 (2nd) 14th Jun - 25th Jun, 2016 (3rd) 1st Sep - 18th Sep, 2016 (4th) 23th Jan - 19th Feb,2017 (5th) 24th Mar - 2nd Apr, 2017 (6th) 18th Aug- 10th Sep, 2017 (7th) 24th Nov- 14th Dec, 2017 (8th) 2nd Feb- 4th Mar, 2018	None
2	Makoto MATSUURA	Deputy Team Leader/ Road Maintenance 2	(1st) 8th Mar – 15th Apr, 2016 (2nd) 14th Jun - 13th Jul, 2016 (3rd) 20th Sep - 14th Oct,2016 (4th) 1st Dec - 16th Dec,2016 (5th) 23th Jan - 19th Feb,2017	None
3	Mitsuhide SAITO	Deputy Team Leader/ Road Maintenance 2	(1st) 24th Mar - 9th Apr, 2017 (2nd) 9th Jun- 25th Jun, 2017 (3rd) 16th Oct- 12th Nov,2017 (4th) 16th Feb - 11th Mar,2018	Note: Mr. Mitsuhide Saito was replaced Mr. Matsuura in Deputy Team Leader post.

4	Johji KOIZUMI	Road Construction Supervision	(1st) 19th Jul -17th Aug, 2016 (2nd) 24th Sep - 14th Oct,2016 (3rd)19th Jun- 5th Jul, 2017 (4th) 21st Aug- 4th Oct,2017 (5th) 14th Nov- 21st Dec,2017 (6th) 30th Jan- 4th Mar, 2018	None
5	Sueo HIROSE	Quality Control/ Road Repair	(1st) 28th Mar - 17th Apr, 2016 (2nd)13th May - 11th Jun, 2016 (3rd) 14th Aug -12th Sep, 2016 (4th) 7th Oct - 14th Oct, 2016 (5th) 23th Jan - 22th Feb,2017 (6th) 4th Aug- 3rd Sep, 2017 (7th) 4th Aug- 3rd Sep, 2017 (8th) 16th Feb- 18th Mar, 2018	None
6	Shutaro SAKANAKA	Disaster Restoration	(1st) 11th May - 31st May, 2016 (2nd) 28th Jun - 21st Jul, 2016 (3rd) 12th Sep – 6th Oct, 2016 (4th) 13th Feb - 8th Mar, 2017 (5th) 17th Apr- 7th May, 2017 (6th) 23rd Oct- 12th Nov, 2017 (7th) 16th Jan- 4rd Feb, 2018 (8th) 2nd Mar- 18th Mar, 2018	None
7	Kazuharu KOISHIKAWA	Disaster Restoration2	(1st) 3th Mar - 24th Mar, 2018	Note: This position has been created to assist drafting guideline on slop protection and landslide investigation, etc. Mr. Koishikawa was assigned for this position

				since March 2018.
8	Yoshiyuki AKAGAWA	Road Design/ Project Coordinator	(1st) 17th Mar - 15th Sep, 2016 (2nd) 21st Jun - 13th Jul, 2016 (3rd) 12th Sep - 6th Oct, 2016 (4th) 13th Feb - 5th Mar, 2017	None
9	Nicholas BROOKER-JONES	Road Design/ Project Coordinator	(1st) 31st Jul- 30th Aug, 2017 (2nd) 16th Oct - 23rd Nov, 2017 (3rd) 2nd Feb - 4th Mar, 2018	Note: Mr. Brooker-Jones was replaced Mr. Akagawa in Project Coordinator post.
10	Kenji MINEGISHI	Structure Design	(1st) 5th Apr - 24th Apr, 2016 (2nd) 5th Jul - 4th Aug, 2016 (3rd) 14th Nov- 13th Dec,2016 (4th) 12th May- 11th Jun, 2017 (5th) 1st Sep- 1st Oct,2017 (6th) 3rd Nov- 17th Dec, 2017	None
11	Takashi SAITO	Database	(1st) 19th Jul - 24th Aug, 2016 (2nd) 3rd Oct - 14th Oct, 2016 (3rd) 13th Mar- 12th Apr, 2017 (4th) 16th Jun- 2nd Jul, 2017 (5th) 18th Aug- 1st Oct, 2017 (6th) 16th Feb- 4th Mar 2018	None
12	Masahiko HAYASHI	Landslide	(1st) 16th Jun- 28th June, 2017 (2nd) 27th Oct - 9th Dec, 2017	Note: Activity on Landslide analysis was approved by 2nd JCC; Mr. Hayashi was assigned in June 2017.
13	Sohshi MIKAMI	Topographical Analysis	(1st) 19th Jun- 16th Jul, 2017	Note: Activity on Landslide

				analysis was approved by 2nd JCC; Mr. Mikami was assigned in June 2017.
14	Nao TSUJIMURA	Evaluation/Monitoring	Resident in Timor-Leste	None

< Equipment and materials >

NO	Items	Qty	Unit price	Unit	Total amount
1	Desktop computer	1	1,150	USD	1,150
2	Inclinometer assembly	1		JPY	
3	Dokenbo assembly	1		JPY	

(Remark: Equipment and materials which have a durable years for 2 years and are more than JPY50,000 are listed.)

1-1-2 Timor-Leste side

- **Counterpart (C/P) personnel (from MPWTC and DRBFC)**

NO	Name	Title of the Project	Engaged Period
1	Rui Hernani F. Guterres	Project Director	20th Feb 2018- at present
2	Milton Ramanata C.Monteiro	Project Manager	20th Feb 2018- at present
3	Joao Gama	C/P staff	8th Mar 2016 – at present
4	Joao Pedro Amaral	C/P staff	8th Mar 2016 – at present
5	Joao Gregorio	C/P staff	8th Mar 2016 – at present

- **Equipment and materials for the project office**

NO	Items	Qty	Unit
1	Office space (including desks and chairs)	1	room

1-2 Progress of Activities

NO	Activity	Achievement level
1.1	To review existing management structure and condition of maintenance and rehabilitation for major roads	● JICA Expert Team proposed idea of personal exchange of DRBFC during 3rd JCC. The idea was suggested in order to secure an organized coordination system under the appropriate division of roles among its staff, and formulate a technical staff organization so as to clarify where the responsibility and each competence.
1.2	To conduct periodic/routine inspection.	● JICA Expert Team drafted plan of road inspection for maintenance and rehabilitation works in 2018. This plan was proposed in 3rd JCC in initiation of the March, 2018.
1.3	To update the database based on the inspection result and repair/rehabilitation works of road and bridges.	● JICA Expert Team taught staff of Dept. Maintenance entering inspection result of 2017 of Reg.1 and 4 into GIS database. After technical transfer training, road data among the A08 and A11 (total length of 67.5km) has been compiled into GIS database by trainee.
1.4	To formulate maintenance and repair/rehabilitation plans for next cycle.	● 2018 budget plan for maintenance was formulated based on inspection.
1.5	To implement emergency inspections and repair/rehabilitation works when necessity arises.	● JICA Expert Team conducted emergency inspection at Jakarta II landslide in Ainaro, A02.
1.7	To propose framework of road maintenance/rehabilitation for major roads	● JICA Expert Team drafted framework of integration work among the both department of Construction and Maintenance in order to strengthen maintenance capacity. This idea was proposed in 3rd JCC in initiation of the March, 2018. ● In order to allow better control of each area of responsibility, design and construction separation order method was proposed in 3rd JCC.
2.1	To identify typical rehabilitation/repair work as case study	● In 3rd JCC, below two (2) case study sites and action plan for each site were proposed. (Totally 6 sites were identified.)

		1. Box culvert planning, design and construction of drainage which located in upper section of Beduku-Sarlala(Ex.Japan) ongoing rehabilitation project ; 2. Safety control and quality control using check list in Humboe- Letefoho emergency work project.
2.2.	To conduct the case studies for the planning, design check and construction supervision of the project.	● JICA Expert Team conducted safety lecture and observation/practicing safety event. ● JICA Expert Team conducted OJT on underground data collection by inclinomere in Aituto landslide area. During training, C/P and relevant entities (IPG, UNTL) learned following contents; • How to connect devices; • How to collect mass movement data; • How to measure water level. ● JICA Expert Team provided lecture on how to operate total station. ● JICA Expert Team conducted room lecture of mix design for asphalt concrete. After room lecture, trainees observed Marshall Test in the laboratory and another day, field observation of quality control using check list.
2.3	To propose preferable structures for construction management for repair/rehabilitation works through case studies.	● JICA Expert Team proposed site management method using check list for quality control during 3rd JCC.
3.3	To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies.	● JICA Expert Team conducted repeat trainings calculation of stability in order to improve trainee's skills on slope collapse countermeasure design. ● JICA Expert Team delivered classroom lecture of shear strength test using 'Dokenbo'. After classroom lecture, C/P learned how to do penetration test and share strength test in the field. ● JICA Expert Team delivered classroom lecture of groin study. This classroom lectures introduced groin as an example of disaster management for Loes river morphological change. Through site inspection, DRBFC technical staff identified damage of embankment; trainees studied this river flow velocity in order to set up groin structures.
3.4	To prepare the technical guideline of investigation and design.	● Guidelines of scouring measures and cross culvert design have been drafted. JICA Expert Team conducted explanation each contents of guideline of scouring. Both before having explanation and after the fact, JICA Expert Team implemented test for leaners judging degree of comprehension of learners based on result of test.

1-3 Achievement of Output

Indicators of Outputs		Achievement level
1.1	More than 30% of requested budget for road maintenance are distributed.	After election of 2017, the fiscal budget proposal of 2018 has been deliberated by 7th coalition government. However, this proposal has been

		rejected. Until now, GOTL is running by short term budget every two months; and resumption of the budget deliberation will be after the re-election in May, 2018.Achievement level of this output is not ready to be measured.
1.2	Improved road database is utilized for preparation of the annual work plan of road maintenance.	49% of target national roads condition data have been updated into GIS database.
2.1	At least 3 case studies for both construction and design are conducted. (Totally 6 case studies)	Four (4) sites proposed for case studies, have approved in February, 2017 in the 2nd JCC.
2.2	More than 60% of trainees pass the achievement test for construction supervision and design.	Baseline survey resulted that percentage of examinees exceeded the passing line by respective subject was a) design: 28%, b) quality control: 8%.
3	Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	Technical guideline for Scouring has been drafted; it will be finalized in March, 2018.

1-4 Achievement of the Project Purpose

Indicators of Project Purpose	Achievement level
Total length of maintained national roads were became 400km.	Achievement level of this output is not ready to be measured.

1-5 Changes of Risks and Actions for Mitigation

- After national election, regime change has been occurred in TL. New government proposed development program and fiscal budget plan; however both development program and budget plan have been rejected by parliament. Timor-Leste President calling for a new legislative election following political impasse in the country. GOTL is running by short term budget every two months; and resumption of the budget deliberation will be after the new legislative election in coming May, 2018.

1-6 Progress of Actions undertaken by JICA

- JICA Timor-Leste shared important information and documents with JICA Expert Team.
- JICA Timor-Leste assisted visa acquisition process for JICA Expert Team.

1-7 Progress of Actions undertaken by Gov. of Timor-Leste

- DRBFC shared necessary information and documents with JICA Expert Team.
- DRBFC has prepared the drawings of road and bridge maintenance based on the road inspection.

1-8 Progress of Environmental and Social Considerations (if applicable)

- No activities for the progress of Environmental and Social Considerations are undertaken.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

- Not Applicable so far.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

- No other issues are confirmed so far.

2. Delay of Work Schedule and/or Problems (if any)

- Based on the PDM, the project activities have been implemented as planned.

3. Modification of the Project Implementation Plan

3-1 PO

- PO is not modified from the Monitoring Sheet ver.1.

3-2 Other modifications on detailed implementation plan

- No other modification of the detailed implementation plan is confirmed.

4. Preparation of Gov. of Timor-Leste toward after completion of the Project

- The Gov. of Timor-Leste tries to secure the budget for road maintenance so that the capacity enhancement of DRBFC for road maintenance which is the Project Purpose will be sustainable and contribute to the achievement of Overall Goal.

< II. Project Monitoring Sheet I & II >

- Project Monitoring Sheet I & II are attached as PM Form I and II.

Project Monitoring Sheet I （Revision of Project Design Matrix）

Version 3
Dated 11th March, 2018

Project Title: The Project for Capacity Development of Road Services in Timor-Leste (CDRS)
Implementing Agency: Ministry of Public Works, Transport and Communications
Target Group: Officials of Direstorate of Road, Bridge and Flood Control (DRBFC)
Period of Project: (Three (3) years)
Project Site: Whole Timor-Leste **Model Site:**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal The maintenance conditions of major roads are improved in TL.	OG1 More than 60% of major national roads is in good condition.	Periodic Road Inspection	Budget and staff will be secured at satisfactory levels. Traffic volume is not increased more than expected.	Indicator has been set up and approved in 2nd JCC on February 2017.	
Project Purpose Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	Total length of maintained national roads become 400km.	Periodic Road Inspection	Enough number of DRBFC staff in the HQs and regional offices is ensured as planned. Budget for road maintenance and management is ensured.	Indicator has been set up and approved in 2nd JCC on February 2017.	
Outputs Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.	1-1 More than 30% of requested budget for road maintenance are distributed. 1-2 Improved road database is utilized for preparing the annual work plan of road maintenance.	Budget Report Monitoring Sheet	Budget for road maintenance and management is ensured. The trained DRBFC personnel continue to work for the Project (They do not quit the Project)	1-2 Inspection handwritten raw data of 2017 inputted to GIS database.(67.5km)	
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country.	2-1. At least 3 case studies for construction and 3 case studies for design are conducted (Totally 6 case studies). 2-2. More than 60 % of trainees pass the achievement	Monitoring Sheet Achievement test	Unforeseen natural disasters will not occur which may destroy construction works under case studies.	2-1. Progress of case study at 4 sites where approved by 2nd JCC; 2 another case study sites	
Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	3. Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	Technical guideline prepared		3. Schedule of completion of technical guideline was proposed in 3rd JCC.	

Activities	Inputs: The Japanese Side	Inputs: The Timor-Leste Side	Pre-Conditions
1.1 To review existing management structure condition of maintenance and rehabilitation for major roads. 1.2 To conduct periodic/routine inspection. 1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges. 1.4 To formulate maintenance and repair/rehabilitation plans for next cycle. 1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises. 1.6 To undertake appropriate road maintenance/rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget. 1.7 To propose appropriate framework of road maintenance and rehabilitation for major roads. 2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies. 2.2 To conduct the case studies for the planning, design and construction supervision of the project. 2.3 To propose preferable structures for construction management for repair/rehabilitation and maintenance works through case studies. 3.1 To review existing technical documents for road maintenance and rehabilitation. 3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works. 3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies. 3.4 To prepare the technical guideline of investigation and design. 3.5 To reflect the lessons learned from case studies to the technical guideline. 3.6 To disseminate the technical guideline for concerned parties.	1. Dispatch of the Japanese experts Short-term experts: - Team leader / Road maintenance 1 - Deputy team leader / Road maintenance 2 - Road construction supervision - Quality control / Road repair - Disaster restoration - Road design / Project coordinator - Structure design - Database - Evaluation / Monitoring - Other areas if needed 2. Facilities and equipment In accordance with necessity of activities 3. Training in Japan In accordance with necessity of activities	1. Assignment of C/Ps - Project Director - Project Manager - DRBFC Staff 2. Assignment of Trainees In accordance of necessity 3. Facilities and Equipment - Project office Equipment and tools 4. Recurrent costs - Expenses for equipment maintenance - Spare parts - Transportation fees of C/Ps and trainees - Expenses for contract-out of works - Necessary expenditures for case studies - C/Ps' wages and allowances	DRBFC's budget necessary for the Project is allocated by TL government. <Issues and countermeasures> Issues: Due to political factor, development program and budget plan for 2018 was rejected by parliament. Countermeasures: Identified ongoing project implementing by Multi-year budget in order to carry out case study.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 3

Dated 11th March, 2018

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste(CDRS)

(Quarterly schedule 2016–2020, quarters I–IV per year; Plan/Actual shown as bars.)

Inputs	Plan / Actual	Remarks	Issue (Monitoring)	Solution (Monitoring)
Expert				
Team Leader/Road Maintenance 1 /Mr. Hisashi MUTO	Plan / Actual		-	-
Deputy Team Leader/Road Maintenance 2 /Mr. Makoto MATSUURA	Plan / Actual		2017 March, Mr.Matsuura resigned.	-
Deputy Team Leader/Road Maintenance 2 /Mr. Mitsuhide SAITO	Plan / Actual	Mr. Mitsuhide Saito was replaced Mr.	-	Mr. Mitsuhide Saito was dispatched as successor of
Road Construction Supervision /Mr. Johji KOIZUMI	Plan / Actual		-	-
Quality Control/Road Repair /Mr. Sueo HIROSE	Plan / Actual		-	-
Disaster Restoration /Mr. Shutaro SAKANAKA	Plan / Actual		2017 July, Mr.Sakanaka resigned.	He will continue his assignment with loan
Road Design/Project Coordinator /Mr. Yoshiyuki AKAGAWA	Plan / Actual		2017 July, Mr.Akagawa resigned.	-
Road Design/Project Coordinator /Mr. Nicholas BROOKER-JONES	Plan / Actual	Mr. Brooker-Jones was replaced Mr.	-	Mr. Brooker-Jones was dispatched as successor of
Structure Design /Mr. Kenji MINEGISHI	Plan / Actual		-	-
Database /Mr. Takashi SAITO	Plan / Actual		-	-
Landslide /Mr. Masahiko HAYASHI	Plan / Actual	Activity on Landslide analysis was	-	-
Topographical Analysis /Mr. Sohshi MIKAMI	Plan / Actual	Activity on Landslide analysis was	-	-
Evaluation/Monitoring /Ms. Nao TSUJIMURA	Plan / Actual		-	-
Equipment	Plan / Actual			
Training in Japan	Plan / Actual			
In-country/Third country Training	Plan / Actual			

Activities / Sub-Activities	Plan / Actual	Responsible Organization: Japan	GOTL	Achievements	Issue & Countermeasures
Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget					
1.1 To review existing management structure and condition of maintenance and rehabilitation for major roads	Plan / Actual			Orgaization and personal exchange have been proposed at 3rd JCC	
1.2 To conduct the periodic/routine inspection	Plan / Actual			Inspection plan for 2018 and IRI inspection system were proposed in 3rd JCC.	Issue: As result of the Parliament election, regime change was occurred. Due to political factor, budget plan for 2018 was rejected. Activities of 1.2, 1.3, 1.4, 1.6 will be delayed. Countermeasure: 2018 inspection work will carry out with integration working members of Dept. Project and Dept. Maintenance in order to increase work efficiency.
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	Plan / Actual			2017 inspection raw data were inputted into GIS database.(67.5km)	
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan / Actual			2018 budget plan for maintenance was formulated based on inspection	
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	Plan / Actual			Emergency inspection on A02 at Jakarta II in Ainaro was conducted.	
1.6 To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget	Plan / Actual				
1.7 To propose appropriate framework of road maintenance/rehabilitation for major roads	Plan / Actual			Integration work among the both department of Construction and	
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope protections					
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	Plan / Actual			2 case study sites and action plan for each site were proposed in 3rd JCC. (totally 6 sites were identified.)	
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	Plan / Actual			Safety lecture and observation/practicing safety event were conducted; OJT on mass movement data collection by	
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	Plan / Actual			Check list for quality control have been proposed during 3rd JCC	
Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.					
3.1 To review existing technical documents for road maintenance and rehabilitation	Plan / Actual				
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works	Plan / Actual				
3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies	Plan / Actual			Classroom lectures on share strength test and penetration test by 'Dokenbo', groin study were conducted.	
3.4 To prepare the technical guideline of investigation and design	Plan / Actual			Draft guide line of scouring measures and cross culvert design have been prepared	
3.5 To reflect the lessons learned from case studies to the technical guideline	Plan / Actual				
3.6 To disseminate the technical guideline for concerned parties	Plan / Actual				
Duration / Phasing	Plan / Actual				

Monitoring Plan	Plan / Actual	Remarks	Issue	Solution
Monitoring				
Joint Coordination Committee	Plan / Actual		-	-
Set-up the Detailed Plan of Operation	Plan / Actual		-	-
Submission of Monitoring Sheet	Plan / Actual		-	-
Joint Monitoring	Plan / Actual		-	-
Post Monitoring	Plan / Actual			
Reports/Documents				
Technical Guideline	Plan / Actual			
Project Completion Report	Plan / Actual			
Public Relations	Plan / Actual			

TO CR of JICA Timor-Leste OFFICE

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Version of the Sheet: Ver.6（Term: July, 2018 – October, 2018）

Name: Hisashi MUTO

Title: Team Leader/ Road Maintenance1

Submission Date: 31st October, 2018

< I. Summary (all achievements are as of 31st October, 2018) >

1. Progress

1-1 Progress of Inputs

1-1-1 Japanese side

< Short-term experts dispatched to Timor-Leste>

NO	Name	Title	Dispatched Period to Timor-Leste	Changes or delay
1	Hisashi MUTO	Team Leader/ Road Maintenance 1	(1st) 8th Mar – 10th Apr, 2016 (2nd) 14th Jun – 25th Jun, 2016 (3rd) 1st Sep – 18th Sep, 2016 (4th) 23rd Jan – 19th Feb,2017 (5th) 24th Mar – 2nd Apr, 2017 (6th) 18th Aug – 10th Sep, 2017 (7th) 24th Nov – 14th Dec, 2017 (8th) 2nd Feb – 4th Mar, 2018 (9th) 8th Jun – 1st Jul, 2018 (10th)19th Sep – 12th Oct, 2018	None
2	Makoto MATSUURA	Deputy Team Leader/ Road Maintenance 2	(1st) 8th Mar – 15th Apr, 2016 (2nd) 14th Jun – 13th Jul, 2016 (3rd) 20th Sep – 14th Oct,2016 (4th) 1st Dec – 16th Dec,2016 (5th) 23rd Jan – 19th Feb,2017	None
3	Mitsuhide SAITO	Deputy Team Leader/ Road Maintenance 2	(1st) 24th Mar – 9th Apr, 2017 (2nd) 9th Jun – 25th Jun, 2017 (3rd) 16th Oct – 12th Nov,2017 (4th) 16th Feb – 11th Mar,2018 (5th) 26th Apr – 16th May,2018	Note: Mr. Mitsuhide Saito replaced Mr. Matsuura in

			(6th) 7th Sep – 28th Sep,2018	Deputy Team Leader post.
4	Johji KOIZUMI	Road Construction Supervision	(1st) 19th Jul – 17th Aug, 2016 (2nd) 24th Sep – 14th Oct,2016 (3rd)19th Jun – 5th Jul, 2017 (4th) 21st Aug – 4th Oct,2017 (5th) 14th Nov – 21st Dec,2017 (6th) 30th Jan – 4th Mar, 2018 (7th) 8th Jun – 1st Jul, 2018 (8th) 7th Sep – 13th Oct, 2018	None
5	Sueo HIROSE	Quality Control/ Road Repair	(1st) 28th Mar – 17th Apr, 2016 (2nd)13th May – 11th Jun, 2016 (3rd) 14th Aug – 12th Sep, 2016 (4th) 7th Oct – 14th Oct, 2016 (5th) 23rd Jan – 22nd Feb,2017 (6th) 4th Aug – 3rd Sep, 2017 (7th) 16th Feb – 18th Mar, 2018	None
6	Shutaro SAKANAKA	Disaster Restoration	(1st) 11th May – 31st May, 2016 (2nd) 28th Jun – 21st Jul, 2016 (3rd) 12th Sep – 6th Oct, 2016 (4th) 13th Feb – 8th Mar, 2017 (5th) 17th Apr – 7th May, 2017 (6th) 23rd Oct – 12th Nov, 2017 (7th) 16th Jan – 4th Feb, 2018 (8th) 2nd Mar – 18th Mar, 2018 (9th) 1st Jun – 17th Jun, 2018	None
7	Kazuharu KOISHIKAWA	Disaster Restoration2	(1st) 3rd Mar – 25th Mar, 2018 (2nd) 15th Jun – 8th Jul, 2018 (3rd) 7th Sep – 30th Sep, 2018	Note: Disaster Restoration 2 has been created as new position; Mr. Koishikawa was assigned for

				this position in March 2018.
8	Yoshiyuki AKAGAWA	Road Design/ Project Coordinator	(1st) 17th Mar – 15th Sep, 2016 (2nd) 21st Jun – 13th Jul, 2016 (3rd) 12th Sep – 6th Oct, 2016 (4th) 13th Feb – 5th Mar, 2017	None
9	Nicholas BROOKER-JONES	Road Design/ Project Coordinator	(1st) 31st Jul – 30th Aug, 2017 (2nd) 16th Oct – 23rd Nov, 2017 (3rd) 2nd Feb – 4th Mar, 2018 (4th) 8th Jun – 1st Jul, 2018 (5th) 7th Sep – 30th Sep, 2018	Note: Mr. Brooker-Jones replaced Mr. Akagawa in Project Coordinator post.
10	Kenji MINEGISHI	Structure Design	(1st) 5th Apr – 24th Apr, 2016 (2nd) 5th Jul – 4th Aug, 2016 (3rd) 14th Nov – 13th Dec,2016 (4th) 12th May – 11th Jun, 2017 (5th) 1st Sep – 1st Oct,2017 (6th) 3rd Nov – 17th Dec, 2017 (7th) 6th Apr – 13th May, 2018 (8th) 24th Aug – 30th Sep, 2018	None
11	Takashi SAITO	Database	(1st) 19th Jul – 24th Aug, 2016 (2nd) 3rd Oct – 14th Oct, 2016 (3rd) 13th Mar – 12th Apr, 2017 (4th) 16th Jun – 2nd Jul, 2017 (5th) 18th Aug – 1st Oct, 2017 (6th) 16th Feb – 4th Mar 2018 (7th) 5th May – 19th May, 2018 (8th) 28th Aug – 11th Oct, 2018	None
12	Masahiko HAYASHI	Landslide	(1st) 16th Jun – 28th June, 2017 (2nd) 27th Oct – 9th Dec, 2017 (3rd) 18th Mar – 18th Apr, 2018	Note: Activity on Landslide analysis was approved by 2nd JCC; Mr. Hayashi was

				assigned in June 2017.
13	Sohshi MIKAMI	Topographical Analysis	(1st) 19th Jun – 16th Jul, 2017 (2nd) 18th Mar – 18th Apr, 2018	Note: Activity on Landslide analysis was approved by 2nd JCC; Mr. Mikami was assigned in June 2017.
14	Nao TSUJIMURA	Evaluation/Monitoring	Resident in Timor-Leste	None

< Equipment and materials >

NO	Items	Qty	Unit price	Unit	Total amount
1	Desktop computer	1	1,150	USD	1,150
2	Inclinometer assembly	1	1,585,800	JPY	1,585,800
3	Borehole casing	1	404,400	JPY	404,400
4	Dokenbo assembly	1	133,000	JPY	133,000

(Remark: Equipment and materials which have a durable years for 2 years and are more than JPY 50,000 are listed.)

1-1-2 Timor-Leste side

- **Counterpart (C/P) personnel (from MPWTC and NDRBFC)**

NO	Name	Title of the Project	Engaged Period
1	Rui Hernani F. Guterres	Project Director	20th Feb 2018 to date
2	Milton Ramanata C. Monteiro	Project Manager	20th Feb 2018 to date
3	Joao Gama	C/P staff	8th Mar 2016 to date
4	Joao Pedro Amaral	C/P staff	8th Mar 2016 to date
5	Joao Gregorio	C/P staff	8th Mar 2016 to date

- **Equipment and materials for the project office**

NO	Items	Qty	Unit
1	Office space (including desks and chairs)	1	room

1-2 Progress of Activities

NO	Activity	Achievement level
1.2	To conduct periodic/routine inspection.	● Periodic/routine inspection has been done along A03 from Loes to Bobonaro and A04 from Tibar to Gleno; ● Road inspection using drive recorder has been conducted from Dili to Ermera and Dili to Maliana. ● Urban & national roads surveys were conducted by Project Department. After 3rd JCC, NDRBFC inspectors were practicing proposed data collection method with drive recorder; video data was used to re-confirm items and efficiency of the data collection was improved.
1.3	To update the database based on the inspection result and repair/rehabilitation works of road and bridges.	● JICA Expert Team conducted training about how to grasp geographic coordination on a map. ● JICA Expert Team trained staff of Maintenance Department about how to compile inspection results into GIS database continuously. After technical training, the inspection results for a total length of 82.7 km have been compiled into GIS database by trainees. ● Collected data from urban & national road surveys were inputted into GIS database (16.8 km).
1.4	To formulate maintenance and repair/rehabilitation plans for next cycle.	● Draft 2019 work plan for maintenance and rehabilitation was formulated based on inspection results.
1.5	To implement emergency inspections and repair/rehabilitation works when necessity arises.	● Emergency inspection on A03 at Loes River was conducted. ● After the inspection, JICA expert team held a seminar to suggest a countermeasure for river bank protection of Loes River.
1.6	To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited	● Based on inspection results, NDRBFC is preparing 5-year and 2019 annual plans.

<table>
<tr><td></td><td>budget.</td><td></td></tr>
<tr><td>2.2.</td><td>To conduct the case studies for the planning, design check and construction supervision of the project.</td><td>

JICA Expert Team and nominated NDRBFC technical staff conducted monitoring of the slope mass movement through data collection by inclinometer and underground water level indicator. (Site: Aituto landslide)
JICA Expert Team conducted safety lectures and observation/practicing safety event. During the coordination meetings, NDBRFC staff acted as the chairperson and committee members and then carried out site inspections using checklists for safety patrol. (Site: A02 bypass road named Ex. Japan Road)
JICA Expert Team organized training to make a plan for box culvert design. NDRBFC inter-departmental working group conducted workshop to present their culvert plan regarding 1) design flood catchment and 2) design capacity of culvert. Presented plan was made using the drafted guideline. (Site: Sarlala, Ex. Japan Road)
JICA Expert Team conducted explanation meeting to introduce drafted checklists to be utilized in each construction stage for 1) quality control, 2) safety control and 3) construction management. (Site: Humboe-Letefoho)
JICA Expert Team examined knowledge improvement of trained NDBRFC staff. The test results for each subject were as follows:

<table>
<tr><th>Subject</th><th>Number of the people whose test scores have improved after training</th></tr>
<tr><td>Landslide investigation</td><td>17 people out of 17</td></tr>
<tr><td>Bridge substructure protection
(Scouring and protection block)</td><td>5 people out of 14</td></tr>
<tr><td>Culvert planning and design</td><td>6 people out of 11</td></tr>
<tr><td>Quality control,
Safety control and
Construction management</td><td>N/A
Pre-test was given in June; the result of the re-examination after the training will be reported in next reporting period.</td></tr>
<tr><td>Slope protection</td><td>3 people out of 7</td></tr>
</table>
</td></tr>
<tr><td>3.3</td><td>To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies.</td><td>

JICA Expert Team provided classroom lectures about bridge substructure protection design along with the drafted guideline.
JICA Expert Team provided classroom lectures for box culvert planning & design along with the drafted

</td></tr>
</table>

		guideline. ● JICA Expert Team organized a workshop by a geologist from the Public Institute of Petroleum and Geology to introduce landslide phenomena of Timor-Leste and investigation procedure. ● Repeat lecture about operation of total station was provided by JICA Expert Team.
3.4	To prepare the technical guideline of investigation and design.	● Draft guidelines for slope protection, bridge substructure protection, culvert design, and landslide investigation have been prepared. ● Draft guidelines for slope protection, bridge substructure protection and culvert design have been submitted to NDRBFC and other entities.
3.5	To reflect the lessons learned from case studies to the technical guideline	● 4 focal points of NDRBFC were nominated to compile drafted guidelines. ● The 4th JCC approved activities to confirm the efficiency and applicability of drafted guidelines. Moreover, drafted guidelines will be introduced to projects other than case studies.

1-3 Achievement of Output

Indicators of Outputs		Achievement level
1.1	More than 30% of requested budget for road maintenance are distributed.	After the re-election, USD 1,000,000 was secured for road maintenance in 2018. However, this budget has been canceled because of insufficient implementation period. Distribution of the annual budget will be determined at the end of December 2018. Therefore achievement level of this output is not ready to be measured.
1.2	Improved road database is utilized for preparation of the annual work plan of road maintenance.	65% Proposed data collection method with drive recorder was adopted. However, volume of data was insufficient to measure its utilization. Moreover, improvement of the database is not ready to be measured.
2.1	At least 3 case studies for both construction and design are conducted. (Totally 6 case studies)	53% Case studies to improve the capacities of survey and design and safety control were conducted as planned. Implementation of case studies for construction management have been delayed due to delayed budget allocation. Those case studies will be conducted in the project extension period.
2.2	More than 60% of trainees pass the achievement test for construction supervision and design.	Baseline survey results showed that the percentage of examinees exceeded the passing line by respective subject was a) design: 28%, & b) quality control: 8%. In order to grasp the knowledge improvement of trained NDBRFC staff, JICA Expert Team gave mock exams continuously. The trainees' scores from the mock exams have been increasing step by step. The final achievement test will be given after the completion of the case studies. Therefore, achievement level of this output is not ready to be

		measured.
3	Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	72% Draft guidelines for slope protection, bridge substructure protection, culvert design, and landslide investigation have been prepared. However, checks for whether prepared guidelines can be utilized by NDBRFC have been insufficient. In order to confirm their efficiency and applicability, guidelines will be introduced to projects other than case studies as well as dissemination of guidelines will be conducted in project extension period.

1-4 Achievement of the Project Purpose

Indicators of Project Purpose	Achievement level
Total length of maintained national roads were became 400km.	Achievement level of this output is not ready to be measured.

1-5 Changes of Risks and Actions for Mitigation

1-6 Progress of Actions undertaken by JICA

- JICA Timor-Leste shared important information and documents with JICA Expert Team.
- JICA Timor-Leste assisted visa acquisition process for JICA Expert Team.

1-7 Progress of Actions undertaken by Gov. of Timor-Leste

- DRBFC shared necessary information and documents with JICA Expert Team.
- DRBFC has prepared the drawings of road and bridge maintenance based on the road inspection.

1-8 Progress of Environmental and Social Considerations (if applicable)

- No activities for the progress of Environmental and Social Considerations are undertaken.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

- Not Applicable so far.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors,

NGOs etc.)

- No other issues are confirmed so far.

2. Delay of Work Schedule and/or Problems (if any)

- Based on the PDM, the project activities have been implemented as planned.

3. Modification of the Project Implementation Plan

3-1 PO

- PO was modified after the 4th JCC. The latest version was ver.6.

3-2 Other modifications on detailed implementation plan

- General issue:
  As a result of the parliamentary election, a regime has change occurred. Due to political factors, the budget plan for 2018 was rejected. Under the influence of delayed budget allocation, implementation of activities 1.2, 1.3, 1.4, 1.6, 2.2, 2.3 and 3.5 has been delayed.

- Countermeasures have been taken by JICA Expert Team:
  1) In the coordination meeting between CDRS project and NDRBFC, CDRS Deputy Team Leader requested the Director of NDRBFC to prioritize allocation of the budget for the projects selected for case studies.
  2) CDRS team leader suggested to NDBRFC that the 2018 inspection work should be carried out by collaboration between relevant staff of Department of Project and Department of Maintenance in order to increase work efficiency with a limited budget.

- Modifications of implementation plan and project period:
  A 9-month extension of project term was approved at the 4th JCC. Those delayed activities mentioned above will be conducted during extension period.

4. Preparation of Gov. of Timor-Leste toward after completion of the Project

- The Gov. of Timor-Leste tries to secure the budget for road maintenance so that the capacity enhancement of NDRBFC for road maintenance which is the Project Purpose will be sustainable and contribute to the achievement of Overall Goal.

< II. Project Monitoring Sheet I & II >

- Project Monitoring Sheet I & II are attached as PM Form I and II.

Project Monitoring Sheet I （Revision of Project Design Matrix）

Version 4
Dated 31st October, 2018

Project Title: The Project for Capacity Development of Road Services in Timor-Leste (CDRS)
Implementing Agency: Ministry of Public Works, Transport and Communications
Target Group: Officials of Directorate of Roads, Bridges and Flood Control (DRBFC)
Period of Project: (Three (3) years and nine(9) month)
Project Site: Whole Timor-Leste **Model Site:**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal The maintenance conditions of major roads are improved in TL.	OG1 More than 60% of major national roads is in good	Periodic Road Inspection	Budget and staff will be secured at satisfactory levels. Traffic volume is not increased more than expected.	Indicator was set up and approved at 2nd JCC in February 2017.	9-month extension of project term was approved at 4th JCC.
Project Purpose Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	Total length of maintained national roads become 400km.	Periodic Road Inspection	Enough number of DRBFC staff in the HQs and regional offices is ensured as planned. Budget for road maintenance and management is ensured	Indicator was set up and approved at 2nd JCC in February 2017.	
Outputs Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.	1-1 More than 30% of requested budget for road maintenance are distributed. 1-2 Improved road database is utilized for preparing the annual work plan of road maintenance.	Budget Report Monitoring Sheet	Budget for road maintenance and management is ensured. The trained DRBFC personnel continue to work for the Project (They do not quit the Project) Unforeseen natural disasters will not occur which may destroy construction works under case studies.	1-1.N/A 1-2. 65%	9-month extension of project term was approved at 4th JCC.
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country.	2-1. At least 3 case studies for construction and 3 case studies for design are conducted (Totally 6 case studies). 2-2. More than 60 % of trainees pass the achievement	Monitoring Sheet Achievement test		2-1. 53% 2-2. N/A	
Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	3. Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	Technical guideline prepared		3. 72%	

Activities	Inputs: The Japanese Side	Inputs: The Timor-Leste Side	Pre-Conditions
1.1 To review existing management structure condition of maintenance and rehabilitation for major roads. 1.2 To conduct periodic/routine inspection. 1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges. 1.4 To formulate maintenance and repair/rehabilitation plans for next cycle. 1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises. 1.6 To undertake appropriate road maintenance/rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget. 1.7 To propose appropriate framework of road maintenance and rehabilitation for major roads. 2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies. 2.2 To conduct the case studies for the planning, design and construction supervision of the project. 2.3 To propose preferable structures for construction management for repair/rehabilitation and maintenance works through case studies. 3.1 To review existing technical documents for road maintenance and rehabilitation. 3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works. 3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and 3.4 To prepare the technical guideline of investigation and design. 3.5 To reflect the lessons learned from case studies to the technical guideline. 3.6 To disseminate the technical guideline for concerned parties.	1. Dispatch of the Japanese experts Short-term experts: - Team leader / Road maintenance 1 - Deputy team leader / Road maintenance 2 - Road construction supervision - Quality control / Road repair - Disaster restoration - Road design / Project coordinator - Structure design - Database - Evaluation / Monitoring - Other areas if needed 2. Facilities and equipment In accordance with necessity of activities 3. Training in Japan In accordance with necessity of activities	1. Assignment of C/Ps - Project Director - Project Manager - DRBFC Staff 2. Assignment of Trainees In accordance of necessity 3. Facilities and Equipment - Project office Equipment and tools 4. Recurrent costs - Expenses for equipment maintenance - Spare parts - Transportation fees of C/Ps and trainees - Expenses for contract-out of works - Necessary expenditures for case studies - C/Ps' wages and allowances	DRBFC's budget necessary for the Project is allocated by TL government. <Issues and countermeasures> Issue: As a result of the second parliamentary election, regime change has occurred. Implementation of activities 1.2, 1.3, 1.4, 1.6, 2.2, 2.3 and 5.5 have been delayed due to delayed budget allocation. Countermeasure: 1) In the coordination meeting between CDRS project and C/P, CDRS deputy team leader requested the director of DRBFC to prioritize allocation of budget for the projects selected for case studies. 2) 2018 inspection work were carried out with integration of relevant staff of Dept. Project and Dept. Maintenance in order to increase work efficiency with limited budget. 3) 9-month extension of project term was approved at 4th JCC; delayed activities mentioned above will be conducted during extension period.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 6
Dated 31st October, 2018

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste(CDRS)

Schedule columns: 2016, 2017, 2018, 2019, 2020 (quarters Ⅰ Ⅱ Ⅲ Ⅳ each)

Inputs	Plan / Actual	Remarks	Monitoring: Issue	Monitoring: Solution
Expert				
Team Leader/Road Maintenance 1 /Mr. Hisashi MUTO	Plan / Modify / Actual		-	-
Deputy Team Leader/Road Maintenance 2 /Mr. Makoto MATSUURA	Plan / Actual		2017 March, Mr. Matsuura resigned.	Mr. Mitsuhide Saito was dispatched as successor of Mr. Matsuura.
Deputy Team Leader/Road Maintenance 2 /Mr. Mitsuhide SAITO	Plan / Modify / Actual	Mr. Mitsuhide Saito replaced Mr. Matsuura in Deputy	-	-
Road Construction Supervision /Mr. Johji KOIZUMI	Plan / Modify / Actual		-	-
Quality Control/Road Repair /Mr. Sueo HIROSE	Plan / Modify / Actual		-	-
Disaster Restoration /Mr. Shutaro SAKANAKA	Plan / Actual		-	-
Disaster Restoration 2 /Mr. Kazuharu KOISHIKAWA	Plan / Modify / Actual		This position has been created to assist drafting guidelines.	Mr. Koishikawa was assigned for this position in March 2018.
Road Design/Project Coordinator /Mr. Yoshiyuki AKAGAWA	Plan / Actual		2017 July, Mr. Akagawa resigned.	Mr. Brooker-Jones was dispatched as successor of Mr. Akagawa.
Road Design/Project Coordinator /Mr. Nicholas BROOKER-JONES	Plan / Modify / Actual	Mr. Brooker-Jones replaced Mr. Akagawa in Project	-	-
Structure Design /Mr. Kenji MINEGISHI	Plan / Modify / Actual		-	-
Database /Mr. Takashi SAITO	Plan / Modify / Actual		-	-
Landslide /Mr. Masahiko HAYASHI	Plan / Actual	Activity on Landslide analysis was	-	-
Topographical Analysis /Mr. Sohshi MIKAMI	Plan / Actual	Activity on Landslide analysis was	-	-
Evaluation/Monitoring Ms. Nao TSUJIMURA	Plan / Modify / Actual		-	-
Equipment				
Desktop computer	Plan / Actual	Office use		
Inclinometer assembly	Plan / Actual	These equipments purchased to monitor landslide mass movement		
Borehole casing	Plan / Actual			
Dokenbo assembly	Plan / Actual	Test equipment to grasp land penetration.		
	Plan / Actual			
Training in Japan				
	Plan / Actual			
In-country/Third country Training				
	Plan / Actual			

Activities / Sub-Activities	Plan / Actual	Responsible Organization (Japan / GOTL)	Achievements	Issue & Countermeasures
Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.				
1.1 To review existing management structure and condition of maintenance and rehabilitation for major roads	Plan / Actual (done)	JICA expert team	Organizational and personnel exchanges were proposed at 3rd JCC.	
1.2 To conduct the periodic/routine inspection	Plan / Modify / Actual	GOTL: NDRBFC Dept. Maintenance and Dept. Project	1) Periodic/routine inspection has been done along A03 from Loes to Maliana; 2) Road inspection using drive recorder has been conducted from Dili to Ermera, Dili to Maliana. 3) Urban & national road surveys were conducted by Dept. Project.	Issue: As a result of the parliamentary election, regime change occurred. Due to political factors, budget plan for 2018 was rejected. Activities of 1.2, 1.3, 1.4, 1.6 have been delayed. Countermeasure: 1) 2018 inspection work will be carried out by collaboration between relevant staff of Dept. Project and Dept. Maintenance in order to increase work efficiency. 2) Extension of project term was approved at 4th JCC; those delayed activities will be conducted during extension period.
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	Plan / Modify / Actual	NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	1) Collected data from urban & national road surveys were inputted into GIS database (16.8 km);	
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan / Modify / Actual	NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	Draft 2019 work plan for maintenance and rehabilitation were formulated based on inspection results.	
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	Plan / Modify / Actual	NDRBFC; JICA expert team assists this activity.	Emergency inspection on A03 at Loes River was conducted; JICA expert team suggested countermeasure for river bank protection.	
1.6 To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget	Plan / Modify / Actual	NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	Based on inspection results NDRBFC prepared draft 5-year and 2019 annual plans.	
1.7 To propose appropriate framework of road maintenance/rehabilitation for major roads	Plan / Modify / Actual	JICA expert team	Integration of work between Dept. Construction and Dept. Maintenance in order to strengthen maintenance capacity was proposed at 3rd JCC.	
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope protections				
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	Plan / Actual (done)	JICA expert team	2 case study sites and action plan for each site were proposed in 3rd JCC and TL stakeholders approved the proposal. (totally 6 sites were identified.)	
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	Plan / Modify / Actual	Responsibility of TL government: secure budget for the projects which were selected for case studies.	Safety lectures and observation/practicing safety event were conducted; OJT on mass movement data collection by inclinometer was conducted; Lectures about mix design of asphalt concrete and quality control of asphalt concrete were delivered; Workshop of culvert planning was conducted; Drafted checklists were introduced.	Issue: 2.2, 2.3 have been delayed due to delayed budget allocation. Countermeasure: 1) In the coordination meeting between CDRS project and C/P, CDRS deputy team leader requested the director of DRBFC to prioritize allocation of budget for the projects selected for case studies. 2) Extension of project term was approved at 4th JCC; those delayed activities will be conducted during extension period.
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	Plan / Modify / Actual	JICA expert team		
Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.				
3.1 To review existing technical documents for road maintenance and rehabilitation	Plan / Actual (done)	JICA expert team	JICA expert team reviewed existing technical documents, such as specifications and drawings from past projects.	
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works	Plan / Actual (done)	JICA expert team	JICA expert team identified factors affecting structural failure / road damage using baseline survey results and road inspection results.	
3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies	Plan / Actual (done)	JICA expert team	Classroom lectures for civil engineering design were implemented on schedule. Repeat lecture about operation of total station was provided.	
3.4 To prepare the technical guideline of investigation and design	Plan / Actual	JICA expert team	Draft guidelines for slope protection, bridge substructure protection and culvert design have been prepared.	
3.5 To reflect the lessons learned from case studies to the technical guideline	Plan / Modify / Actual	NDRBFC Dept. Project, chief of planning section and JICA expert team		Issue: Checks for whether prepared guidelines (on slope protection, bridge substructure protection and culvert design) can be utilized by C/P have been insufficient. Countermeasure: In order to confirm their efficiency and applicability, guidelines will be introduced to projects other than case studies.
3.6 To disseminate the technical guideline for concerned parties	Plan / Modify / Actual	JICA expert team and C/P		
Duration / Phasing	Plan / Actual			

Monitoring Plan	Plan / Actual	Remarks	Issue	Solution
Monitoring				
Joint Coordination Committee	Plan / Modify / Actual	9-month extension of project period has been approved by 4th JCC. In the extension period, additional JCCs and monitoring activities will be conducted.	-	-
Set-up the Detailed Plan of Operation	Plan / Modify / Actual		-	-
Submission of Monitoring Sheet	Plan / Modify / Actual		Submission of monitoring sheet Ver.5 was delayed.	In order to improve project management, internal coordination meetings of CDRS expert team have been held.
Joint Monitoring	Plan / Modify / Actual		-	-
Post Monitoring	Plan / Actual			
	Plan / Actual			
Reports/Documents				
Technical Guideline	Plan / Modify / Actual	9-month extension of project period has been approved by 4th JCC.	Checks for whether prepared guidelines can be utilized by C/P have been insufficient.	During extension period, guidelines will be introduced to projects other than case studies.
Project Completion Report	Plan / Modify / Actual		Project completion will be postponed.	Submission of project completion report will be postponed to December 2019.
Public Relations				
information to road users	Plan / Actual			
Event or opening ceremony for a OJT site	Plan / Actual			
	Plan / Actual			

Attachment 1

Design Guideline for Bridge sub structure Protection in Timor Leste on 12 June 2018

Républica Democrática de Timor-Leste

DRAFT

Bridge Substructure Protection Guidelines

WD stage

Contents

Design Guideline
For
Bridge Substructure Protection
In
Timor-Leste

June 2018

Presented By :
1. Letigia Dos Reis Hanjan Corbafo
2. Julius Kehi
3. Antonio Araujo

Outline of the Presentation

I. Introduction
II. Objective
III. Characteristics of rivers in Timor-Leste
IV. Damage of bridge substructures in Timor-Leste
V. Hydraulic phenomena around bridge pier
VI. Study of bridge substructure and scour depth
VII. Study for protection of bridge substructure

I. Introduction

- Bridges are easily damaged during flooding periods and there are caving and settlement damage at the bottom of abutments and piers
- When bridges are repeatedly damaged and then repaired with each flood, this increases lifecycle cost
- The lack of Maintenance program for bridge
- This design guideline primarily is prepared according to Japanese technical standards for countermeasures to protect bridge substructures from flood scour

II. Objective of the design guideline

Objective

- To improve the design of countermeasure for bridge protection substructure from flood scour
- To reduce flood scour damage to bridge substructure in Timor-Leste

III. Characteristics of majority of Rivers in Timor-Leste

- Rivers in Timor-Leste are located in the mountainous area, at an altitude of 1000m to 2000m
- The average annual rainfall in the northern region of Timor-Leste is approximately 1000mm to 2000mm and in the southern region it is 1500 mm to 2000 mm
- The length of their rivers is short and share many natural characteristics with rivers in Japan

IV. Condition of Bridges Substructure in Timor Leste

- The following figures show the scouring damage of sahen Bridges right bank abutment and pier.

Figure 1. Sahen bridge abutment 2017

Figure 2. Sahen bridge pier 2017

- Figures 3 and 4 show the scouring damage of Mola Bridges Pier. Due to scouring damage, the caving of the footing can be seen

Figure 3. Mola bridge abutment 2011

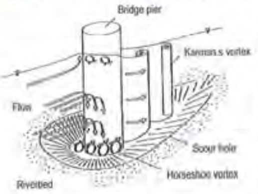
Figure 4. Mola bridge abutment 2011

❖ If appropriate countermeasure are not applied out and scouring is allowed to progress into the long term,overall bridge settlement damage (as can see in figure 5,6) is likely to occur

Figure. 5 Bridge settlement damage due to bridge pier scouring (Japan Example)

Figure. 6 Bridge settlement damange due to bridge pier scouring (Japan Example)

V. Hydraulic Phenomena Around Bridge Pier



- The figure shows the hydraulic phenomenon that occurs around bridge piers during flood.
- Bridge piers located in a river cause complex vortices and waves that disturb the flow and water surface during flood; as a result, an increase in water level and riverbed scouring occur

Hydraulic Phenomenal around bridge pier (Japan Example)

The figure show the actual phenomenon around a bridge pier during floods.the occurrences of complex flow around the bridges pier apparent.

The figure show the state of scour on bridge pier after a flood in Japan.The flood caused a scour hole to form around the bridge pier

VI. Study of Bridge Substructure Scour Depth

1. **Scour depth around bridge pier**

$$\frac{Z}{D}=f\cdot\left(\frac{h0}{D}\cdot\frac{h0}{dm}\cdot Fr\right)$$

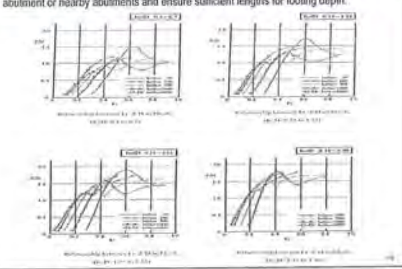
h_0 : Average water depth
D : Diameter of bridge pier
dm : Average grain diameter of riverbed material
Fr : Froude number
Z : Scour depth

Step1
Calculate the dimensionless scour depth Z/D using the target locations average water depth h0, the diameter of bridge pier D, average grain diameter of riverbed material dm, and Froude number Fr

Step 2
The resulting Z/D should be corrected for changes in flow direction due to flooding or nearby bridge piers. After these corrections, the depth of scour hole around a bridge pier can be calculated.

2. Scour depth around abutments

Timor-Leste have short lengths for the footings depth of their abutments, so when new bridges are being planned, it is necessary to conduct the field investigations of the abutment or nearby abutments and ensure sufficient lengths for footing depth.



3. Calculation Example

Calculation Condition

High water level ; 24.80 m
Design river bed ; 18.97 m
Diameter bridge pier (D) = 2.0 m
Average grain diameter of riverbed material (dm) = 24.9 mm
Froude number (Fr) = 0.54

Figure 1 Cross Section

Study Process

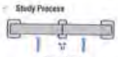


Figure 2 Plan

Average Water depth $h_0 = 24.80 - 18.97 = 5.83\ m$

$\frac{h_0}{D} = \frac{5.83}{2.0} = 2.915$

$\frac{h_0}{dm} = \frac{5.83}{0.0249} = 234.91$

Z/D= 1.5 (Refer to right figure)

Scour depth $Z = (Z/D)\cdot D = 1.5 \times 2.0 = 3.0\ m$

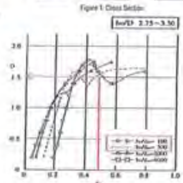


Figure 3 Relationship between Fr~Z/D

VII. Study for Protection of Bridge Substructure

There are two types of protection work:Gabion and foot protection block.However, due to issues with the durability(due to deteriotation, etc) of the metal wire use for gabion,it is recommended to that Timor Leste take the same approach as Japan and use Foot Protection

Gabion damaged situation Mota 2011

Foot Protection blocks in Japan

Foot Protection Blocks in Japan

Types of foot protection block

Types of foot protection blocks in Japan

Calculation of weight of food Protection blocks

The formula is used in Japan to calculate the necessary weight of foot protection blocks.

$$W > a\left(\frac{\rho w}{\rho b-\rho w}\right)^3 \frac{\rho b}{g^2}\left(\frac{Vm}{\beta}\right)^6$$

where

W	is the weight of foot protection block
a	is the factor of foot protection block shape
β	is the factor of setting type
Vm	is the average velocity
ρw:	is the density of water: (980 kg/m³)
ρb	is the density of blocks (2030 kg/m³)
g	is the acceleration of gravity (9.8 m/s²)

Table Factor of α and β

Shape of block	specific gravity ρb/ρw	$a \times 10^{-4}$	β
Type A: Projection	2.22	1.2	1.5
Type B: Plane	2.03	0.54	2.0
Type C: Triangular conic	2.35	0.83	1.4
Type D: Triangular bearing	2.25	0.45	2.3
Type E: Rectangle	2.09	0.79	2.8

Calculation Example for weight of foot Protection Block

- **Calculation Condition**

$$W > a\left(\frac{\rho w}{\rho b-\rho w}\right)^3 \frac{\rho b}{g^2}\left(\frac{Vm}{\beta}\right)^6$$

Here

W		is the weight of foot protection block
Vm	5.1m/s	is the river velocity;
Shape	Type B	is the block type;
α	0.54	is the block factor;
β	2.0	is the block factor;
ρw	980kg/m³	is the density of water
ρb	2030kg/m³	is the density of block
g	9.8m/s²	is the acceleration of gravity

- **Now W can be calculated as follows**

$$W > a\left(\frac{\rho w}{\rho b-\rho w}\right)^3 \frac{\rho b}{g^2}\left(\frac{Vm}{\beta}\right)^6$$

$$W = 0.54 \times \left(\frac{1000}{2030-1000}\right)^3 \times \frac{2030}{9.8^2} \times \left(\frac{5.1}{2}\right)^6$$

$W = 2872\ N$

$W = 293\ kg$

Average Velocity

The flow velocity used I the calculation of foot protection block weight is calculated using the manning formula for calculating the average velocity. The roughness coefficient is selected from the table below based on the conditions at the target river site.

[illegible]	[illegible]
[illegible]	[illegible]

Table. Revised Ministry of Construction River and Erosion Control standard (draft) Japan 1997,Survey Section P131

Step 1

Set up of river flow velocity

How to set up velocity of Loes river

↓

Manning formula

Manning's formula

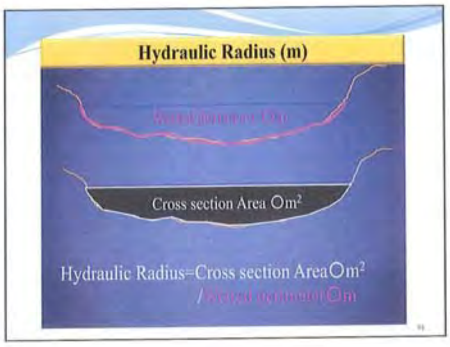
$$V = \frac{1}{n} \times R^{\frac{2}{3}} \times I^{1/2}$$

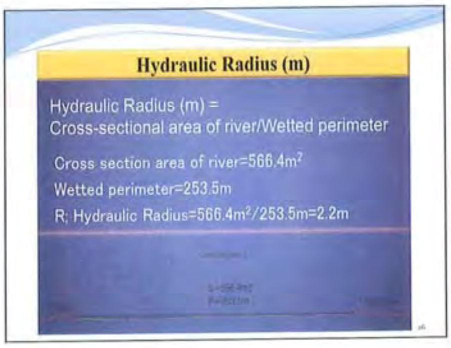
V: Flow velocity (m/s)
n: Coefficient of roughness
R: Hydraulic radius (m) = Cross-sectional area of river/Wetted perimeter
I: Riverbed gradient

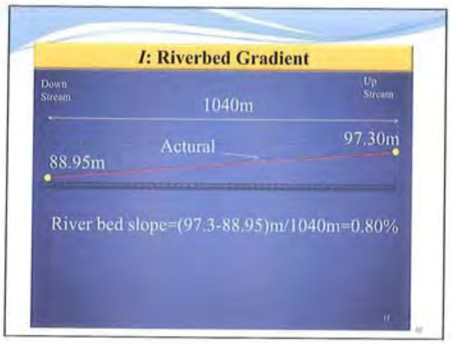
N: Coefficient of roughness

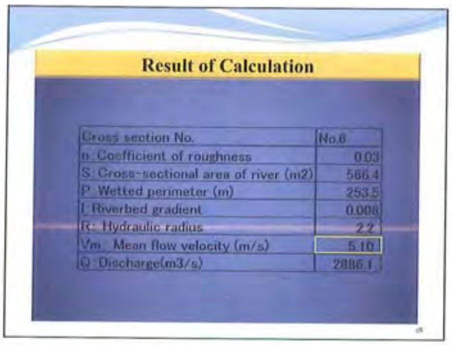
River or channel conditions		Scope of Manning's n
[illegible]	Concrete artificial channel	0.014~0.020
	Spiral half-pipe channel	0.021~0.030
	Channel with stone masonry on both banks (mud bed)	0.025 (mean value)
	Bedrock excavation	0.035~0.05
	Bedrock forming	0.025~0.04
	Clay riverbed with flow velocity not enough to cause scouring	0.016~0.022
	Sandy loam, clayey soil loam	0.020 (mean value)
	Drag line dredging, little weeds	0.025~0.033
[illegible]	Small channel on plain, with no grass	0.025~0.033
	Small channel on plain, with grass and shrubs	0.030~0.040
	Small channel on plain, with lots of grass and gravel bed	0.040~0.055
	Mountain channel, with gravel and boulders	0.030~0.050
	Mountain channel, with boulders and large boulders	0.040 or higher
	Large channel, with sandy bed and little meandering	0.018~0.035
	Large channel, with gravel bed	0.025~0.040

Source: Revised Ministry of Construction River and Erosion Control Standard (draft) 1997









Cross section No.	No.6
n:Coefficient of roughness	0.03
S:Cross-sectional area of river (m2)	566.4
P:Wetted perimeter (m)	253.5
I:Riverbed gradient	0.008
R: Hydraulic radius	2.2
Vm : Mean flow velocity (m/s)	5.10
Q:Discharge(m3/s)	2886.1

Attachment 2

Groin Study Using Loes River on 13 June 2018

The Project
for
Capacity Development of Road Services
in
the Democratic Republic of Timor-Leste

Training No.4 Groin Study

November 2017

JICA Expert Teams

Self-introduction

Name: Shutaro SAKANAKA

Specialized field: River Plan and River Design
Disaster Management
Disaster Restoration

E-mail: sakanaka@oriconsul.com

Today's Training

Groin Study using Loes River

Morphological Change

Damage of embankment

Groin Study Step

Step 1

Set of River Flow Velocity

Step 2

Study of Groin Structure

Step 1

Set up of river flow velocity

How to set up Velocity of Loes River

↓

Manning formula

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Manning's formula

$V = \frac{1}{n} \times R^{\frac{2}{3}} \times I^{1/2}$

V: Flow velocity (m/s)
n: Coefficient of roughness
R: Hydraulic radius (m) = Cross-sectional area of river/Wetted perimeter
I: Riverbed gradient

10

N: Coefficient of roughness

	River or channel conditions	Scope of Manning's n
Artificial channel, improved river	Concrete artificial channel	0.014~0.020
	Spiral half-pipe channel	0.021~0.030
	Channel with stone masonry on both banks (mud bed)	0.025 (mean value)
	Bedrock excavation	0.035~0.05
	Bedrock forming	0.025~0.04
	Clay riverbed with flow velocity not enough to cause scouring	0.016~0.022
	Sandy loam, clayey soil loam	0.020 (mean value)
	Drag line dredging, little weeds	0.025~0.033
Natural river	Small channel on plain, with no grass	0.025~0.033
	Small channel on plain, with grass and shrubs	0.030~0.040
	Small channel on plain, with lots of grass and gravel bed	0.040~0.055
	Mountain channel, with gravel and boulders	0.030~0.050
	Mountain channel, with boulders and large boulders	0.040 or higher
	Large channel, with sandy bed and little meandering	0.018~0.035
	Large channel, with gravel bed	0.025~0.040

Source: Revised Ministry of Construction River and Erosion Control Standard (draft) 1997

11

Hydraulic Radius (m)

Hydraulic Radius=Cross section Area○m² /Wetted perimeter○m

12

Hydraulic Radius (m)

Hydraulic Radius (m) =
Cross-sectional area of river/Wetted perimeter

Cross section area of river=5417.9m²
Wetted perimeter=503.4m

R: Hydraulic Radius=5417.9m²/503.4m=10.762m

13

I: Riverbed Gradient

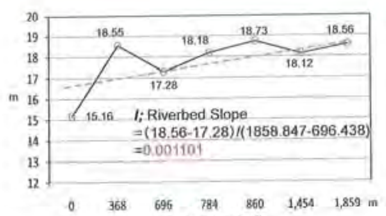


Figure Riverbed Profile

Result of Calculation

Cross section No.	
n: Coefficient of roughness	0.035
S: Cross-sectional area of river (m2)	5417.9
P: Wetted perimeter (m)	503.4
I: Riverbed gradient	0.001101
R: Hydraulic radius	10.8
Vm: Mean flow velocity (m/s)	4.62

15

Step 2

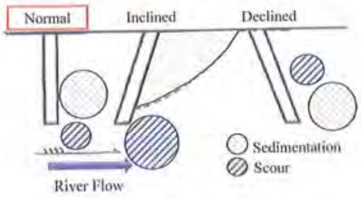
Study of Groin Structure

16

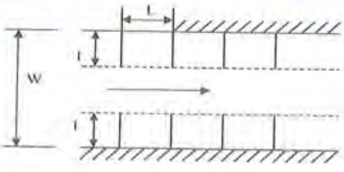
Comparison of Groin Structure Type

Table1 Comparison of Groin

Set of Direction Type of Groin



Set of Length and Interval of Groin



W: River Width=350m

l: Length of Groin (l<w/10)=350/10≦35m Selection 14m

L: Interval of Groin L=(1.5～2.0) ×l=20 ×2=40m

Set of Groin Height

Groin Height=
River Depth 2.0m (Field Survey)+0.5m=2.5m

Set of Groin Weight

$$Dm = \frac{V0^2}{E1^2 \times 2g\left[\frac{\rho s}{\rho w}-1\right]}$$

Dm: diameter of stone
V_0: Average velocity=4.62m/s
G: Acceleration of gravity=9.8m/s
Pw: Density of water
ρs/ρw=2.65
E1=Factor of Strength turbulence=1.20

Source: Dynamically Design Method on Revetment, 2007, Japan

Set of Groin diameter

$$Dm = \frac{V0^2}{E1^2 \times 2g\left[\frac{\rho s}{\rho w}-1\right]}$$

⇩

$$Dm = \frac{4.62^2}{1.2^2 \times 2 \times 9.8[2.65-1]}$$

$Dm = 0.46m\,(Diameter)$

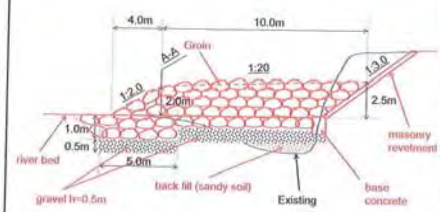
Radius=0.46/2=0.23m

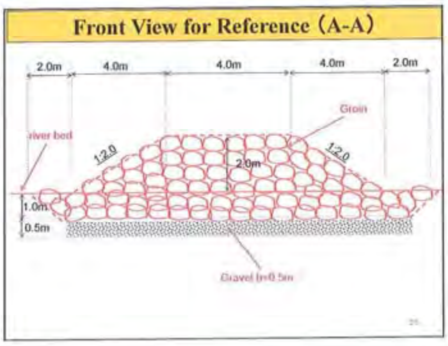
Set of Groin Weight

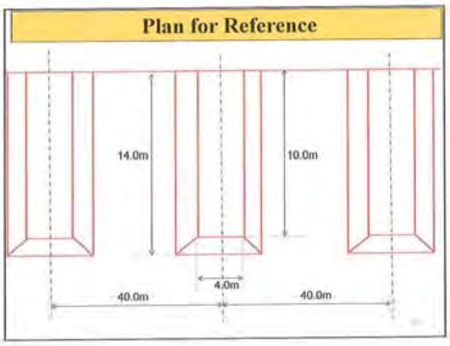
$W=\frac{4}{3} \times \pi \times r^3 \times \frac{\rho s}{\rho w}$ *(Globe formula)*
$=4/3 \times 3.14 \times 0.23^3 \times 2.65$
=134.9kg

i.e. Adoption Weight=200kg

Standard Cross Section for Reference




Front View for Reference (A-A)
2.0m
4.0m
4.0m
4.0m
2.0m
Groin
river bed
1:2.0
2.0m
1:2.0
1.0m
0.5m
Gravel (t=0.5m)


Plan for Reference
14.0m
10.0m
4.0m
40.0m
40.0m


Plan for Reference
Google Earth


Thank you very much for your kind attention!
30

Attachment 3

Explanation of Guideline for Box Culvert planning and Design on 21st June 2018

República Democrática de Timor-Leste

Ministério de Desenvolvimento e de Reforma Institucional

Ministério Geral das Obras Públicas

Direcção Nacional de Estradas, Pontes e Controlo de Cheias

Road Guidelines — Drainage — Culvert Design

Diretrizes Rodoviárias — Drenagem — Desenho de Alcatrão

DG stage

Warning

This document is not a Timor-Leste Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as a National Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Document type: Technical Specification
Document subtype:
Document stage: (DG) Draft Guideline
Document language: E

Contents

Foreword

In the interest of constructing high quality and economically viable government infrastructure to serve the nation, this guideline for optimal design of drainage components was prepared by the JICA Project for Capacity Development of Road Services in the Independent Republic of Timor-Leste (CDRS) in collaboration with the Direcção Nacional de Estradas, Pontes e Controlo de Cheias (DNEPCC, 'National Directorate of Roads, Bridges and Flood Control') of the Ministério Geral das Obras Públicas ('Ministry of Public Works'). We would like to thank JICA for their continuing support.

September, 2018

His Excellency —

Minister for Development and Institutional Reform

Ministério de Desenvolvimento e de Reforma Institucional

Japan International Cooperation Agency (JICA) has been conducting a technical cooperation project for development of capacity regarding road services, which is called CDRS, in order to facilitate the DNEPCC in properly managing and maintaining the road infrastructure that is the basis of social and economic activities. To this end, JICA has been dispatching a team of experts from March 2016 to August 2019. As a result of collaborative work with counterparts of the DNEPCC, this guideline for design of culverts has been finalized. I hope that this guideline will contribute to infrastructure development and maintenance, and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government of the Democratic Republic of Timor-Leste for their close cooperation with the expert team.

September, 2018

Masafumi NAGAISHI

Chief Representative of JICA Timor-Leste Office

Japan International Cooperation Agency

Acknowledgements

The Project for Capacity Development of Road Services in the Independent Republic of Timor-Leste wishes to thank all parties involved in preparing and revising the Culvert Design guideline.

In support of the project, the officials of the Ministry of Development and Institutional Reform: M. R. M. Cruz, J. L. C. C. P. Mestre and J. Santos; and the officials of the Ministry of Public Works: C. M. Henrique and especially R. H. F. Guierres; are hereby acknowledged.

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In addition, the Seeds of Life Program: S. Bacon is hereby acknowledged.

Feedback:

Any positive feedback for possible incorporation into future editions would be appreciated. Please send such comments or feedback to the below address.

CDRSsahen@gmail.com

Direcção Nacional de Estradas, Pontes e Controlo de Cheias (DNEPCC)
Address: Avenida da Restauração, Rai Kotuk, Comoro, Dili, Timor-Leste
Telephone: +670 3311408

Introduction

This guideline was developed by JICA Project for Capacity Development of Road Services in the Independent Republic of Timor-Leste in collaboration with the *Direcção Nacional de Estradas, Pontes e Controlo de Cheias* (DNEPCC, 'National Directorate of Roads, Bridges and Flood Control') for the purpose of developing institutional capacity regarding drainage design of cross culverts.

The purpose of drainage design is to ensure reasonable capacity of drainage facilities, which means specifying culverts with sufficient drainage capacity to accommodate probable volumes of stormwater and at reasonable construction costs compared to their benefit to economic activities. Within the context of road crossings, the purpose of box culverts is to ensure the protection of road structures and road users.

The chronology of editions are as follows:

— First edition in English September 2018

The main changes compared to the previous edition are as follows:

— No changes

Road Guidelines — Drainage — Culvert Design

1 Scope

This guideline aims to provide practical information for planning and design of box culverts for the purpose of culvert construction or reconstruction. This guideline does not cover culvert rehabilitation or repair. The design methodologies presented here have been recommended on the basis that they are easy in application and consistent in approach.

For information regarding construction and maintenance on site, please see the relevant section in the *Standard Specifications* (Section 600 – Drainage and Slope Protection Structures) (1).

The language used in this guideline is generally Latinate to facilitate comprehension by the engineers of the directorate.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standard Specifications (2014) (1)

Bridge Design Manual (2010) (2)

Road Geometric Design Standards (2010) (3)

3 Terms and definitions

For reference, a glossary of terms and their equivalent meaning in Tetun, Portuguese or Indonesian, and Japanese has been included at the back of this guideline.

For the purpose of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
catchment
area of land where all of the water that is under it or drains off of it goes into the same place

[SOURCE: ISO 14055-1:2017(en), 3.2.19]

3.2
culvert
transverse drain or waterway structure under a road, railway, or canal, or through an embankment, in the form of a large pipe or enclosed channel

[SOURCE: ISO 6707-1:2017(en), 3.1.2.33]

3.3
return period
average number of years in which a stated action statistically is exceeded once

[SOURCE: ISO 12494:2017(en), 3.8]

3.4
river
natural body of water flowing continuously or intermittently along a well-defined course into an ocean, sea, lake, inland depression, marsh, or other watercourse

[SOURCE: ISO 5667-6:2014(en), 3.9]

3.5
subcritical flow
flow in an open channel at less than critical velocity, that has a Froude number of less than unity, and in which small surface disturbances can travel upstream

[SOURCE: ISO 772:2011(en), 1.7]

3.6
supercritical flow
flow in an open channel at more than critical velocity, that has a Froude number of greater than unity, and in which small surface disturbances cannot travel upstream

[SOURCE: ISO 772:2011(en), 1.8]

3.7
watercourse
channel on or below the earth's surface, through which water may flow

[SOURCE: ISO 6107-7:2006(en), 50]

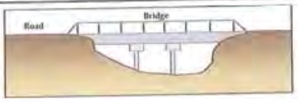
3.8
wetted perimeter
contact length between a stream of flowing water and its containing open channel, measured in a direction normal to the flow

[SOURCE: ISO 772:2011(en), 1.54]

4 Planning

4.1 Selection of structure

The first step in planning is selection of the most appropriate type of structure for crossing a watercourse. The two main types of structure for crossing are bridges and culverts. They both have advantages and disadvantages, as shown in Figure 4.1. There may also be other factors that an engineer needs to consider. If a bridge is a more appropriate, then please refer to the *Bridge Design Manual* (2).



Bridge
- Cost of construction: higher
- Watercourse flow: less affect
- Debris: less problematic
- Land-use / environment: less affect

Culvert
- Cost of construction: lower
- Watercourse flow: more affect
- Debris: more problematic
- Land-use / environment: more affect

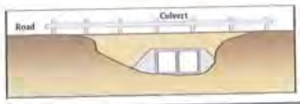


Figure 4.1 — Comparison of application of bridges and culverts

4.2 Overview of culverts

There are various shapes (rectangular box, circular pipe, elliptical pipe, arch pipe, etc.), materials (concrete, corrugated steel, etc.) and inlets (wing walls, flat headwall, square edge at crown, bevel at crown, etc.). This guideline will primarily cover box culverts made of concrete. The parts of a culvert are shown in Figure 4.2 and Figure 4.3.

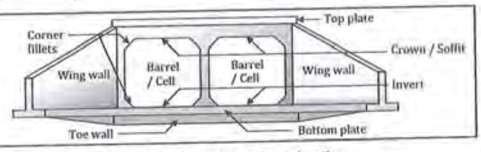


Figure 4.2 — Parts of a culvert on front elevation

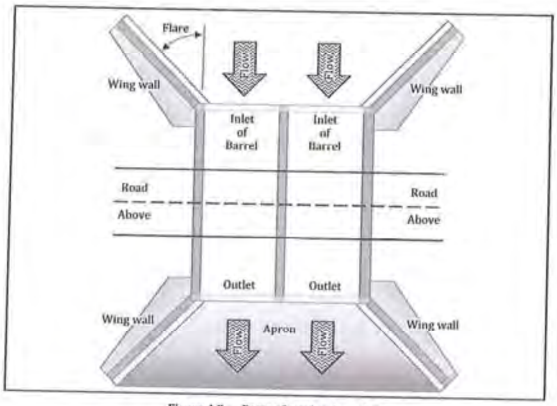


Figure 4.3 — Parts of a culvert on plan

4.3 Application of culverts

There are limitations to the application of culvert structures. The recommended range of application for each barrel of a concrete box culvert is shown in Table 4.1. It is possible to design beyond these limitations with sufficient consideration of structural design and traffic loads.

The proportion of a culvert (height : width) is normally in the range of 1 : 1 to 1 : 3. The most hydraulically efficient proportion is 1 : 2. However, the most normal proportion for road culverts is 1 : 1, because the culvert must structurally support the loads from traffic.

Table 4.1 — Recommended limits for a concrete box culvert (4) (5)

Property	Minimum	Maximum
Height, D	0.75 m 750 mm	5.0 m 5000 mm
Width, B	0.45 m 450 mm	6.5 m 6500 mm
Cover depth (of material) above top plate	0.5 m 500 mm	—
Proportion (height : width)	1 : 1	1 : 3
Gradient of culvert	0.5% or 0.005 m/m	10% or 0.100 m/m

In principle, the geometry of a box culvert (width, gradient and bottom elevation) should be similar to the original watercourse in order to reduce sedimentation or erosion. The gradient should be more than (≥) 0.5% or 0.005 m/m to reduce sedimentation, and less than (≤) 10% or 0.100 m/m to ensure workability & prevent slippage.

4.4 Alignment of culverts

Culvert alignment is important for the function of the culvert and watercourse. If possible, the inlet and outlet of the culvert should be located in the natural channel at the intersection with the roadway fill slopes.

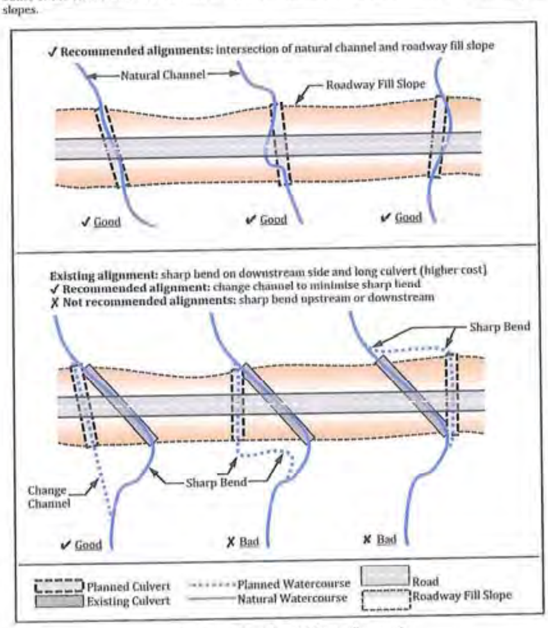


Figure 4.4 — Examples of culvert alignment

4.5 Design process

An outline of the stages for the process of design are shown in Figure 4.5.

Data collection	○ Basic site information ○ Topographic data ○ Cartographic (map) / geospatial data ○ Rainfall data	Section 5
Rainfall analysis	○ Frequency analysis ○ Calculation of daily rainfall for design	Section 6
Flood calculation	○ Calculation of catchment area ○ Calculation of time of concentration ○ Calculation of rainfall intensity ○ Assessment of run-off coefficient ○ Calculation of flood discharge	Section 7
Open-channel hydraulics	○ Selection of culvert size ○ Calculation of culvert capacity for discharge ○ Calculation of flow type and velocity	Section 8
Protection works	○ Selection of protection measure and size	Section 9

Figure 4.5 — Outline of process for design

In some cases, a simplified process for design could be adopted, as shown in Figure 4.6. This process is based on adoption of a rainfall intensity of 200 mm/hour from the *Bridge Design Manual* (2). However, this process may result in excessive or insufficient designs and should be used with caution. This process should only be used for small applications on minor routes, such as rural local roads.

Data collection	○ Basic site information ○ Cartographic (map) / geospatial data	Section 5
Flood calculation	○ Calculation of catchment area ○ Rainfall intensity = 200 mm/hour ○ Assessment of run-off coefficient ○ Calculation of flood discharge	Section 7
Open-channel hydraulics	○ Selection of culvert size ○ Calculation of culvert capacity for discharge ○ Calculation of flow type and velocity	Section 8
Protection works	○ Selection of protection measure and size	Section 9

Figure 4.6 — Outline of simplified process for design

DNEPCC

5 Data collection

The design of culverts requires an understanding of the site conditions. The following section outlines the various information that should be collected through site investigations and desk studies (off-site investigations).

5.1 Basic site investigation

A basic site investigation should be implemented on site for every culvert design. This information will be necessary for planning and also support the decisions made in the process of design regarding run-off. Examples of the information that is required are shown in Table 5.1 and Figure 5.1.

Table 5.1 — Example checklist of items for site investigation

☑	Information / Item of investigation	Possible source
☐	Coordinates of site location (latitude & longitude)	GNSS (GPS) receiver / smartphone
☐	Measurement of size of existing culvert (m), if any	Tape measure
☐	Measurement of level (m) of normal flow	Tape measure and marks on structures / land
☐	Photograph of normal flow	Camera / smartphone / local residents
☐	Measurement of level (m) of high flow / flood	Tape measure and marks on structures / land
☐	Photograph of high flow / flood	Camera / smartphone / local residents
☐	Date of high flow / flood	Local residents / officers / administration
☐	Photographs of whole site on elevation / along road	Camera / smartphone
☐	Photograph of surrounding mountains / terrain	Camera / smartphone
☐	Photograph of surrounding buildings / land features	Camera / smartphone
☐	Photographs of culvert inlet (proposed/existing)	Camera / smartphone
☐	Photographs of upstream / ascending direction	Camera / smartphone
☐	Photographs of culvert outlet (proposed/existing)	Camera / smartphone
☐	Photographs of downstream / descending direction	Camera / smartphone
☐	Aerial photograph of area	UAV (drone) / Satellite (Google Earth)

Figure 5.1 — Diagram of site photography

5.2 Topographic investigation

If possible, a topographic investigation should be implemented on site. This information will be necessary for planning and will form a fundamental part of the design calculations regarding the watercourse gradient. In addition, this information can improve the accuracy of a design and facilitate the verification of results. An example of the information that is required is shown in Table 5.2.

DNEPCC

Table 5.2 — Example checklist of items for topographic investigation

☑	Information / Item of investigation	Possible source
☐	Level of invert (m AOD) at proposed/existing inlet	Total station / theodolite
☐	Level of invert (m AOD) at proposed/existing outlet	Total station / theodolite
☐	Level of road (m AOD)	Total station / theodolite
☐	Profile of watercourse	Total station / theodolite
☐	Cross sections of watercourse (2 / 3 sections in both directions)	Total station / theodolite

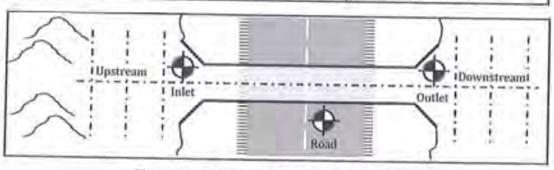


Figure 5.2 — Diagram of basic topographic survey

5.3 Cartographic investigation

A cartographic investigation should be implemented off-site for every culvert design. This map / geospatial information will form a fundamental part of the design calculations regarding the catchment. An example of the information that is required is shown in Table 5.3.

Table 5.3 — Example checklist of items for cartographic investigation

☑	Information / Item of investigation	Possible source
☐	Cartographic map (T755 series of 1:50,000 maps, etc.)	In-house resources (Mapping & GIS)
☐	Digital elevation model (GIS DEM raster)	In-house resources (Mapping & GIS)
☐	Watercourse line (GIS vector)	In-house resources (Mapping & GIS)
☐	Road line (GIS vector)	In-house resources (Mapping & GIS)

5.4 Rainfall data

A pluvial investigation should be implemented off-site for every culvert design. This rainfall data will form a fundamental part of the design calculations regarding the rainfall intensity. An example of the information that is required is shown in Table 3.

Table 5.4 — Example checklist of items for pluvial investigation

☑	Information / Item of investigation	Possible source
☐	Monthly rainfall data	In-house resources / relevant authority (see Annex C)
☐	Daily rainfall data	In-house resources / relevant authority (see Annex C)
☐	Short-interval / hourly rainfall data	(currently unavailable in Timor-Leste)

The availability of rainfall data will influence the design. The following are considered ideal characteristics for a set of rainfall data:

- 1+ stations in the catchment or near the catchment

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- Records at 15-minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour and 24-hour intervals
- Long records (30+ years)

In this case, the process of design can utilise intensity-duration-frequency (IDF) curves, as shown in Figure 5.3. The advantage of IDF curves is that storms can be accurately predicted. The disadvantage is that the development of IDF curves requires a significant amount of rainfall data.

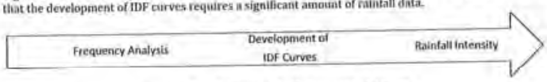


Figure 5.3 — IDF curves in the process of design

Currently, the method of IDF curves cannot be utilised in Timor–Leste, because of the limited length and limited detail of rainfall data. The following is a summary of characteristics for rainfall data in Timor-Leste:

- Currently 82 stations in operation across Timor-Leste (on average, 1 for every 180 km²)
- Monthly rainfall records exist from 1950s (for 36 stations with gaps)
- Daily rainfall records exist for 40 weather stations (approximate availability)
- Long record of 34 years for daily rainfall in Dili (with gaps)
- Short records of 7 - 11 years for daily rainfall in other areas (approximately)

In this case, only daily rainfall data is available, so the process of design in Timor-Leste can utilise the Mononobe formula in the process of design, as shown in Figure 5.4. The Mononobe formula is used to derive an approximation of rainfall intensity for any storm duration from daily rainfall data. The advantage of the Mononobe formula is simplicity. However, the disadvantage is that the approximation of storms with short duration (6 hours or less) may not be accurate. The Mononobe formula is explained in more detail in Section 7.4.

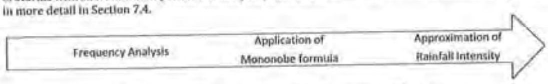


Figure 5.4 — Mononobe formula in the process of design

The rainfall varies depending on the region. The average of the monthly rainfall across the whole country is shown in Figure 5.5. In addition, the variance between the regions is indicated with the following summaries:

- Average of annual rainfall is approximately 1700 mm (whole country)
- Maximum of annual rainfall is approximately 3100 mm (Same)
- Minimum of annual rainfall is approximately 600 mm (Manatuto)

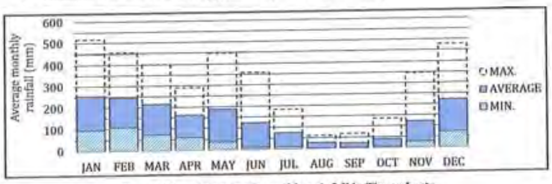


Figure 5.5 — Average of monthly rainfall in Timor-Leste

6 Rainfall analysis

Rainfall analysis reflects the hydrological risk for a road, and ensures protection against probable floods. The input of this process is a long record of daily rainfall, and the output is a maximum probable daily rainfall, also called the design daily rainfall.

The design daily rainfall is determined by analysis of historical rainfall records. The historical rainfall records show the relationship between the frequency of occurrence of storms and the magnitude of storms. The frequency of occurrence for a probable storm / design storm is called the 'return period'. The prediction of the magnitude of the storm for the return period determines the design rainfall.

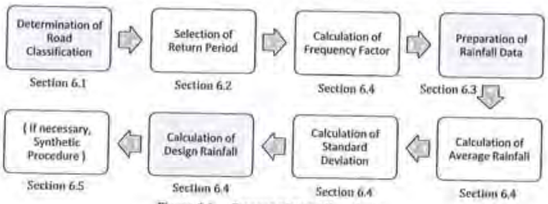


Figure 6.1 — Process of rainfall analysis

6.1 Classification of roads

According to the *Road Geometric Design Standards* (3), the roads in Timor-Leste are classified as shown in Table 6.1.

Table 6.1 — Classification of roads (3)

Rural Roads	Roads outside towns and cities.
National Roads	• Arterial roads are centres of national and international importance and roads terminating at international boundaries, connecting nation's capital and to region's capitals. • Provides high level of service for long distance movement of goods and people and thus to/from central corridors for especially heavy vehicles. • These roads link locations where change of transport mode is possible.
Regional Roads	• Roads that provides more local purposes, serve mainly traffic within regions and districts at lower speeds and shorter distances. • Roads that serve as collector of traffic to/from local network to the national road network.
Local Roads	• Local roads connecting sub-district capitals to villages and more remote areas with agricultural potential.
Urban Roads	Local roads inside towns and cities.
Urban Arterial Roads	• An Urban Arterial Road is a continuous road with partial access control for through traffic within urban areas. Basically it conveys traffic from residential areas to the vicinity of the central business district or from one part of a city to another

	which does not intend to penetrate the city centre. Arterial roads do not penetrate identifiable neighbourhoods. Smooth traffic flow is essential since it carries large traffic volume.
Urban Collector Roads	• A collector road is a road with partial access control designed to serve on a collector or distributor of traffic between the arterial and the local road systems. Collectors are the major roads that penetrate and serve identifiable neighbourhoods, commercial areas and industrial areas.
Urban Local Roads	• The local street system is the basic road network within a neighbourhood and provides direct access to abutting land. They are links to the collector road and thus serve short trip lengths. Through traffic should be discouraged.

6.2 Return period

The return period reflects the hydrological risk for a road. The selection of an appropriate mitigation of risk depends on the economic value / importance of a road asset. The balance between the cost of the road asset and the cost to protect the road asset is important: inadequate protection may allow damage of a road asset and a loss of economic value; excessive protection will cause unnecessary expenditure and an uneconomical solution.

The return period (years) represents probability of occurrence. The return period does not represent a guaranteed period without flooding and it is not related to the design life of a road. The probability of occurrence has an inverse relationship to the magnitude of rainfall events. Therefore, a long return period equals a low probability, which means a high magnitude of rainfall event.

Table 6.2 — Recommended returns period of rainfall for culverts (4) (6)

Road class	Level of drainage capacity	Return period of rainfall
National Roads / Urban Arterial Roads	High	10 years
Regional Roads / Urban Collector Roads	Medium	7 years
Local Roads / Urban Local Roads	Low	5 years

The classification of a road is related to its economic value. Therefore, selection of a return period is recommended based on the classification of a road, as shown in Table 6.2. The return period may be modified by the engineer in situations where a higher level of drainage capacity is desirable. For example, roads that are designed for service of major national assets and where the level of risk must be agreed in conjunction with other national authorities.

6.3 Preparation of rainfall data

The rainfall data for frequency analysis is the maximum of daily rainfall per annum. The preparation of rainfall data for analysis should be implemented in the following manner:

1. Acquisition of daily rainfall data
2. Examination of all data (365 days) in same annum (coeval data)
3. Selection of maximum rainfall value (1 day) per annum
4. Repetition of 2 and 3 (above) for every annum

Complete rainfall records are necessary for analysis. The confirmation of data integrity should be implemented in the following manner:

- If data contains null or erroneous values (for example, " ** " or " — " or " NA "), deletion of these values is necessary
- If data for 1 annum is missing approximately 90 days (¼ annum) of data, then that annum is invalid and cannot be utilized for analysis

6.4 Frequency analysis

Frequency analysis utilises a probability distribution for the prediction of design rainfall. A probability distribution is a general relationship between the frequency and the magnitude. The probability distribution conforms to the rainfall data, similar to a trend line (or line of tendency). An example of a probability distribution on a bell-shaped diagram is shown in Figure 6.2.

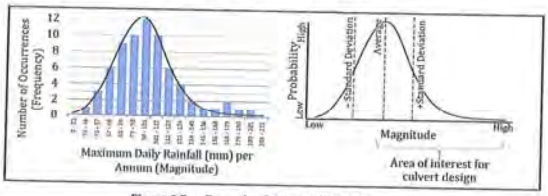


Figure 6.2 — Example of a probability distribution

For culvert design, it is necessary for prediction of higher-magnitude lower-probability for the design rainfall. The process of prediction utilises the 'Gumbel' distribution to represent the rainfall data.

The Gumbel distribution is adjusted to the rainfall data with two parameters: the average and the standard deviation. The return period is incorporated using a frequency factor. In essence, the Gumbel distribution predicts the magnitude of the design rainfall as a departure from the average rainfall. The departure depends on the number of standard deviations, where the number is the frequency factor (return period).

The following is the Gumbel distribution for calculation of the design rainfall:

$$R_{24} = \mu + \sigma \times K \quad [1]$$

where

- R_{24} design rainfall for a given return period (mm/day)
- μ average of rainfall records (mm/day), see equation 2
- σ standard deviation of rainfall records, see equation 3
- K frequency factor, see equation 4

The following is the equation for calculation of the average of rainfall data:

$$\mu = \frac{\sum x_i}{n} \quad [2]$$

where

- μ average of rainfall data (mm/day)
- X_i annual maximum of daily rainfall data values (mm/day)
- n number of rainfall data values

[NOTE: in spreadsheet software, this can be calculated using the AVERAGE function]

The following is the equation for calculation of the standard deviation of rainfall data:

$$\sigma = \sqrt{\frac{\sum (X_i - \mu)^2}{n-1}} \quad [3]$$

where

- σ standard deviation of rainfall data
- X_i annual maximum of daily rainfall data values (mm/day)
- μ average of rainfall records (mm/day)
- n number of rainfall data values

[NOTE: in spreadsheet software, this can be calculated using the STDEV or STDEV.S functions]

The following is the equation for calculation of the frequency factor (incorporation of return period):

$$K = -\frac{\sqrt{6}}{\pi} \times \left(\gamma + \ln\left(\ln\frac{T}{T-1}\right)\right) \quad [4]$$

where

- K frequency factor (normally between -1 and 5)
- π Pi mathematical constant = 3.14159
- γ Euler–Mascheroni constant = 0.5772
- T return period (years), see Table 6.2

[NOTE: in spreadsheet software, this can be calculated using the SQRT, PI and LN functions]

6.5 Synthetic procedure

In many cases in Timor-Leste, it is necessary to implement a synthetic (compensative) procedure. The reason is that most locations only have short records of rainfall data (see Section 5.4). Therefore, currently, Dili is the only location with rainfall data that is suitable for frequency analysis. Using the frequency analysis of design daily rainfall for Dili, it is possible to synthesise for other locations by scaling up / down (escalate / de-escalate) using the ratio of average annual rainfall as a multiplier. The procedure of deriving daily rainfall for any target location in Timor-Leste using Dili as a basis is shown in Table 6.3.

Table 6.3 — Synthetic procedure for deriving daily rainfall for a target location

Return period of rainfall	Design daily rainfall in Dili, R_{24} (mm/day)		Ratio of annual rainfall (multiplier)
10 years	131.4		(Target Location / Dili)
7 years	122.3	×	(... mm / 940 mm)
5 years	113.6		

For reference, a list of target locations and derived design daily rainfall are shown in Table 6.4.

Table 6.4 — List of target locations and derived design daily rainfall

Target location	Average annual rainfall (mm/day)	Multiplier	Design daily rainfall, R_{24} (mm/day) for return period		
			5 years	7 years	10 years
Dili	940	1.00	113.6	122.3	131.4
Aileu	2653	2.82	320.5	345.3	370.8
Alas	1965	2.09	237.4	255.7	274.6
Algarve (Fazenda)	1870	1.99	225.9	243.4	261.3
Atauro (Mau-Meta)	871	0.93	105.2	113.4	121.7
Baguia	2399	2.55	289.8	312.2	335.3
Baucau	1208	1.29	145.9	157.2	168.8
Betano	1298	1.38	156.8	168.9	181.4
Bobonaro	2432	2.59	293.8	316.5	339.9
Dare	1533	1.63	185.2	199.5	214.2
Fatubessi	2929	3.12	353.8	381.2	409.3
Fohorem	1536	1.63	185.6	199.9	214.7
Gleno	1765	1.88	213.2	229.7	246.7
Hato-Builico	2418	2.57	292.1	314.7	337.9
Iliomar	2090	2.22	252.5	272.0	292.1
Laga	770	0.82	93.0	100.2	107.6
Laivai	696	0.74	84.1	90.6	97.3
Lautem	1511	1.61	182.5	196.6	211.2
Liquica	1383	1.47	167.1	180.0	193.3
Lore	1669	1.78	201.6	217.2	233.2
Lospalos	1918	2.04	231.7	249.6	268.0
Luro	1707	1.82	206.2	222.2	238.6
Maliana	2062	2.19	249.1	268.4	288.2
Manatuto	610	0.65	73.7	79.4	85.2
Oecusse	1070	1.14	129.3	139.3	149.5
Ossu	1948	2.07	235.3	253.5	272.2
Quelicai	1728	1.84	208.8	224.9	241.5
Same	3117	3.32	376.5	405.7	435.6
Soibada	2396	2.55	289.4	311.8	334.8
Suai	1355	1.44	163.7	176.3	189.4
Tutuala	1511	1.61	182.5	196.6	211.2
Uatolari	1879	2.00	227.0	244.5	262.6
Vemasse	706	0.75	85.3	91.9	98.7
Venilale	1764	1.88	213.1	229.6	246.5
Viqueque	1577	1.68	190.5	205.2	220.4
Zumalai	1328	1.41	160.4	172.8	185.6

NOTE Average annual rainfall values were taken from data records of the Ministry of Agriculture, Forestry and Fisheries (MAFF) for the period 1950s – 1990s. These should be supplemented by recent rainfall data if possible.

7 Design flood

The calculation of design flood determines the volume of water that will be discharged from the catchment during the design rainfall. The design flood determines the required capacity of the culvert. The procedure for calculation of a design flood is shown in Figure 7.1.

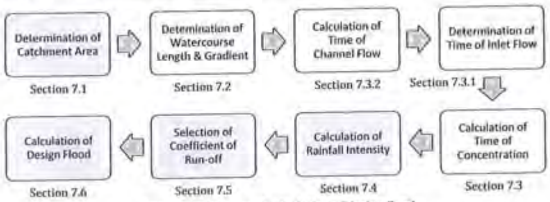


Figure 7.1 — Process of calculation of design flood

7.1 Catchment area

A catchment is an area of land that drains to a point of interest, such as a culvert, as shown in Figure 7.2. All water flow that originates inside the catchment area passes the point of interest before proceeding downstream. The watershed is the boundary between a catchment and its neighbour catchment. The extent of the watershed (boundary) can be identified by connecting the surrounding points with highest elevation, such a mountain summits, hilltops, ridges, saddles and spurs as shown in Figure 7.3.

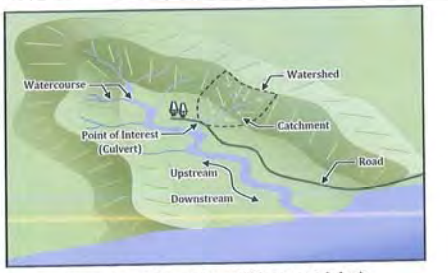


Figure 7.2 — Catchment area within a mountain basin

The size of a catchment has an important influence on the calculation of run-off. The size is expressed as area in terms of km^2 ($1\ km^2 = 1{,}000{,}000\ m^2 = 100$ ha). Topographical maps (1:50,000, such as T755 series) can be used for determination of catchment area. However, smaller scale maps (1:10,000) or geographic information system (GIS) data are recommended for small catchments. It is important for the designer to visit a site personally to obtain an impression of the characteristics of the catchment.

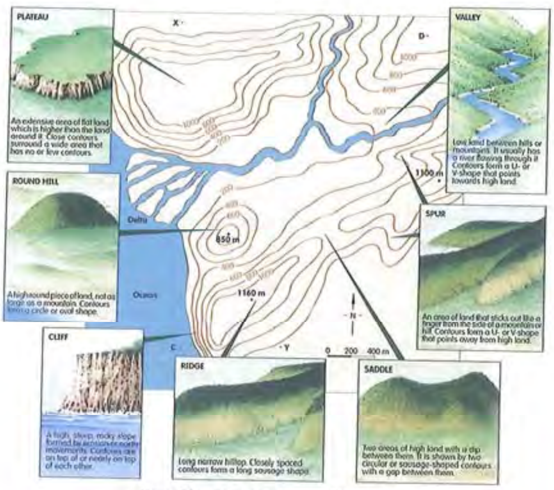


Figure 7.3 — Example of topographic features

Measurement techniques for area include: transferring the catchment outline onto square-lined paper using tracing paper; importing and scaling maps into computer aided design (CAD) software; and using digital elevation models (DEMs, data) and spatial data in a geographic information systems (GISs, software). Usage of GISs is the recommended measurement technique for accurate results. If possible, a request for information should be made to the GIS & Mapping Section of DNEPCC.

The GIS & Mapping Section can analyse a catchment either by delineating a watershed based on contours (in other words, drawing a polygon shape file to represent a catchment) or by using algorithms to derive watersheds from digital elevation models (DEMs). Examples of algorithms for delineation include "r.watershed" and "r.water.outlet" in GRASS Tools of QGIS software, and "Watershed" in Spatial Analyst toolbox of ArcGIS software. An example sequence for delineating a watershed from a DEM is as follows:

- Step 1) Fill the depressions in the DEM
- Step 2) Calculate flow directions
- Step 3) Delineate the catchment and derive its area
  - Step 3.1) Choose the point of interest ("Outlet" in QGIS and "Pour Point" in ArcGIS)
  - Step 3.2) Delineate the watershed
  - Step 3.3) Calculate the area

In addition to the total catchment area, calculation of the sub-catchment areas is required if locations have distinctly different types of terrain. The boundary of terrain types can be analysed by site investigation, by satellite imagery or by land cover data.

7.2 Watercourse properties

Similar to Section 7.1, watercourse properties can be measured with topographical maps, CAD software or GIS. If possible, a request for information should be made to the GIS & Mapping Section of DNEPCC.

The watercourse properties required for calculation of time of concentration are the length and the gradient. The length of a watercourse (L) should be measured from the furthest discernible start of a watercourse to the point of interest, as shown in Figure 7.4.

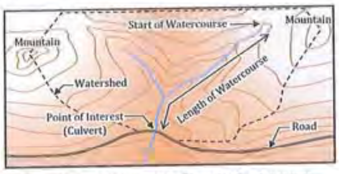


Figure 7.4 — Measurement of length of watercourse

The average gradient should be used for the gradient of a watercourse (G), as shown in Figure 7.5. The calculation of average gradient requires lengths (L values) and the heights (H values) at several points along the profile of the watercourse. In most spreadsheet software, the average gradient can be calculated utilising the LINEST function: *LINEST([H values] , [L values] , FALSE)* gives a result in m/m or *LINEST([H values] , [L values] , FALSE)*100* gives a result in percentage (%).

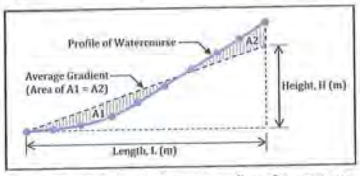


Figure 7.5 — Calculation of average gradient of watercourse

7.3 Time of concentration

The time of concentration is required for the calculation of rainfall intensity. The time of concentration is the time for water to flow from the furthest point in the watershed (i.e. the mountain) to the point of interest (i.e. the culvert). Different areas of a watershed contribute to run-off at different times after rainfall begins. Time at which all parts of the watershed begin contributing to the run-off from the basin, as shown in Figure 7.6. The time of concentration is calculated with equation 5.

The following is the equation for calculation of time of concentration

$$t_r = t_e + t_f \qquad [5]$$

where

- t_r time of concentration (hours)
- t_e time of flow from watershed to watercourse (hours), see Table 7.1
- t_f time of flow from start of watercourse to point of discharge (hours), see equation 6

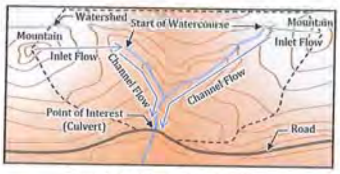


Figure 7.6 — Time of concentration

7.3.1 Time for inlet flow

The time for inlet flow is the time for surface flow to travel from the watershed to the start of the watercourse.

Table 7.1 — Inlet flow times (4)

Catchment type	Inlet time (minutes)	Inlet time (hours)
Mountainous land	15.0 – 30.0	0.25 – 0.50
Cut slopes	3.0 – 5.0	0.05 – 0.083
Urban areas	5.0	0.083

7.3.2 Time for channel flow

The time for channel flow is the time for surface flow to travel from the start of the watercourse to the point of interest (culvert). The Kraven Formula is an empirical equation based on basin data.

The following is the Kraven Formula for calculation of the time for channel flow:

$$t_f = \frac{L}{3600 \times W} \qquad [6]$$

where

- t_f time of flow from start of watercourse to point of discharge (hours)
- L watercourse length (m)
- W velocity of run-off (m/s), see Table 7.2

Table 7.2 — Velocity of run-off (4)

Gradient of watercourse, G			Velocity of run-off, W (m/s)
> 1 / 100	> 1.0%	> 0.010 m/m	3.5
1 / 200 – 1 / 100	0.5% – 1.0%	0.005 – 0.010 m/m	3.0
< 1 / 200	< 0.5%	< 0.005 m/m	2.1

7.4 Intensity of rainfall

Generally, storm intensity is inversely proportionate to storm duration for most climates. This inverse relationship means that shorter-duration storms have higher intensity of rainfall and longer-duration storms have lower intensity of rainfall, as shown in Figure 7.7.

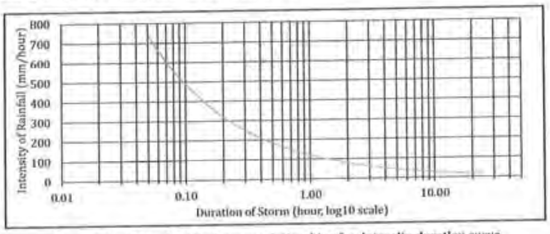


Figure 7.7 — Example of the inverse relationship of an intensity-duration curve

The design intensity of rainfall is when the duration of a storm is equal to the time of concentration, as shown by (b) in Figure 7.8. As shown in (a), when the duration of a storm is less than the time of concentration, then all of the catchment area is not discharging to the culvert, so it is not the maximum discharge. As shown in (c), when the duration of a storm is more than the time of concentration, then the intensity of rainfall will be lower, so it is also not the maximum discharge. Time of concentration is when all parts of the watershed start to contribute to the run-off from the basin and this is when the design intensity of rainfall occurs.

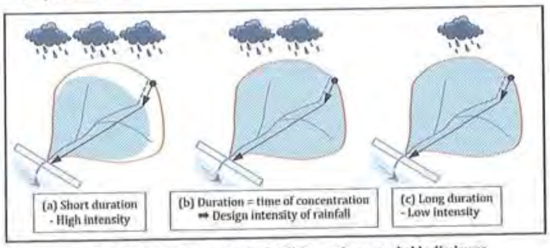


Figure 7.8 — Design intensity of rainfall for maximum probable discharge

As mentioned in Section 5.4, there is insufficient rainfall data in Timor-Leste for creation of intensity-duration curves, such as Figure 7.7. The Mononobe Formula is an empirical equation for estimation of intensity of rainfall. It is a practical solution for applications with few rainfall data.

The following is the Mononobe Formula for calculation of the rainfall intensity:

$$i = \frac{R_{24}}{24} \times \left(\frac{24}{t_c}\right)^{0.6} \qquad [7]$$

where

- i rainfall intensity (mm/hour)
- R_{24} design daily rainfall (mm/day), see Section 6
- t_c time of concentration (hours), see equation 5

The disadvantage of the Mononobe Formula is that it may not accurately predict intensity of rainfall for storms with a short duration (<6 hours). It is recommended that Timor-Leste collects rainfall data at 15-minute, 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour and 24-hour intervals in all weather stations. Provided this data can be collected, intensity-duration-frequency (IDF) charts could be developed by 2050 and hydrological design techniques could be refined.

7.5 Coefficient of run-off

Run-off is water from rainfall that flows on the surface (in other words, surface flow). The amount of rainfall that becomes run-off flow depends on the amount of water lost by infiltration and evaporation. This loss of water due to infiltration and evaporation is represented by a coefficient of run-off. Therefore, the coefficient of run-off is the proportion of rainfall that becomes run-off.

Recommended coefficients of run-off, C, are shown in Table 7.3. A higher coefficient of run-off indicates that more rainfall becomes run-off, and likewise a lower coefficient of run-off indicates the less rainfall becomes run-off.

If you a catchment area contains different types of terrain, then application of a weighted coefficient is recommended. The weighted coefficient should be calculated as shown in equation 8.

Table 7.3 — Coefficients of run-off (4)

Terrain type	Coefficient of run-off	Average value
Road surfaces and sloped surfaces	0.70 – 1.00	0.85
Steep mountainous land	0.75 – 0.90	0.83
Gentle mountainous land	0.70 – 0.80	0.75
Undulating land and woods	0.50 – 0.75	0.63
Flat farmlands	0.45 – 0.60	0.53
Rice paddy (fields)	0.70 – 0.80	0.75
Urban areas	0.60 – 0.90	0.75
Forest zones	0.20 – 0.40	0.30
Catchment areas of mountain streams	0.75 – 0.85	0.80
Catchment areas of small rivers on flat land	0.45 – 0.75	0.60
Catchment areas of major rivers of which more than half run on flat land	0.50 – 0.75	0.63

The following is the equation for calculation of a weighted coefficient of run-off:

$$C = \frac{(C_1 \times A_1 + C_2 \times A_2 + \dots + C_n \times A_n)}{(A_1 + A_2 + \dots + A_n)} \qquad [8]$$

where

- C weighted coefficient of run-off (dimensionless)
- $C_{1,2,n}$ coefficients of run-off for different types of terrain (dimensionless), see Table 7.3
- $A_{1,2,n}$ areas of catchments with different types of terrain (m^2), see Section 7.1

7.6 Rational method

The Rational Method shall be applied for calculation of a design flood. It was first proposed in 1851 by an Irish engineer called Mulvaney. It is based on a simplistic relationship between rainfall and run-off for empirical prediction of discharge from a catchment. This method is appropriate for the following design conditions:

- Calculation of peak discharge
- Ungauged sites (without streamflow / river data)
- Deterministic analysis based on rainfall
- Catchments without significant water storage (no lakes, no ponds, no wetlands, etc.)
- Applicable < 15.0 km^2 (5)
- Best suited ≤ 0.8 km^2 (7)

The limitation of application to catchments < 15.0 km^2 is because the coefficient of run-off cannot accurately represent water storage (or hydrologically complex catchments). The method assumes that intensity of rainfall is uniform over the catchment; hence, the peak run-off is assumed to occur when duration of a storm equals the time of concentration.

The following is the Rational Method equation for calculation of peak discharge:

$$Q_P = \frac{1}{3.6} \times C \times i \times A \qquad [9]$$

where

- Q_P peak discharge or design flood of a watercourse (m^3/s)
- C coefficient of run-off, see Table 7.3
- i rainfall intensity (mm/hour), see equation 7
- A catchment area of watercourse (km^2)

As mentioned in Section 4.5, a simplified process for design based on adoption of a rainfall intensity of 200 mm/hour from the *Bridge Design Manual* (2) could be used for small applications on minor routes, such as rural local roads. For reference, design floods of the simplified process are shown in Table 7.4.

Table 7.4 — Examples of design floods for small applications using the simplified process

Coefficient of run-off, C	Design flood, Q_P, (m^3/s) for a catchment area of									
	0.1 km^2	0.2 km^2	0.3 km^2	0.4 km^2	0.5 km^2	0.6 km^2	0.7 km^2	0.8 km^2	0.9 km^2	1.0 km^2
0.20	1.2	2.3	3.4	4.5	5.6	6.7	7.8	8.9	10.0	11.2
0.30	1.7	3.4	5.0	6.7	8.4	10.0	11.7	13.4	15.0	16.7
0.40	2.3	4.5	6.7	8.9	11.2	13.4	15.6	17.8	20.0	22.3
0.45	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0
0.50	2.8	5.6	8.4	11.2	13.9	16.7	19.5	22.3	25.0	27.8
0.55	3.1	6.2	9.2	12.3	15.3	18.4	21.4	24.5	27.5	30.6
0.60	3.4	6.7	10.0	13.4	16.7	20.0	23.4	26.7	30.0	33.4
0.65	3.7	7.3	10.9	14.5	18.1	21.7	25.3	28.9	32.5	36.2
0.70	3.9	7.8	11.7	15.6	19.5	23.4	27.3	31.2	35.0	38.9
0.75	4.2	8.4	12.5	16.7	20.9	25.0	29.2	33.4	37.5	41.7
0.80	4.5	8.9	13.4	17.8	22.3	26.7	31.2	35.6	40.0	44.5
0.85	4.8	9.5	14.2	18.9	23.7	28.4	33.1	37.8	42.5	47.3
0.90	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
NOTE: The above values are for the simplified process that adopts a rainfall intensity of 200 mm/hour. These values should be used with caution. Where possible, the full process should be used and rainfall intensity should be calculated.										

8 Open-channel hydraulics

Open-channel hydraulics is characterised by water flowing under gravity and at atmospheric pressure due to the water surface being in contact with the air (a free surface). The process of design is outlined in Figure 8.1

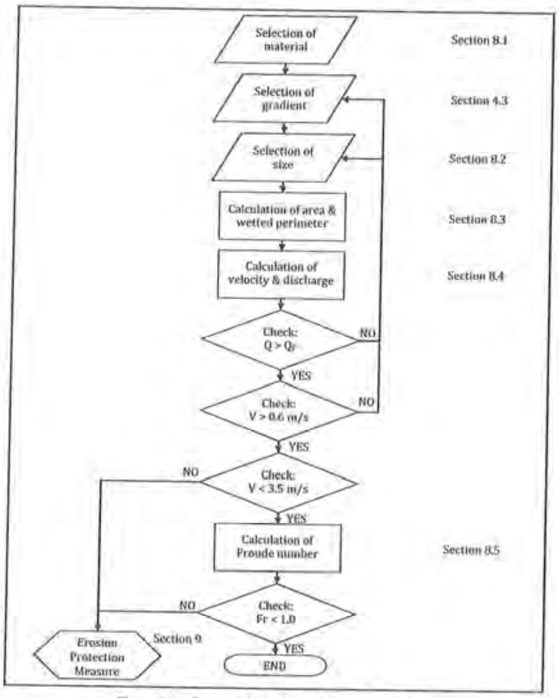


Figure 8.1 — Process of calculation of open-channel flow

8.1 Material of culverts

The material (and condition) of a channel determines the roughness. The roughness is the representation of the frictional resistance of the boundary shear force. For uniform flow calculations, the gravity forces must balance the frictional resistance forces which constitute the boundary shear force (τ). This concept is outlined in Figure 8.2.

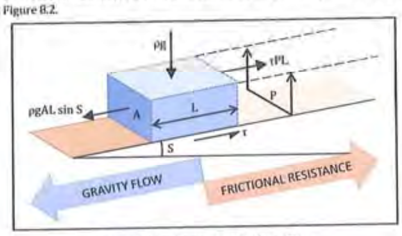


Figure 8.2 — Concept of uniform flow

The roughness is represented in the calculation of flow by the Manning number, n. The normal material for construction of box culverts is concrete. The recommended values of Manning number for concrete are shown in Table 8.1.

Table 8.1 — Recommended values of Manning number (4)

Material of culvert	Manning number, n
Concrete:	
Cast in-situ concrete	0.015
Factory-made concrete products	0.013

8.2 Size of culvert

It is recommended that selection of the size of a culvert is in accordance with the relevant structural design standard. For reference, the size of culverts are shown in Table 8.2, Table 8.3 and Table 8.4.

Table 8.2 — Standard dimensions for single culverts (8)

Width, b (mm)	Height, D (mm)	Thickness of wall & fillets, w (mm)
1000	1000	160
1000	1500	170
1000	2000	180
2000	1000	220
2000	1500	230
2000	2000	250
2000	2500	260
2000	3000	280
3000	1500	280
3000	2000	300
3000	2500	300
3000	3000	300

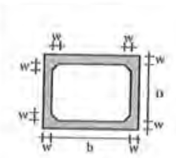


Table 8.3 — Standard dimensions for double culverts (9)

Width, b (mm)	Height, D (mm)	Thickness of wall & fillets, w (mm)
1500	1000	200
2000	1000	240
2000	1500	240
2000	2000	240
2000	2500	250
2000	3000	260
2500	1500	260
2500	2000	260
2500	2500	260
2500	3000	280
3000	1500	300
3000	2000	300
3000	2500	300
3000	3000	300

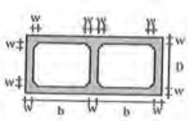
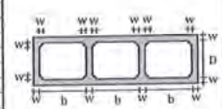


Table 8.4 — Standard dimensions for triple culverts (10)

Width, b (mm)	Height, D (mm)	Thickness of wall & fillets, w (mm)
1500	1000	160
1500	1500	170
1500	2000	180
1500	2500	220
1500	3000	260
2000	1000	200
2000	1500	220
2000	2000	250
2000	2500	260
2000	3000	300
2500	1500	280
2500	2000	280
2500	2500	280
2500	3000	300
3000	1500	300
3000	2000	300
3000	2500	300
3000	3000	300



8.3 Geometry of culverts

The geometry of a culvert affects the frictional resistance. In addition to the boundary roughness, frictional resistance will increase as the size of the boundary increases. The size of the boundary is calculated as follows.

The area is the cross-sectional area of flow in the direction normal (perpendicular) to the direction of flow. The wetted perimeter is the length of the perimeter that is in contact with the flow measured in the direction normal (perpendicular) to the direction of flow. The hydraulic radius is the ratio of the area to the wetted perimeter, as shown in equation 10. The surface width is the width of the channel at the free surface.

The following is the general equation for calculation of hydraulic radius:

$$R = \frac{A}{P} \qquad [10]$$

where

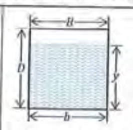
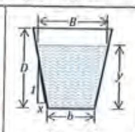
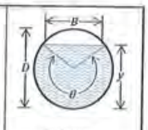
R hydraulic radius (m)

A cross-sectional area of flow (m^2)

P wetted perimeter (m)

The equations for calculating the properties for geometries of some channels are shown in Table 8.5. This guideline is concerning box culverts, so equations for rectangular geometries shall be applied. The equations for trapezoidal and circular geometries have been provided for reference only.

Table 8.5 — Geometric properties for channels

Geometry	 Rectangle (box)	 Trapezoid	 Circle (pipe)
Area of flow, A (m^2)	$b \times y$	$(b + x \times y) \times y$	$\frac{1}{8} \times (\theta - \sin\theta) \times D^2$
Wetted perimeter, P (m)	$b + 2 \times y$	$b + 2 \times y \times \sqrt{1 + x^2}$	$\frac{1}{2} \times \theta \times D$
Hydraulic radius, R (m)	$\frac{b \times y}{b + 2 \times y}$	$\frac{(b + x \times y) \times y}{b + 2 \times y \times \sqrt{1 + x^2}}$	$\frac{1}{4} \times \left(1 - \frac{\sin\theta}{\theta}\right) \times D$
Surface width, B (m)	b	$b + 2 \times x \times y$	$\left(\sin\frac{\theta}{2}\right) \times D$
Angle of flow, θ (radians)			$2 \times \cos^{-1}\left(1 - 2 \times \frac{y}{D}\right)$

where
- b base width (m)
- y depth of flow (m)
- D internal height or diameter (m)
- x width per 1-m height of side slope (m)
- θ angle of flow (radians)

8.4 Design capacity of culverts

The design capacity of discharge for culverts is calculated with equation 11. The design capacity should be more than the design flood, ($Q > Q_F$).

The following is the equation for calculation of design capacity for culverts:

$$Q = \frac{A^{5/3} \times S_0^{1/2}}{P^{2/3} \times n} \qquad [11]$$

where
- Q design capacity of culvert (m^3/s)
- A area of flow (m^2)
- P wetted perimeter (m)
- S_0 gradient of culvert (m/m)

For reference, it should be noted that equation 11 is a combination of the equation for discharge and the Manning equation, as shown below in equations 12 and 13, respectively.

The following is the general equation for calculation of discharge:

$$Q = A \times V \qquad [12]$$

where
- Q design capacity of culvert (m^3/s)
- A area of flow (m^2)
- V velocity of flow (m/s), see equation 13

Sedimentation and debris affects the hydraulic performance of culverts. A margin of 20% of cross-sectional area (A) is recommended for anticipation of sedimentation. In other words, depth of flow should be designed as less than or equal to 80% of the internal height of a box culvert ($y \leq 0.8 \times D$).

The following is the Manning equation for calculation of velocity for culverts:

$$V = \frac{1}{n} \times R^{2/3} \times S_0^{1/2} \qquad [13]$$

where
- V velocity of flow (m/s)
- n Manning coefficient of roughness, see Table 8.1
- R hydraulic radius (m), see Section 8.3
- S_0 culvert gradient (m/m)

The velocity of flow affects the erosion and sedimentation of a culvert. The normal range of velocity of flows are 0.6 m/s ≤ V < 3.5 m/s. In order to reduce the amount of sedimentation, it is recommended that flow velocities are more than 0.6 m/s; if not, regular maintenance should be considered. In order to reduce the amount of erosion, it is recommended that flow velocities are less than 3.5 m/s; if not, erosion protection measures should be considered.

Examples of the design capacity of culverts at various gradients is shown in Table 8.6.

Table 8.6 — Design capacities for example culverts

Size of culvert			Design capacity, Q, (m^3/s) for gradient of							
b (m)	D (m)	y (m)	0.5%	1.0%	1.5%	2.0%	2.5%	3.0%	5.0%	7.0%
1.0	1.0	0.8	1.72	2.43	2.98	3.44	3.84	4.21	5.44	6.43
1.0	1.5	1.2	2.83	4.00	4.89	5.65	6.32	6.92	8.93	10.57
1.0	2.0	1.6	3.96	5.61	6.87	7.93	8.86	9.71	12.53	14.83
1.5	1.0	0.8	3.00	4.25	5.20	6.01	6.72	7.36	9.50	11.24
1.5	1.5	1.2	5.07	7.17	8.78	10.14	11.33	12.41	16.03	18.96
1.5	2.0	1.6	7.23	10.22	12.52	14.46	16.16	17.70	22.86	27.04
1.5	2.5	2.0	9.44	13.35	16.35	18.88	21.11	23.13	29.86	35.33
1.5	3.0	2.4	11.69	16.53	20.24	23.37	26.13	28.63	36.95	43.73
2.0	1.0	0.8	4.39	6.21	7.61	8.79	9.82	10.76	13.89	16.44
2.0	1.5	1.2	7.55	10.68	13.08	15.11	16.89	18.50	23.88	28.26
2.0	2.0	1.6	10.91	15.43	18.90	21.83	24.40	26.73	34.51	40.84
2.0	2.5	2.0	14.39	20.35	24.92	28.78	32.18	35.25	45.51	53.84
2.0	3.0	2.4	17.94	25.37	31.07	35.88	40.11	43.94	56.73	67.12
2.5	1.5	1.2	10.20	14.42	17.66	20.39	22.80	24.98	32.25	38.15
2.5	2.0	1.6	14.89	21.06	25.79	29.78	33.30	36.47	47.09	55.72
2.5	2.5	2.0	19.79	27.98	34.27	39.58	44.25	48.47	62.58	74.04
2.5	3.0	2.4	24.82	35.10	42.99	49.64	55.49	60.79	78.48	92.86
3.0	1.5	1.2	12.95	18.32	22.43	25.90	28.96	31.72	40.95	48.46
3.0	2.0	1.6	19.08	26.98	33.04	38.16	42.66	46.73	60.33	71.38
3.0	2.5	2.0	25.52	36.09	44.21	51.04	57.07	62.52	80.71	95.49
3.0	3.0	2.4	32.18	45.51	55.73	64.35	71.95	78.82	101.75	120.40

8.5 Type of flow

In addition to velocity of flow, the type of flow should be considered when assessing if erosion protection measures are necessary. The type of flow can be considered with the Froude number, as shown in Figure 8.3. The Froude number indicates the flow type as follows:

- $Fr > 1$: supercritical flow (fast)
- $Fr = 1$: critical flow (change point)
- $Fr < 1$: subcritical flow (slow)

The following is the equation for calculation of Froude number and simplification for box culverts:

$$Fr = \frac{V}{(g \times y)^{0.5}} = \left(\frac{Q_F{}^2 \times b}{g \times (y_n \times b)^3}\right)^{0.5} \qquad [14]$$

where
- Fr Froude number (dimensionless)
- V velocity of flow (m/s)
- g gravitational acceleration (m/s^2) = 9.81 m/s^2
- y depth of flow (m)
- Q_F peak discharge or design flood of a watercourse (m^3/s)
- y_n normal depth of flow (m)
- b base width of culvert (m)
- g gravitational acceleration (m/s^2) = 9.81 m/s^2

Normal depth of flow, y_n, can be calculated by changing the depth of flow, y, and subsequently recalculating the area, A, and wetted perimeter, P, for equation 11 until the design capacity is equal to the design flood ($Q = Q_F$). Alternatively, the Newton-Raphson Method may also be used for efficient convergence of $Q = Q_F$.

In addition to high velocity of flow, erosion protection measures at outlets should be considered for supercritical flows where Fr > 1. Recommendations for selection and dimensions of erosion protection measures are outlined in Section 9.

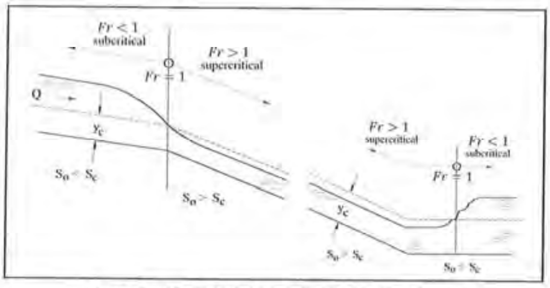


Figure 8.3 — Concept of Froude number indicating type of flow (5)

9 Protection works

Protection measures are necessary where erosion can occur. Outlets of culverts are more problematic and examples of erosion are shown in Figure 9.1. Generally, erosion occurs where:

- velocity of flow is high / flow is supercritical, see Sections 8.4 and 8.5
- direction of flow changes rapidly (i.e. sharp bends), see Section 4.4

Figure 9.1 — Examples of erosion at culvert outlets (7)

9.1 Inlet protection

Erosion upstream of culverts is rarely a problem if inlets have standard wing walls. In case of erosion, provision of stone pitching or gabion mat, or construction of a concrete apron between the wing walls is usually sufficient. Stone pitching of size 200 mm and for a distance of twice the culvert height is normal, as shown in Figure 9.2. A concrete apron at the inlet is shown in Figure 9.3.

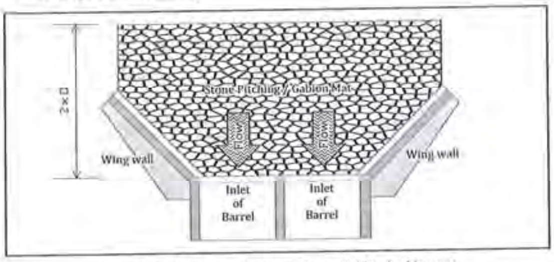


Figure 9.2 — Inlet protection using stone pitching / gabion mat

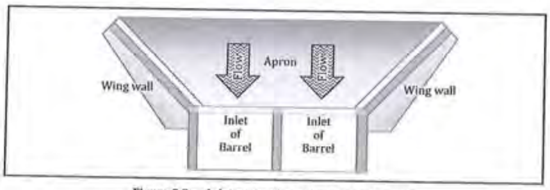


Figure 9.3 — Inlet protection using concrete apron

9.2 Outlet protection

Erosion downstream of culverts is more frequent because of the change in velocity of flow. The change in velocity of flow is because of the difference in cross-section and roughness of channel. The purpose of protection measures is to reduce the velocity until it is similar to the flow in the natural channel.

Erosion protection measures are a standard part of construction for outlets. For normal applications, measures for outlets are similar to inlets, as shown in Figure 9.2 and Figure 9.3. In cases where erosion is a serious concern, a structure for energy dissipation is recommended. The following structures are possible solutions for erosion protection at outlets:

- Type 1 stone stilling basin, see Figure 9.5
- Type 2 stone stilling basin, see Figure 9.6
- Type 3(a) and 3(b) stone stilling basins, see Figure 9.7 and Figure 9.8
- Type 5 concrete stilling basin, see Figure 9.9

9.2.1 Selection of protection measure

The method for selection of an appropriate erosion protection measure is shown in Figure 9.4. Two lines should be drawn perpendicular to axes. The intersection of two lines shows the recommended measure.

Normal flow depth at the outlet and Froude number are required for this selection method. Normal flow depth and subsequently the Froude number for box culverts can be calculated according to Section 8.5. The y-axis is ratio of the normal depth of flow to the height of culvert, y_n / D, and the x-axis is the Froude number, Fr.

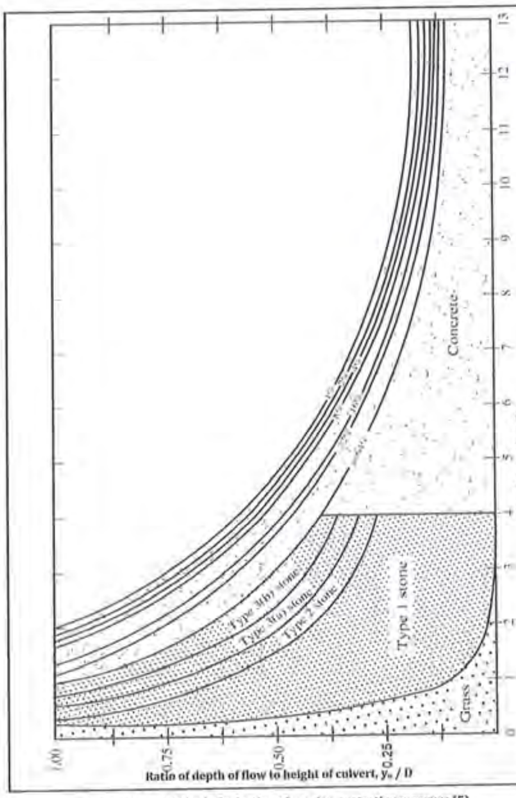
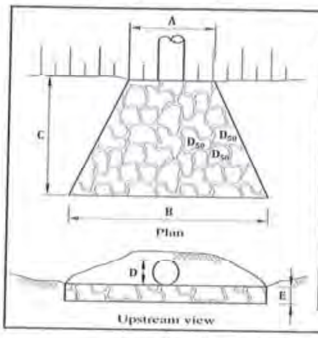


Figure 9.4 — Method of selection of erosion protection measure (5)

9.2.2 Detailing of protection measures

The recommended dimensions and construction of erosion protection measures are shown in Figure 9.5, Figure 9.6, Figure 9.7, Figure 9.8 and Figure 9.9.



D = height of culvert (m)

$A = 3 \times D$
= width of stone basin at outlet (m)

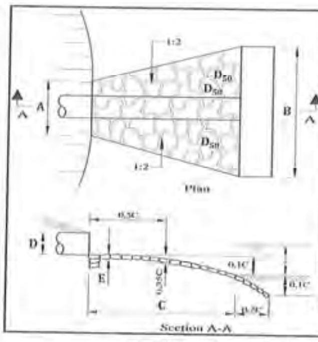
$B = A + C$
= width downstream (m)

$C = 3.0792 \times \frac{Q}{D^{1.6}} + 2.4384$
= length of stone basin (m)

$E = 0.5 \times D \times Fr$
= thickness of stone basin (m)

$D_{50} = 0.0883 \times \frac{Q^{1.333}}{D^{2.333}}$ = minimum size of stones in 50% of basin material (m)

Figure 9.5 — Diagram of type 1 stone stilling basin (5)



D = height of culvert (m)

$A = 3 \times D$
= width of stone basin at outlet (m)

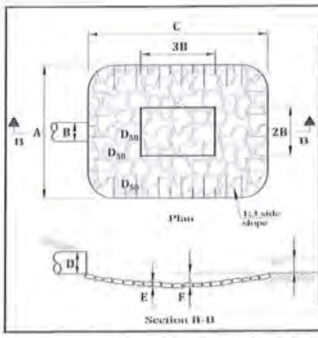
$B = 5 \times D$
= width downstream (m)

$C = 5 \times D$
= length of stone basin (m)

$E = 2 \times D_{50}$
= thickness of stone basin (m)

$D_{50} = 0.0707 \times \frac{Q^{1.333}}{D^{2.333}}$ = minimum size of stones in 50% of basin material (m)

Figure 9.6 — Diagram of type 2 stone stilling basin (5)



D = height of culvert (m)

B = width of culvert (m)

$A = 2 \times D + 6 \times F$
= width of stone basin (m)

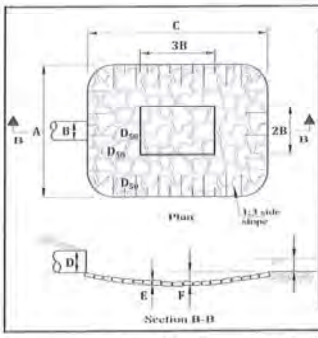
$C = 3 \times D + 6 \times F$
= length of stone basin (m)

$F = 0.5 \times D$
= depth of stone basin (m)

$E = 2 \times D_{50}$
= thickness of stone basin (m)

$D_{50} = 0.0552 \times \frac{Q^{1.333}}{D^{2.333}}$ = minimum size of stones in 50% of basin material (m)

Figure 9.7 — Diagram of type 3a stone stilling basin (5)



D = height of culvert (m)

B = width of culvert (m)

$A = 2 \times D + 6 \times F$
= width of stone basin (m)

$C = 3 \times D + 6 \times F$
= length of stone basin (m)

$F = D$
= depth of stone basin (m)

$E = 2 \times D_{50}$
= thickness of stone basin (m)

$D_{50} = 0.0362 \times \frac{Q^{1.333}}{D^{2.333}}$ = minimum size of stones in 50% of basin material (m)

Figure 9.8 — Diagram of type 3b stone stilling basin (5)

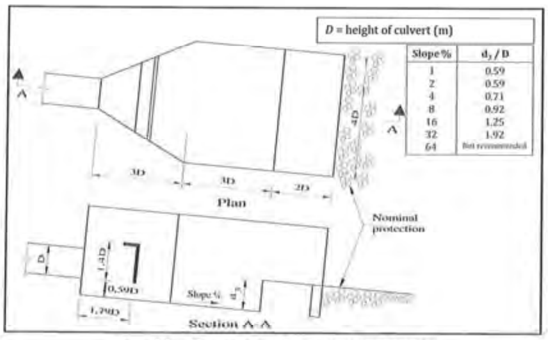


Figure 9.9 — Diagram of type 5 concrete stilling basin (5)

Glossary

English	Tetun / Portuguese/ Indonesian	Japanese
Alignment	Alinhamento / Penjajaran	線型
Allowance height	Altura / Tunjangan tinggi	余裕高
Annual maximum daily rainfall	Chuva diária máxima anual	年最大日降雨量
Annual rainfall	Chuvas anuais	年間降雨量
Area (cross-section of flow)	Área (seção transversal do fluxo)	通水断面積
Artificial channel	Canal artificial / Saluran buatan	人工水路
Basin	Bacia/ Baskom	流域
Catastrophe	Catastrophe / Malapetaka	災害
Catchment area	Área de captação / Area tangkapan	集水地域
Channel profile	Perfil do canal	横断断面
Coefficient	Coeficiente	係数
Critical depth	Profundidade crítica / Kedalaman kritis	臨界深度
Critical flow	Fluxo crítico / Aliran kritis	限界の流れ
Departure	Partida	偏差計算
Depth (of flow)	Profundidade (do fluxo) / Kedalaman (arus)	水深
Discharge	Descarga	排水
Discharge capacity	Capacidade de descarga / Merancang kapasitas debit	通水量
Duration	Duração	期間
Elongated	Alongada /Memanjang	伸びた
Empirical	Empírico	経験的
Erosion protection measure	Medida oinsa atu prevene erosaun	浸食防止工法
Evaporation	Evaporação	蒸発
Extrapolation	Extrapolação	外挿
Factor	Fator	因子
Flood hazard	Perigo de inundação / Bahaya banjir	洪水の危険
Flow	Fluxo / Mengalir	流れ
Frequency	Freqüência	周波数
Friction	Atrito / Gesekan	摩擦
Frictional resistance	Resistência à fricção / Resistensi gesekan	きしみ反応
Froude number	Nural Froude	フルード数
Gradient	Gradiente/Kemiringan	流路勾配
Gradient / bed slope	Gradiente / Encosta do rio / lereng sungai	勾配
Gravitational acceleration	Aceleração gravitacional / Percepatan gravitasi	重力加速度
Headwater	Kedalaman air di Upstream	上流
Height of culvert (internal)	Altura do cais (interno) / Tinggi gorong-gorong (internal)	高さ
Hydraulic jump	Salto hidráulico / Lompatan hidrolik	跳水
Hydraulic mean depth	Profundidade média hidráulica / Hydraulic mean depth	流体平均深さ
Hydraulic radius	Raio hidráulico / Radius hidrolik	径深
Infiltration	Infiltração	浸潤
Influence	Influência	影響
Interpolation	Interpolação	内挿
Lag	Atraso/ Ketinggalan	時差（遅れ）
Limitation	Limitação	制限
Longitudinal section	Seção longitudinal	縦断面
Magnitude	Magnitude	マグニチュード

English	Tetun / Portuguese/ Indonesian	Japanese
Manning's roughness coefficient	Coeficiente de rugosidade de Manning / Koefisien kekasaran Manning	粗度係数
Maximum 24-hour rainfall / Probable daily rainfall	Chuva máxima de 24 horas / Chuva diária provável	確率日降雨量
Mean	Média	平均
Natural channel	Canal natural / Saluran alami	自然水路
Newton-Raphson method	Metodo Newthon-Rapshon	ニュートン・ラプソン法
Normal depth	Kedalaman normal	等流水深
Normal flow	Aliran normal	等流の流れ
Occurrence	Ocorrência / Kejadian	発生
Peak	Pico/ Puncak	ピーク（最大）
Ponding	Ponding/ Kolam	たん水
Prediction	Predição	予測
Probability	Probabilidade	確率
Probability distribution	Distribuição de probabilidade	確率分布
Rainfall	Chuva / Precipitação	降雨
Rainfall intensity	Intensidade da chuva	降雨強度
Rational Method	Método Racional (hidrología)	合理式
Return period	Período de retorno	確率年
Riprap	Riprap (Fatuk kasar nebe usa ba protesaun ba erosaun)	護岸工
Runoff	Escoamento/ Limpasan	流出
Sedimentation	Sedimentação / Pengendapan	堆積
Sharp bend	Curva acentuada / Tikungan tajam	急カーブ
Standard deviation	Desvio padrão	標準偏差（SD）
Stilling basin	Posisi celungan	減勢池
Storage	Armazenamento	貯水池
Subcritical flow	Fluxo subcrítico / Aliran subkritis	常流
Supercritical flow	Fluxo supercrítico / Aliran supercritical	射流
Tailwater	Kedalaman air di Downstream	下流
Time of concentration	Tempo de concentração	洪水到達時間
Trial-and-error method	Metodo trial no error	試行錯誤手法
Uniform	Uniforme	均一
Urbanised	Urbanizado	都市化された
Velocity	Velocidade/Kecepatan	洪水速度
Watercourse	Curso de água / Anak sungai	水路
Watershed	Bacias hidrográficas/ Batas air	分水地点
Weighted average	Média ponderada	加重平均
Wetted perimeter	Perímetro molhado / Perimeter terbasah/Keliling basah	潤辺
Width (internal)	Largura (interna) / Lebar (internal)	幅

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7. **Federal Highway Administration.** *Hydraulic Design of Highway Culverts.* 3rd Ed. Springfield : U.S. Department of Transportation, 2012. FHWA HIF-12-026.

8. **Direktorat Jenderal Bina Marga.** *Standar Gorong-gorong Persegi Beton Bertulang Tipe Single [Standard for Single Concrete Box Culverts].* Jakarta : Indonesian Directorate General of Highways, 2009. BTI/S.

9. —. *Standar Gorong-gorong Persegi Beton Bertulang Tipe Double [Standard for Double Concrete Box Culverts].* Jakarta : Indonesian Directorate General of Highways, 2009. BTI/D.

10. —. *Standar Gorong-gorong Persegi Beton Bertulang Tipe Triple [Standard for Double Concrete Box Culverts].* Jakarta : Indonesian Directorate General of Highways, 2009. BTI/T.

Attachment 4

Workshop “Explanation & Usage of checklist for Construction on Site on 25 June 2018

Work Shop : Work Shop for Explain & Usage of "Check List for Construction" on sites

On-going construction area for Stone Masonry Retaining Wall, on Emergency Works Humboe-Letefoho Road, Jct.A04 Gleno - Jct A10 Letrfoho, on February 2018

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

Work Shop : Explanation & Usage of "Check List for Construction" on site,

as Case Study, OJT using "Check List" on the site of "Emergency Work" (Humboe - Letefoho, Ermera on A10)

0) Small test for Road Construction Supervising
1) Showing examples of "Check List for Construction"
2) Explain and demonstration of Usage of the List

references: Booklet of Construction Check List _ version 0

25th June, 2018
10:00～11:30

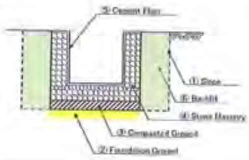
Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC) and JICA Expert Team (JET)

1) Showing examples of " Check List for Construction"

"Stone Masonry Drainage" of small structure and "Regular Safety Activities for Safety Control"

Please see example of "Check List", explanatory sketches and checking table

CHECK LISTS
Stone Masonry Drainage



Example of Check List for Stone Masonry Drainage

Name of Project:	[illegible]
Location:	STA [illegible] – STA [illegible]
Date:	[illegible]
Inspector:	[illegible]

No.	Check Items	Judgements		[illegible]	Remarks
0	Preparatory activity				
	Did you confirm the drawings?	Yes	No		
	Did you confirm the construction work plan?	Yes	No		
1	Slope				
	Was excavation slope appropriate?	Yes	No		
	Was removal of water appropriate?	Yes	No		
2	Foundation Ground				
	Is strength of bearing ground sufficient?	Yes	No		
	If No, was the replacement of soft ground appropriate?	Yes	No		Replacement. Thickness [illegible]
3	Compacted Ground				
	Did you use the compactor for compaction?	Yes	No		
4	Stone Masonry				
	Was Stone material appropriately?	Yes	No		150mm ≦ Stone thickness ≦ [illegible]
	Was cement mortar composed appropriately?	Yes	No		Cement 1 : Sand 3
5	Cement Floor				
	Was cement mortar composed appropriately?	Yes	No		Cement 1 : Sand 3
5	Foundation Ground				
	Did you check the backfill material?	Yes	No	—	Selected Material. From [illegible] Pit No.1
	Did you confirm the soil density test results?	Yes	No	[illegible]	Expected density [illegible]
	Did you confirm the compacted thickness?	Yes	No	[illegible]	Expected thickness [illegible]

CHECK LISTS for Safety Control 2. Regulay Safety Activities

CL.SC-2

Following requlary safety activies are desired on the site;

Tool box meeting

As a each working group, supervisors explain today's work procedures and safety remarks to workers

Safety Patrol

Jointly site inspection and find out dangerous points and if necessary instructions are to be made

Safety Assembly

Safety Gatherings are to be made in order to promote all workers' awarness of Safety on the construction site.

2. Regulay Safety Activities

Name of the Project:

Date: [illegible]

Location: STA [illegible] – STA [illegible]

No.	Check Items	Judgements		[illegible]	Remarks
	- Safety Patrol by the Contractor				
1	Does PM or site engineer conduct Daily Safety Patrol ?	Yes	No		
2	Does PM or site engineer conduct Weekly Safety Patrol ?	Yes	No		Joining sub-contractor is preferable
3	Does PM or site engineer conduct Monthly Safety Patrol ?	Yes	No		Joining Employer is preferable
	- Progress and Safety Meeting				
4	Weekly Progress & Safety meeting is held?	Yes	No		Joining Employer and sub-contractor is preferable
5	Monthly Progress & Safety meeting is held?	Yes	No		Joining Employer essential
6	Site Safety Committee meeting is held ?	Yes	No		
	- Regulay Safety Activities				
6	Have Safety Assembly been carried out ?	Yes	No		Safety Gatherings are to be made in order to promote all workers' awareness of Safety on the construction site
7	Educational training to operators and workers have been conducted?	Yes	No		[illegible]
8	Contractor's PM or site supervisors do safety patrol [illegible] every day ?	Yes	No		[illegible]

2) Explain and demonstration of Usage of the List

In case of "Stone Masonry Drainage" on following sites;

Check existing ground condition → If not strong enough

When you find the existing ground is not strong enough, fill the countermeasures in the checking List

Please fill counter measures for the ground/and others

CHECK LISTS Stone Masonry Drainage

Name of Project:	Package [illegible] Emergency Works
Location:	Near Dato[illegible], A10 Ermera
Date:	[illegible]
Inspector:	Atandes of WS for Explanation of Check List

No.	Check Items	Judgements		[illegible]	Remarks
0	Preparatory activity				
	Did you confirm the drawings?	Yes	No		
	Did you confirm the construction work plan?	Yes	No		
1	Excavation, Slope				
	Was excavation width appropriate?	Yes	No		1) Gravel foundation
	Was excavation slope appropriate?	Yes	No		2) Replace existing materieal with good materil
	Was removal of water appropriate?	Yes	No		
2	Foundation Ground				
	Is strength of bearing ground sufficient?	Yes	No		
	If No, was the replacement of soft ground appropriate?	Yes	No		3) Stabilization Cement
3	Compacted Ground				
	Did you use the compactor for compaction?	Yes	No		
4	Stone Masonry				

Check basement of stone masonry → Thickness and material

When you find the foundation and base part of Stone Masonry Drain is not properly, check the relevant item of the Checking List

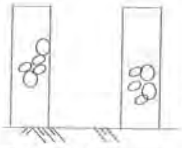
Please check items, Drawing and thickness and material for the foundation and basements

CHECK LISTS Stone Masonry Drainage

Name of Project: Package 9 and/or Emergency Works

No	Check Items	Judgement		[illegible]	Remarks
0	Preparatory activity				
	Did you confirm the drawings?	Yes	No		
	Did you confirm the construction work plan?	Yes	No		
1	Excavation, Slope				
	Was excavation width appropriate?	Yes	No		
	Was excavation slope appropriate?	Yes	No		
	Was removal of water appropriate?	Yes	No		
2	Foundation Ground				
	Is strength of bearing ground sufficient?	Yes	No		
	If No, was the replacement of soft ground appropriate?	Yes	No		Countermeasures:
3	Compacted Ground				
	Did you use the compactor for compaction?	Yes	No		
4	Stone Masonry				
	Was Stone material appropriately?	Yes	No		150mm ≦ Stone thickness < [illegible]mm
	Was cement mortar composed appropriately?	Yes	No		Cement 1 : Sand 3
5	Cement Floor				
	Was cement mortar composed appropriately?	Yes	No		Cement 1 : Sand 3

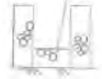
In case of base part of Stone Masonry Drain cannot be found at the site



Original ground is no treatment

Foreseen counter measures:
1) Check the Drawing and how much thickness of base part

2) Making the base part of Stone Masonry



3) Check the construction joint of base/wall and sealing with mortar plaster is preferable

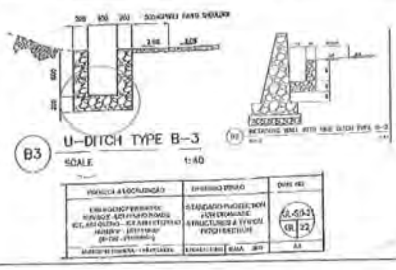
Counter measures for the ground and Procedures of construction (1) Gravel base, base concrete and Form works

Stone Masonry Drainage at Package 9 near Betano, 2017

Record of construction (2) Casting concrete and completion of the Drain

Stone Masonry Drainage at Package 9 near Betano, 2017

See the Drawing (Contract or Shop-drawing) for the Stone Masonry Line Drainage structure



Record of construction completion of the Stone Masonry Drain

Stone Masonry Drainage at Emergency Works in Ermera, 2018

Practice of Usage of the List

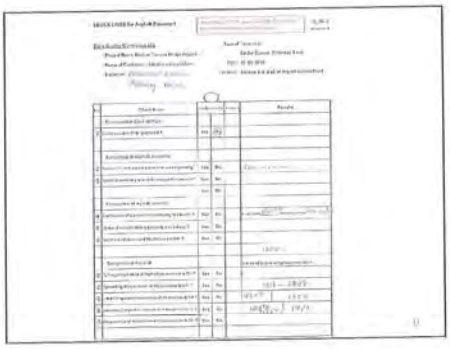
Initial temperature checking

Initial Compaction by Macadam

Record data on to Check-list during QC

Work Shop 3-2 of Observation Asphalt Pavement on up-river Comoro Bridge Project

2018/10/30



Practice of Usage of the List

Excavation for Stone Masonry Line Drain. OJT for how to use the Check List for supervision

at about STA13km near existing Bridge Emergency Works Humboe-Letefoho Road

2018/10/30

References

- Booklet "Check List for Construction" _Version 0

★ *Proposed Schedule of Case Study (C/S) for Road Construction Supervision*

- On 26 June, 2018, Coordinate Meeting of Site Safety Committee for the pilot site
- On26PM June, 2018, Safety Patrol on the site of Ex-Japan Road
- On the Job Training for Construction Supervision using "Check List" at the site of Emergency Works Humboe-Letefoho Road, Jct.A04 Geleno - Jct A10 Letrfoho and other sites

☆ Obrigado Barak !!

2018/10/30

Small test for Supervising the construction site under DRBFC

Responsor Department	Name			Date
Question	Answer : Choose the one of them as the most appropriated answer.			
Q- 1 Which combination is said three major control items for supervision of construction site / *Cobinasaun ida neba mak hatelen item principais ba supervisaun area construsaun)*	1) Safety control, Cost control, Quality control *(Controlo seguransa,cost relo custo,controlo Qualidade)* ☐	2)Cost control, Progress control, Quality control*(Control o custo, controlo progresu,controlo Qualidade)* ■	3) Progress control, Quality control, Employment control *(Controlo Progreso,Controlo Qualidade Control o do empregu)* ☐	1) Safety control, Quality control, Employment control *(Controlo Seguransa,Controlo Qualidade,Controlo de Emprego)* ☐

Answer & Expalanation of Small test

Answer	Expalnation
Q-2	· Generall speaking, major control items of supervision for on-going construction site are said following three; i) Progress Control ii) Cost Control iii) Quality Control
(2)	

2018/10/30

Q- 2 Which is the original word of the abviation of "ESI" *(Liafuan saida mak sai hanesan liafuan original ba singkatan*	1) Engineering Special Inspector	2) Engineering Social Improvement	3) Enviromental Social Impact	4) Enviromental Social Improvement

Q-2	Enviromental Social Impact (ESI) is one of most essential issue for the implimentation for infrasture Project, such as removal & compensation of resident people/farm land/ building. ESI is most attention at Planing Stage and is also most important matter of the Project as well as the issue of Sfety / Heath of workers. <see STS item 104>

Q- 3 Which measure will you take, when you find the existing ground of Line Drain is not strong enough, like the case of below photo; *(Medida saida mak ita foti, wainhira ita hetan rai saluran drainagem la forte e sufisiente,hanesan imagem nebe hatudu iha okos ne)* 	1)Replace unsuitable material and fill good material to the foundation *(Subtitui material sira neba ladiak no prenche fali ho material sira nebe mak diak ba fondasi)* ☐	2) Additional gravel/stone material in place at the foundation of the Line Drain *(Material gravel adicional tau iha naha iha fondasi saluran drainagem.)* ☐ In case of Line "Stone Masonry Drainage"	3) Add cement or lime into original soil, mixing them to be stabilized strengthen *(aumenta kes semente ou Kapur ba rai original,kahur (semente/kapur no rai original) nune bele stabiliza rai nia forsa)* ☐	4) Consider conter measure and estimate the Cost and Instruct to Contractor *(Considera Contramedida no estimasaun ba custo no instrusi ba Contractor)* ■

Answer	Expalnation
Q-3 Both (1),(2)&(3) are 0.5 marks	· Both countermeasures of 1), 2) and 3) are not wrong counter-measures. · Firstly, Supervisor (SV,Residend Engineer or engineer in charge of the construction) must check the site condition and consider countermeasures. · Secondery, SV compare possible counter- measures, togerwith its cost and make decision

In case of additional cost needs , it would be Variation Order

Q- 4	Which year of edition for Standard Specification (STS) of Minister of Publick Works is stipulated/used in the Contract of DRBFC (*[illegible]*)	1) 2000	2) 2005	3) 2010	4) 2014

Q-4	In current DRBFC Contract, Standard Specification (STS) of Minister of Publick Works edition on 2005 are applied. - The same of edittion on 2014 were also publishaed.

Responsor Department:		Name:		Date:
Questions	Answer : Choose the one of them as the most appropriated answer.			
Q- 5 How do you protect the coordination of control points physically and formaly ? (*[illegible]*)	1)To cover with a little soil on 2018 (*[illegible]*) ☐	2)To cover with a much soil (*[illegible]*) ☐	3)To install peg and instruct the resident to protect (*[illegible]*) ☐	4)To set up by reference points for restoration (*[illegible]*) ■

Answer	Expalnation
Q-5	· Bench Marks and Control Points for cordination are essential phyical point of the Works. They must be proptected and secured for restoration<refert to STS 109.4 Setting Out of Works>

Q- 6 Which combination of descripetions is required for Shop /Contract Drawing from the Contractor (*[illegible]*)	1) Places of structure, Cost of work item, Dimentions of cross section (*[illegible]*)	2) Cordination of survey points, Cost of work item, Dimentions of cross section (*[illegible]*)	3) Cordination of survey points, Daily Safety activities, Places of structure (*[illegible]*)	4) Cordination of survey points, Places of structure, Dimentions of structure (*[illegible]*)

Q-6	· Shop /Contract Drawing from the Contractor should provide/show following descriptions; i] Cordination of survey points, ii] Alinement of Structure such as Road etc ii] Sowing the places of structure, iv] Dimentions of structure/ cross section and others,

Responsor Department:		Name		Date
Questions	Answer : Choose the one of them as the most appropriated answer.			
Q- 7 Which measur will you take, when you cannot find the part of basis of stone masonry drain during the construction, like the case of below photo. (*[illegible]*) 	1) Ask the Contractor why there is not base of stone Maisony Drain (*[illegible]*) ☐	2) Check the ground condition and the Drawing (*[illegible]*) ■	3) Instruct the Contractor to re-construct Drain, firstly make basement (*[illegible]*) ☐	4) Instruct the Contractor to replace the soil and make basement first (*[illegible]*) ☐

Answer	Expalnation
Q-7	· Check the ground condition First i] If the ground condition is not strong, it will be necessary for treatment of existing groud, In case like answer 4) action ii] If the ground condition is good and strong enough and the Dwraing shows the Basement part of Stone Masonry, then instruct to make basement

Q- 8 Which combination of explination is correct for each Photos. (*[illegible]*)	1) a)Safety patrol b)Safety Assembly c)Safety education ☐	2) a)Tool Box Meeting b)Safety education c)Safety Assembly ☐	3) a)Tool Box Meeting b)Safety Patrol c)Safety Assembly ■	4) a)Tool Box Meeting b)Safety education C)Safety Patrol ☐

Photo (a)

Photo (b)

Photo (C)

Q-8 (2) is 0.5 marks	· The name of Safety activities on site are: a)Tool Box Meeting (usuay carried out after daily morning Meeting by all personnel) b)Safety Patrol c)Safety Assemblyth countermeasures but all activities involve the "Safety education" for all workers and site staff

Responsor	Department	Name		Date
Questions	Answer : Choose the one of them as the most Appropriate answer.			
Q-9 Which is correct answer, do you think, regarding below Progress Charts? Please (✓) among following answers. [illegible]	1) Chart (a) is difficult for calculation for cumulative value, so it is not suite for actually construction project. [illegible]	2) Chart (b) (Net Works) is easy to make chart, so it is suite for simple and small scale of construction project [illegible]	3) Chart (a) is combine the bar chart and cumulative curve and it is common to be applied to construction project [illegible]	4) Bar chart represents the days for each works and cumulative curve represents the progress. So such charts should not be shown in the same chart. [illegible]

Progress Chart (a)

Progress Chart (b)

Answer	Expalnation
Q-9	・ You can easily see such "Progress Chart" consits bar-chart and cumulative curve on the Contractor's initial Plan and Monthly Report. [illegible]

Responsor	Department	Name		Date
Questions	Answer : Choose the one of them as the most appropriated answer.			
Q-10 Which combination of temperature is preferable for each stage of Asphalt Pavement, as below stage. a) Initial Stage b) Fist compaction by Macadam Roller c) Second compaction by Tire Roller *(Combinasaun ba Temperatura ida nebe mak diak liu ba cada tahap asphalt pavement,hanesan etapa kuir mai ne;* *a) Etapa inicio* *b) Primeiro compactação usa macadame Roller* *c) Segundo compactação usa pneu Roller*	1) a): > 155℃ b): 135 - 155 ℃ c): 120 - 140 ℃	2) a): > 155℃ b): 130 - 150 ℃ c): 125 - 145 ℃	3) a): > 145℃ b): 125 - 145 ℃ c): 100 - 120 ℃	4) a): 135 - 150℃ b): 125 - 145 ℃ c): 100 - 125 ℃

a)Initial temperature checking

b)First Compaction by Macadam

Q-10 According to Table 411.5.4 of Standard Technicalspecification, ecxact answer is 4). And Final Critieria of tempiature will be mode by the Design and Engineer's Instruction with consideration of the site condition
5. Delivery to finisher = initial temprature
6. DBreaking Rolling = First Compaction by Macadum Roller
7. Second Rolling = Second compaction by Tire Roller

Table 411.5.4 [illegible]

No	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	Delivery to Finisher [illegible]	[illegible]	[illegible]
6	Breakdown Rolling [illegible]	[illegible]	[illegible]
7	Secondary Rolling [illegible]	[illegible]	[illegible]
8	Finishing Rolling [illegible]	[illegible]	[illegible]

A 4) is exactly same as Table 411.5.4
and
A 3) is also not wrong

CHECK LISTS for Tender Document 1. Type of Tender

Select & decide the Type of Tender (Contract)

According to the Type of Tender (Contract), requirements and documents of Tender are to be differs.
Firstly, Type of Tender or Contract are selected and decided among below classification:

I. Category of Competitiveness
1. Open Tender (Bidding)
 1-1: International Competitive Tender (Bid) : ICB
 1-2: Domestic Tender : Only Timor Leste company can participate
 1-3: Conditional domestic Tender : Limitation of tender with some condition among domestic company
2. Nomination, proposal and Negotiation Tender
 2-1: Single nomination company
 2-2: Plural nomination companys : Procedure is almost the same as Type 1-2 and/or 1-3

II. Category of Terms of Contract (responsibility of Contractor)
A. Contract consits of Design and Construction
B. Contract consits of only Construction

* This Check List applys only Domistic Type of Tender, because of 1-1Tender are large scale of Project and made by almost Loan Project.
** 1-2 is as same as 1-3 only conditions, so show the List only 1-2
*** Requirements of Tender Document is the same of both open (plural nomination) and single nomination.
Only the evaluation for Tender is different

1. Secting and decision of Type of Tender Name of the Project
Tender section of the Project Date:
Name of person in charge the Tender:

No.	Check Items	Judgements		[illegible]	Remarks
	I. Category of Competitiveness Protection equipment for workers				
1	Is Tender Open Bid or Nomination/Proposal Type	Yes	No		If Yes: Forward ②Checking
					If No: it is Nomination/Proposal Type, Forward ③
2	Are there any conditions of the candidate (Tenderer)?	Yes	No		If yes: Type 1-2
					If No: Type 1-3
3	Is Nomination to only one company ?	Yes	No		If yes: Type 2-1
		Yes	No		If No: Type 2-2
	II. Category of Terms of Contract (responsibility of Contractor)				
1	Does Contract consits of Desig and Construction?	Yes	No		If yes: Type X-Y-A
					If No: Type X-Y-B

CHECK LISTS for Tender Document 2. Documents for Type 1-2-B

Tender Documents for
- Conditional domistic open Tender
- Plural companys (Tenderers)
- Contract consits of only Construction

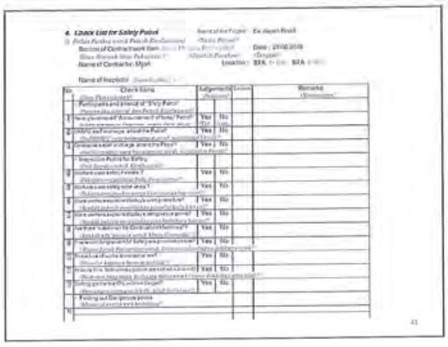
[illegible]

I. [illegible]
II. [illegible]

	Volume I		✓	[illegible]
1	Instruction to Tenderers	[illegible]		
2	Tender Data Sheet	[illegible]		
3	Form of Contract Agreement	[illegible]		
4	Particular Conditions of Contract (PCC)	[illegible]		
5	General Conditions of Contract (GCC)	[illegible]		
6	Specifications	[illegible]		
7	Special Specification (if any)			
8	Tendering Forms	[illegible]		
	Power of Attorney	[illegible]		
	Certificate of Signature of the Issuer	[illegible]		
	Letter of Price Technical Tender	[illegible]		
	Proposed Construction Schedule	[illegible]		
	Proposed Contractor's key staff Schedule	[illegible]		
9	Form of Bill of Quantities			
	Volume II			
	Drawing			
	[illegible]			

CHECK LISTS for Tender Document 3. [illegible]

[illegible]



4. Check List for Safety Patrol

Section of Contract work item

Name of Contractor:

Name of Inspector

Check Items

Remarks

Finding out Dangerous points

Instructions and expecting counter measures (if any)

Attachment 5

Record of 1st Coordination Meeting of Site safety patrol and record of 1st safety patrol by DRBFC on 26 June 2018

Enclosure :

29 June, 2018

Record of Coordination Meeting of Site Safety Committee and Safety Patrol by DRBFC (For Case Study activity of CDRS project; Safety Patrol by DRBFC)

Members of Site Safety Committee for
DRBFC Safety Activities

This is the record of the Coordination Meeting of Site Safety Committee and Safety Patrol by DRBFC for said Case Study of CDRS project.
Date/places and the record of the discussions in the Meeting and Finding of dangerous point are follows. Reference information is shown herewith in the attachments.

1. Date and Places

1) Coordination Meeting of Site Safety Committee
   - Time and Date : 10:00 – 11:20, Tuesday 26 June, 2018
   - Venue : Conference room of DRBFC, Dili

2) Safety Patrol by DRBFC
   - Time and Date : 14:30 – 16:30, Tuesday 26 June, 2018
   - Places ①: STA 18+300, Footway construction using precast concrete block Constructed by "Sunrise" management by "NTN"
   - ②: STA 7 – 8km, Stone Masonry Retaining Wall Constructed by "Mijori" management by "Jonise"

2. Discussions in the Meeting

- Opening speech by Mr. Nazario, a coordinator of the Committee, with explaining the objective of the meeting for pilot safety patrol by DRBFC and how to coordinate the member of the safety patrol and introduce the member of safety committee, what kind of the activities the committee member will do during the Patrol.
- After Mr. Nazario finish the speech CDRS Expert continue the meeting with the explanation of Safety patrol procedure, objective of the safety patrol and explanation of usage checklist for safety patrol.

Agenda and attendance list are referred to the attachments #1 -3.
Following question/answer and discussion were made during the Coordination Meeting;

Question / Answer

1) Selection of the committee member and Who in charge of the Committee

Q1/ Contractor: Base on the procedure of safety patrol on slide number 7, in first part mention "Organize the site by safety committee", the question is who will in charge for this committee?

A2/ CDRS adviser: Firstly Director of DRBFC instructed the Construction Department to carry out Safety activities and organize the Site Safety Committee. And the Chief of Construction Dept. requested contractors to participate such Safety Activities and other observing member were selected by each Department Chief's recommendation. Usually, safety patrol conducted by contractor consist the Client, the Consultant and Financial support, but this safety patrol is introduce to DRBFC, that's why it's conducted by DRBFC, but still including the contractor and the consultant.

2) How approach the initiative of Safety Activity

Q2/ JICA representative: How you approach this initiative to the Director?

A2/CDRS adviser: In 2016 and 2017, we conducted Lectures for Safety and Observations of Safety activities on Up-Comoro Bridge construction site. In those activities, explanation of the importance of Safety and introduced to execution of Safety Activities.
And it is made of the understanding of the Director because of the without Instruction/Initiative from the Director, any action cannot start with.

3) Objective of Safety Patrol

Q3/ Contractor: what is the objective of this safety patrol?

A3/ JICA representative: the goal is to ensure the safety of workers, because if safety is guaranteed the project will automatically run smoothly, activities undertaken in safety patrol are inspection of the project site and discussing about what is found on the project site and recommend to the contractor to repair.

Comments / Suggestions

CS1/ Coordinator of the Committee: DRBFC appreciates the initiative form JICA EXPERT Team (CDRS), how to implemented safety Patrol in the Future.

CS2/ DRBFC member: It's better for the safety patrol us also including another ministry like SEFOPE

CS3/ some of the contractor are not concerned about of safety issues because no budget for safety equipment, that is one of reason.

CS4/ Contractor: this meeting is pre-design, it's would be better to invite ADN because sometimes we put the safety worker as importance issues but they did not pay attention, because they think it's not necessary. They have no knowledge of safety patrol they only know about safety management.

3. Findings of dangerous points and counter measures.

①: STA 18+300, Footway construction using precast concrete block (Constructed by "Sunrise" management by "NTN")

Finding out dangerous point

1) Temporary Exit /Entering point looks danger for vehicles because there is no indication from main road to temporary detour road before Chines Quarry Factory
2) Workers don't wear safety helmet

Expecting counter- measures

1) To put signboard to show the detour road Exit/ Entrances
2) To instruct contractor to let workers to wear safety apparatus

②: STA 7 – 8km, Stone Masonry Retaining Wall (Constructed by "Mijori" management by "Jonise")

Finding out dangerous point

1) There is much dust on the site with affecting everybody's healthy condition
2) In some work group, workers don't wear safety helmet
3) In Rainy season, slope of weak ground is likely to cause the slope collapse and it becomes danger for workers.

Expecting counter- measures

1-1) To carry out watering to the dusty road
1-2) To wear musk preventing such dust from the workers
2) To instruct contractor to let workers to wear safety apparatus

Attachment1: Attendance List
2: Photos of Works Shop
3: Agenda of Site Safety Committee
4: Hand-out material of presentation of Explanation for Safety Patrol
5. Check List for Safety Patrol used on the site on 26 June 2018

Attachment1. Attendance List

ATTENDANCE LIST

Date :26 June 2018
Subject :Kick-off meeting for Pilot Safety Patrol by DRBFC
Venue : DNEPCC Conference Room

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
1	Mr/Ms	Joao Geregorio de Carvalho	Chief	Construction			
	Mr/Ms	Nazario De Jesus Freitas	Engineer	construction			
2	Mr/Ms	Pricilia I. Dos R. Gomes	Engineer	Construction			
3	Mr/Ms	Alfredo E. Dos Santos	Engineer	Training & Cooperation			
4	Mr/Ms	Angelo Riberiro	Engineer	Training & Cooperation			
5	Mr/Ms	Lourenco Luis	Engineer	Project			
6	Mr/Ms	Julias L. Kely	Engineer	Project			
7	Mr/Ms	Mouzinho Tilman	Engineer	Maintenance			
8	Mr/Ms	Albino Fernandes Da Costa	Engineer	Maintenance			
9	Mr/Ms	Fernando F. F. C. Freitas	Engineer	Highway			
10	Mr/Ms	Celestino F. Ximenes	Engineer	Highway			
11	Mr/Ms	Syahrul Akbar	Project Manager	Jonise			
12	Mr/Ms	Jonji Kairumi	Advisor	CDRS Road Construction supervision			
13	Mr/Ms	Leticia Silveira A. Barreto	Asst. Advisor	CDRS			
14	Mr/Ms	Steven N. S. - Rag[illegible]	Engineer	Jonise			
15	Mr/Ms	[illegible]	[illegible]	[illegible]			
16	Mr/Ms	MANUEL Soares	Engineer	Project Dep			
17	Mr/Ms	AGUSTINHO DA COSTA	ASST. SUP [illegible]	MAINTENANCE			

No	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
18	Mr/Ms	Bernardo Ferreira	Tec.	Mantinance			
19	Mr/Ms	Pedro C.R. [illegible]	Tec	----			
20	Mr/Ms	Luis S. da Cruz		Constrution			
21	Mr/Ms	[illegible]	Tec	[illegible]			
22	Mr/Ms						
23	Mr/Ms						

ATTENDANCE LIST

Date :26 June 2018
Subject :Pilot Safety Patrol by DRBFC at Ex Japan Road
Venue : DNEPCC Conference Room

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
1	Mr/Ms	Joao Gregorio de Carvalho	Chief	Construction			
	Mr/Ms	Nuario Da Jesus Freitas	Engineer	construction			
2	Mr/Ms	Pricilla L. Dos R. Gomes	Engineer	Construction			
3	Mr/Ms	Alfonso C. Dos Santos	Engineer	Training & Cooperation			
4	Mr/Ms	Angela Ribeiro	Engineer	Training & Cooperation			
5	Mr/Ms	Lourenco Luis	Engineer	Project			
6	Mr/Ms	Julius L. Kehy	Engineer	Project			
7	Mr/Ms	Mesquita Tilman	Engineer	Maintenance			
8	Mr/Ms	Afonso Fernandes Da Costa	Engineer	Maintenance			
9	Mr/Ms	Fernando F. P. C. Freitas	Engineer	Highway			
10	Mr/Ms	Celestino L. Ximenes	Engineer	Highway			
11	Mr/Ms	Ryoichi Akiba	Project Manager	Jonise			
12	Mr/Ms	Joji Kotani	Advisor	CDRS/Road Construction supervision			
13	Mr/Ms	Leticia Silvoira A. Barreto	Asst. Advisor	CDRS			
14	Mr/Ms	[illegible]	[illegible]	[illegible]			
15	Mr/Ms	Steven N. C. Rajah	[illegible]	[illegible]			
16	Mr/Ms	Antalisio Da Costa	[illegible]	[illegible]			
17	Mr/Ms	[illegible]	[illegible]	[illegible]			

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
18	Mr/Ms	[illegible]	[illegible]	[illegible]			
19	Mr/Ms						
20	Mr/Ms						

Attachment 2: Photos for the Meeting and Safety Patrol by DRBFC on 26 June, 2018


Ph1: Coordination Meeting of site Safety Committee were held at the conference room of DRBFC, Dili


Ph-2: Ditto but including Contractor


Ph-3: Inspection site ①: STA 18+300, Footway construction using precast concrete block, constructed by "Suntise"


Ph-4: Ditto but joint Inspection by site Safety Committee, including Contractor in charge of the works


Ph-5: Ditto but member using Check List for "Safety Patrol" and points out dangerous point


Ph-5: Inspection site ②: STA 7 – 8km, Stone Masonry Retaining Wall (Constructed by "Mijori" management by "Jonise")


Ph-6: Ditto but joint Inspection by site Safety Committee, including Contractor in charge of the works


Ph-7: Ditto but member using Check List for "Safety Patrol" and points out dangerous point


Ph-8: Ditto but also discuss about counter measures


Ph-9: Ditto


Ph-7: Ditto but member of Site Safety Committee and supervisors from contractor

Attachment 3: Agenda of Site Safety Committee

Coordination Meeting

For

Site Safety Committee for "Safety Patrol by DRBFC"

(Rapat Koordinasi untuk Panitia Keselamatan di lokasi untuk "Patroli Keselamatan oleh DNEPCC")

Date: Tuesday 26 June, 2018

Time: 10:00 – 11:30

Venue: Conference Room, DRBFC Head quarter, Dili

AGENDA

09:50 – 10:00	Arrival and Reception for proposed site Safety Committee member,attendance
10:00 – 10:10	Opening Address: *(Kata Sambutan :)* Eng. Joao Gregorio de Carvalho Chief of Dep. Construction of DRBFC and Chairman of pilot Site Safety Committee
10:10 – 10:20	1. Introduction of the member of pilot Site Safety Committee *(Pengenalan anggota panitia dan percontohan Keselamatan lokasi Proyek)* See proposed List of member of the Committee *(Lihat daftar usalan anggota panitia)*
10:20 – 10:35	2.Explanation of procedure of Safety Patrol *(Penjelasan prosedur dari Patroli keselamatan)* CDRS, Expert Mr. J. Koizumi (Road Construction Supervision)
10:35 – 11:00	3.Discussion/decision of the Date and Place of 1st "Safety Patrol" *(Diskusi/keputusan tanggal dan tempat untuk "Patroli Keselamatan" Pertama diadakan)* See the location Map of Ex-Japan Road construction site *(Lihat peta lokasi konstruksi Ex-Japan Road)*
11:55 – 11:00	Closing Remarks
11:00	Adjourn

References: 1. Proposed member of "Site Safety Committee"
2. Location Map of Ex-Japan Road construction site
3. Draft of "Check List of Safety Control" on site *(Draft Untuk "Check list of Safety Control" di lokasi Proyek)*

Reference 1: Coordination Meeting

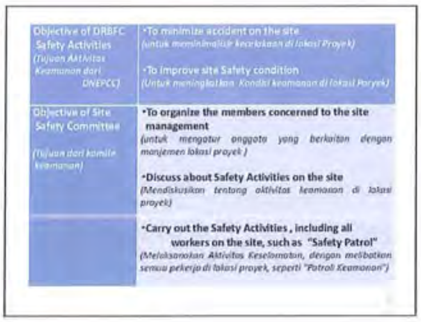
Draft of Member of pilot "Site Safety Committee"

= For Case Study of "Safety Patrol by DRBFC" at pilot site on Ex-Japan Road =

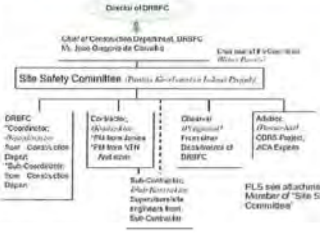
Updated on 2018.06.21 First wrote on 2018.03.01

Party	Role in the Committee	Title and Department	Name of member (Draft only)	Correspondence
DRBFC	Chair person	Chief of Construction Dept.	Eng. Joao Geregorio de Carvalho	
	Coordinator	Engineer in charge of proposed site	Eng. Nazario De Jesus Freitas	
	Sub-coordinator	Construction Dept.	Eng. Pricilla I. Dos R Gomas	
	Observer	Representative of Training & Cooperation Dept.	Mr. Alfredo E. Dos Santos	
			Mr. Angelo Ribeiro	
	Observer	Ditto but Project Dept.	Eng. Louenco, Chief of Planning	
			Eng. Julius L. Kehy, Planning Section	
	Observer	Ditto but Maintenance Dept.	Eng. Mourinho Tilman, Coordinator of Region 2	
			Eng. Altino Fernasndes Da Costa, Region 2	
	Observer	Ditto but Highway Dept.	Mr. Fernando F. F. C. Freitas	
			Mr. Selestino E. Ximenes	
Contrac-tor	**Jonise**	Project Manager	Mr. Syahrul Akbar	
		engineer in charge of Safety	XX	
	NTN (NATUREZA TIMOR NAROMAN Lda)	Project Manager or engineer in charge of Safety Ditto	aa	
			bb	
	Mijori	PM or Staff in charge Safety	cc	
	Sunrise	PM or Staff in charge Safety	dd	
CDRS	Advisor(Ad)	CDRS, Road Construction Supervisor	Mr. Johji Koizumi	
	Assistant Ad and Interpreter	Civil Engineer	Ms. Letichia Silveira A. Barreto	

Attachment 4: Hand-out material of presentation of Explanation for Safety Patrol



1) Organization of Site Safety Committee
(organisasi dari Panitia Keselamatan di lokasi proyek)



2) Cycle of "Safety Patrol" activity
(Siklus dari aktivitas"Patroli Keselamatan)

- **Objective of Safety Patrol**
  - To find out dangerous works by workers
  - To Discuss about counter measure on the site
  - To improve the site safety conditions
- ***Tujuan dari Patroli Keamnan***
  - *Untuk mencari pekerjaan yang membahayakan pekerja*
  - *Mengdiskusikan tentang penaggulangan di lokasi proyek*
  - *Untuk meningkatkan kondisi keselamatan di lokasi proyek*

3) Procedure of Safety Patrol by DRBFC
(Prosedur dari Patroli keselamatan oleh DNEPCC)

(0) Organize the Site Safety Committee
(Mengatur Panitia keselematan di Lokasi)

↓

(1) Discussion and preparation meeting by Site Safety Committee
(Diskusi dan persiapan rapat dengan Panitia keselamatan di lokasi)

↓

(2) Decision/Announcement for "Safety Patrol" on AA day and at BB site by the Site Safety Committee
(Keputusan /pengumuman untuk "Patroli Keselamatan pada hari AA dan di lokasi BB oleh Panitia Keselamatan di lokasi)

↓

(3) Conduct "Safety Patrol", jointly site inspection and point out danger of works/ find out counter measures;
(Mengadakan "Patroli Keselamatan",melakukan inspeksi lokasi proyek Bersama dan menunjukkan titik-titik pekerjaan yang berbahaya/menentukan penanggulanganya

↓

Procedure of Safety Patrol by DRBFC
(Prosedur dari Patroli keselamatan oleh DNEPCC)

↓

4) Making record of Patrol and instructions are made, if necessary
(Membuat catatn dari Patroli tersebut dan membuta instruksi jika dibutuhkan?)

↓

5) On next Patrol, checking improvement danger works which were pointed out previous Patrol
(Pada patroli selanjutnya, periksa kembali perbaikkan pekerjaan berbahaya yang ditunjukkan pada Patroli sebelumnya.)

Jointly inspect for the line Drainage In-situ concrete at the access road in Comoro

☆ Obrigado Barak !!

3. Discussion/decision of the Date and Place of 1st "Safety Patrol"
(Diskusi/keputusan untuk tanggal dan tempat untuk Patroli Keselamatan yang Pertama)

Date (Tanggal)	･9:00-11:00 Wednesday 27 June, 2018
Place of the site for Safety Patrol (tempat untuk Patroli keselamatan di lokasi Proyek)	① **Foot Pass construction** site at STA 18km, No.A secssion of Pavement Work by Sunrise (management by NTN) ② **Stone Masonry Retaining construction** site at about STA7-8km(Lokasi konstruksi Tembok Penahan di STA 7-8 km), No.3 section of Ex-Japan Road, "Mijori" and management by "Jonise" (Kedua lokasi tersebut merupakan bagian dari Ex-Japan Road, dibangun oleh "Mijori" dan dibawah management "Jonise"
Meeting Point (Titik Pertemuan)	Gathering & Start:27 June, 2018 ･**9:00**- start from DRBFC Office ･9:30- ① **Foot Pass construction** at STA 18km ･10:30- ② **Stone Masonry Retaining construction at STA 7.5km**

See the location Map of Ex-Japan Road construction site

A3-195

Check List
for
Safety Patrol

①

Foot Pass construction

②

Stone Masonry Retaining construction

②

②

Attachment 5. Check List for Safety Patrol used on the site on 26 June 2018

① *Check List for Safety Patrol*

Name of the Project: Ex Japan Road

Section of Contract/work item: [illegible]

Date: 26/06/2018

Name of Contractor: Sunrise (management by NTB)

Location: ① STA [illegible] ~ STA [illegible]

Name of Inspector: [illegible]

No	Check Items	Judgement		Remarks
	Participants and interval of "Safety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	(No)	
⑤	Workers wear safety color vests?	Yes	(No)	
⑥	Were workers explained today's work procedure?	Yes	No	
⑦	Were workers explained today's dangerous points?	Yes	(No)	[illegible]
⑧	Are there "watchman for Construction Machinery"?	Yes	(No)	[illegible]
⑨	Precaution Signboard for Safety are provided on site?	Yes	No	
⑩	Procedure of work is correct or not?	Yes	No	
⑪	At same time, both work up/down are conducted or not?	Yes	(No)	
⑫	Cutting gradient is OK, with no danger?	Yes	(No)	
	Finding out Dangerous points			
1)				[illegible]
2)				
3)				
4)				
	Instructions and expecting counter-measures (if any)			
1)	[illegible]			
2)	[illegible]			
3)				

Overall comments:

② *Check List for Safety Patrol*

Name of the Project: Ex Japan Road

Section of Contract/work item: [illegible]

Date: 26/06/2018

Name of Contractor: Mijati (management by Japan)

Location: ② STA [illegible] ~ STA [illegible]

Name of Inspector: [illegible]

No	Check Items	Judgement		Remarks
	Participants and interval of "Safety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	(No)	
⑤	Workers wear safety color vests?	Yes	(No)	
⑥	Were workers explained today's work procedure?	(Yes)	No	
⑦	Were workers explained today's dangerous points?	Yes	No	[illegible]
⑧	Are there "watchman for Construction Machinery"?	Yes	(No)	
⑨	Precaution Signboard for Safety are provided on site?	Yes	No	
⑩	Procedure of works is correct or not?	(Yes)	No	
⑪	At same time, both work up/down are conducted or not?	Yes	No	
⑫	Cutting gradient is OK, with no danger?	Yes	(No)	
	Finding out Dangerous points			
1)				[illegible]
2)				
3)				
4)				
	Instructions and expecting counter-measures (if any)			
1)	[illegible]			
2)	[illegible]			
3)	[illegible]			

Overall comments:

① Check List for Safety Patrol

Name of the Project : Ex-Japan Road

Section of Contract/work item: [illegible]

Date : 26/09/2018

Name of Contractor: Sundae (management by NHI)

Location : ① STA [illegible] – STA [illegible]

Name of Inspector: [illegible]

No.	Check Items	Judgment			Remarks
	Participants and Interest of "Safety Patrol"				
①	Have you received "Announcement" of today' Patrol?	Yes	No		
②	DRBFC staff in charge, attend the Patrol?	Yes	No		
③	Contractor's staff in charge, attend the Patrol?	Yes	No		
	Inspection Points for Safety				
④	Workers wear safety helmets ?	Yes	No		
⑤	Workers wear safety color vests ?	Yes	No		
⑥	Were workers explained today's work procedure?	Yes	No		
⑦	Were workers explained today's dangerous points?	Yes	No		[illegible]
⑧	Are there "watchman for Construction Machinery"?	Yes	No		[illegible]
⑨	Precaution Signboard for Safety are provided on site?	Yes	No		[illegible]
⑩	Procedure of works is correct or not?	Yes	No		
⑪	At same time, both works up/down are conducted or not?	Yes	No		[illegible]
⑫	Cutting gradient is OK, with no danger?	Yes	No		
	Finding out Dangerous points				
1)					
2)					
3)					
4)					
	Instructions and expecting counter-measures (if any)				
1)					
2)					
3)					

Overall comments:

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor Leste (CDRS)

② Check List for Safety Patrol

Name of the Project : Ex-Japan Road

Section of Contract/work item: [illegible]

Date : 26/09/2018

Name of Contractor: Mipri (management by [illegible])

Location : ② STA [illegible] – STA [illegible]

Name of Inspector: [illegible]

No.	Check Items	Judgment			Remarks
	Participants and Interest of "Safety Patrol"				
①	Have you received "Announcement" of today' Patrol?	Yes	No		
②	DRBFC staff in charge, attend the Patrol?	Yes	No		
③	Contractor's staff in charge, attend the Patrol?	Yes	No		
	Inspection Points for Safety				
④	Workers wear safety helmets ?	Yes	No		[illegible]
⑤	Workers wear safety color vests ?	Yes	No		
⑥	Were workers explained today's work procedure?	Yes	No		
⑦	Were workers explained today's dangerous points?	Yes	No		[illegible]
⑧	Are there "watchman for Construction Machinery"?	Yes	No		[illegible]
⑨	Precaution Signboard for Safety are provided on site?	Yes	No		[illegible]
⑩	Procedure of works is correct or not?	Yes	No		
⑪	At same time, both works up/down are conducted or not?	Yes	No		
⑫	Cutting gradient is OK, with no danger?	Yes	No		
	Finding out Dangerous points				
1)	[illegible]				
2)	[illegible]				
3)	[illegible]				
4)					
	Instructions and expecting counter-measures (if any)				
1)					
2)					
3)					

Overall comments: [illegible]

Attachment 6

Introduction of Guideline of Slope Protection Gravity Retaining Wallon 11 September 2018

Républica Democrática de Timor-Leste

Ministério de Desenvolvimento e de Reforma Institucional

Ministério Geral das Obras Públicas

Direcção Nacional de Estradas, Pontes e Controlo de Cheias

Road Guidelines—Slope Protection—Retaining Wall and Slope Collapese

DG stage

Warning

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Document type: Technical Specification
Document subtype:
Document stage: (WD) Working Draft / (CD) Committee Draft / (DG) Draft Guideline / (FDG) Final Draft
Document language: E

Contents

Foreword

In the interest of constructing high quality and economically viable government infrastructure to serve the nation, this guideline for optimal design of slope protection components was prepared by the JICA Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS) in collaboration with the Direcção Nacional de Estradas, Pontes e Controlo de Cheias (DNEPCC, 'National Directorate of Roads, Bridges and Flood Control') of the Ministério Geral das Obras Públicas ('Ministry of Public Works'). We would like to thank JICA for their continuing support.

September, 2018

His Excellency —

Minister for Development and Institutional Reform

Ministério de Desenvolvimento e de Reforma Institucional

Japan International Cooperation Agency (JICA) has been conducting a technical cooperation project for development of capacity regarding road services, which is called CDRS, in order to facilitate the DNEPCC in properly managing and maintaining the road infrastructure that is the basis of social and economic activities. To this end, JICA has been dispatching a team of experts from March 2016 to August 2019. As a result of collaborative work with counterparts of the DNEPCC, this guideline for slope protection has been finalized. I hope that this guideline will contribute to infrastructure development and maintenance, and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government of the Democratic Republic of Timor-Leste for their close cooperation with the expert team.

September, 2018

Masafumi NAGAISHI

Chief Representative of JICA Timor-Leste Office

Japan International Cooperation Agency

Introduction

This guideline was developed by JICA Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste in collaboration with the *Direcção Nacional de Estradas, Pontes e Controlo de Cheias* (DNEPCC, 'National Directorate of Roads, Bridges and Flood Control') for the purpose of developing institutional capacity regarding slope protection.

Generally speaking, design in civil engineering must stands on geological information and survey drawings instead of impression at the site. Therefore this guideline starts with "Minimum Required Information for Design".

Most of all projects use the common drawings in Timor-Leste. However how many in-house engineers are conscience backgrounds of them, in other words their original design. The guideline treats stability calculations of gravity retaining walls in the common drawings in order to present hints for better user of the common drawings. On the other hand, stability calculation of gravity retaining wall is front door for other structures design. Master of the calculation has got a step to higher level.

Existing countermeasures against slope collapse in Timor-Leste are mainly re-cutting. And existing slope protection methods are vegetation and cover sheet. These means must face limit in many cases of shallow slope collapse. Combination of sewing bar and surface cover structure seems one of most adequate countermeasure against shallow slope collapse. Therefore this method shall be introduced into Timor-Leste to control shallow slope collapse.

There are other types of slope disaster such as rock fall, rock mass failure, mass movement (land slide), debris flow and embankment collapse. This guideline focus on slope collapse on cut or natural slope because of secure capacity development. The project provides other guideline named Slope Protection-Mass movement.

Road Guidelines—Slope Protection—Retaining Wall and Slope Collapse

1 Scope

This guideline consists of three themes, investigation, gravity retaining wall and slope protection.

When some problem in civil engineering occurs the first step of procedure shall be scientific investigation. The investigation must include ground shape and substance. Clause 4 presents minimum required information for design.

Clause 5 to 7 treat gravity retaining wall. Clause 5 shows design procedure of gravity retaining wall. Clause 6 aims to support users of the common drawing in case of selection. Characteristics of Type1 and Type2 are shown. Most of all failed retaining walls are due to shortage of bearing capacity of foundation ground. Clause 7 handles this matter.

Clause 8 to 12 treat slope stability. Clause 8 and 9 present general information of slope and slope disaster as background knowledge of slope stability. Clause 10 introduces a method of slope stability calculation. Clause 11 is influence analysis on safety factor of slope by surface gradient, shear strength and ground water. Clause 12 is design example of combination of sewing bar and surface cover structure against shallow slope collapse on a cut slope.

This guideline focuses on slope collapse on cut or natural slope because of secure capacity development.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
retaining wall
wall supporting backfill soil, embankment soil or a cut slope

[SOURCE:ISO 23469:2005(en),3.46]

3.2
earth pressure
pressure from soil on a wall or an embedded portion of a structure

[SOURCE:ISO 23469:2005(en),3.11]

3.3
bearing capacity of the soil
maximum permissible stress on the foundation soil that provides adequate safety against bearing failure of the soil, or settlement of the foundation of such magnitude as to impair the structure

[SOURCE:ISO 28842:2013(en),3.9]

4 Investigation (Minimum Required Information for Design)

Phenomenon of slope disaster is that ground moves downward by gravity force under influence of water. Therefore Information of ground shape and content, water condition just at disaster occurring can be said the minimum required information for countermeasure design. In many cases water condition is unknown because of no observation so estimation is alternative for it. Survey gives information of ground shape. Geological investigation gives information of ground content.

4.1 Ground Shape

Representative cross section is vital for countermeasure basic design. We can get it easily by cross section survey at the site.

In detail design plan with contour map, longitudinal section and cross sections are necessary as ground shape information. We can study placement, coverage and matching with surrounding land on the plan. And plan must have bench mark which can be found in-situ by peg or pin. Longitudinal section fulfils the function to show road longitudinal gradient and elevation and location of survey point. Cross sections of survey point present working area and construction quantity.

4.2 Geological Information

Basically geologist is in charge of geological investigation and civil engineer is an user of geological information however the civil engineer should approach actively geological knowledge to become a smart user. If there is no geologist in the project civil engineer must get geological information by himself.

(1) Geomorphologic approach

Ground shape reflexes ground content. Geomorphologic approach is the first step of geological investigation. We can get aerial or satellite photo through the internet easily. The photo teaches us ground shape around the target point. Geologist figures out detail geomorphic characteristics such as colluvial deposit, alluvial fan, mass movement fluvial terrace and so on from aerial stereo photograph.

Figure 4.1 Birds-eye view of satellite photo

Typical geological contests of mountainside is shown in next figure. When road goes near ridge line weathered soil often appears on cut slope, and near bottom of valley we often face colluvial deposit. These two have potential of collapse because of unconsolidated layers

Adapted from bibl. [1]

Figure 4.2 Typical mountainside structure

(2) Surficial geological observation

Surficial geological observation targets; to collect geological information at exposure which can be found cut slope and gully sides, to observe ground water condition through gully stream, trace of flow, spring, and to confirm site-scale geomorphic impression.

(3) Mechanical boring and standard penetration test

Most popular mean of geological investigation is mechanical boring and standard penetration test for soil layer. Of course it takes cost and time however there is no other choice to get clear evidence of ground content. N-value since standard penetration test is linked evaluation of bearing capacity and shear strength. Therefore it can be said that N-value is like a common ruler of soil layer. There is a weak point of N-value when a layer has rich gravel, the gravel messes N-value too much bigger.

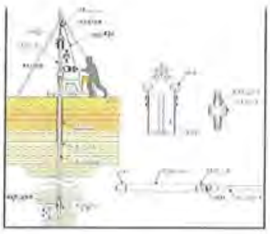


Figure 4.3 Mechanical boring and SPT

(4) Other penetration tests

There are some types of penetration test by man power as shown in figure 4.4. These test can execute far cheaper than mechanical boring but have limits in allowable layer and depth. In the project one Dokenbo is provided to DRBFC for simple geological investigation. Usage manual is compiled as Annex A.

Table 4.1 Characteristics of penetration tests

	Standard Penetration Test SPT	Simplified Dynamic Cone Penetration Test	Swedish Sounding Test	Portable Cone Penetration Test	Prospect Rod for Soil Layer Strength Cone Penetration Test (Dokenbo)
Driving Method	Dynamic Hammering by Weight	Dynamic Hammering by Weight	Static Pushing by Weight and Turning by Hand	Static Pushing by Hand	Static Pushing by Hand
Power	Mechanical Power	Man power	Man power	Man power	Man power
Portability	Un-portable	16kgf / 1set	More than 100kgf		4.5kgf / 1set
Penetrator	Sampler ϕ51mm	Cone ϕ25mm	Screw-point ϕ33.3mm	Cone ϕ28.6mm	Cone ϕ15mm
Rod Diameter	ϕ40.5mm	ϕ16mm	ϕ19mm	ϕ16mm	ϕ10mm
Weight and Stroke	63.5kgf, 760mm	5kgf, 500mm	5,15,25,50,75,100kgf		
Unit testing Length	30cm, Pre-Blow 15cm	10cm	25cm	Every 10cm	At the Point
Allowable Layer	All Soil Layer Except Gravel Layer	All Soil Layer Except Gravel Layer	All Soil Layer Except Gravel Layer	Clayey Layer	Soil Layer except Dense Sandy Layer
Maximum Depth	Limitless	15m	15m	5m	5m
Outcome	SPT- N: Number of hammering per 30cm penetration	N_d: Number of hammering per 10cm penetration	N_{sw}: Number of half revolution per 1m penetration	D: Pushing Load q_c: Penetration resistance	W: Pushing Load q_{dc}: Penetration strength
Characteristics	King of penetration test So many past results Established outcome usage With boring	Downsized SPT	Common test for house foundation in Japan	Test only for soft soil layer	Good for slope investigation Multi use for Soil depth prospection Penetration test Shear strength test

A3-201

Simplified dynamic cone penetration test

Swedish sounding test

Portable cone penetration test

Prospect rod for soil layer strength

Dokenbo

Figure 4.4 Penetration tests by man power

5 Design of Gravity Retaining Wall

Design of gravity retaining wall seems an entrance door of civil engineering design. It is simple but included an useful method. If you understand it then you have easier way to approach other structures such as gabion wall, bridge abutment, debris flow barrier dam, gravity concrete dam and so on. That why the guideline treats this theme.

5.1 Design Procedure

Gravity retaining wall often applies as stop of embankment. Design procedure of gravity retaining wall is shown in Figure 5.1. The procedure mainly consist of stability calculation. Self-standing structures such as bridge abutment and gravity dam take similar procedure therefore understanding the procedure is good for first step of youth civil engineers.

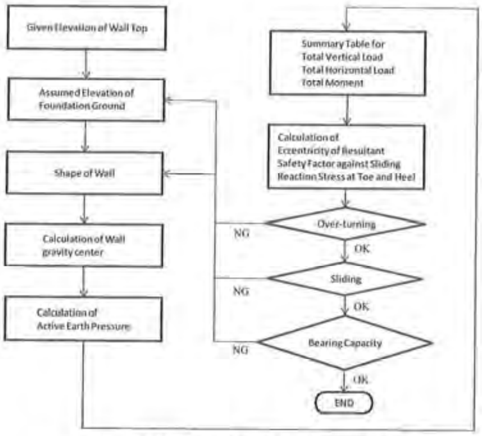


Figure 5.1 Design procedure of gravity retaining wall

5.2 Each step of the procedure

Each step of the procedure will describe along an example as below.

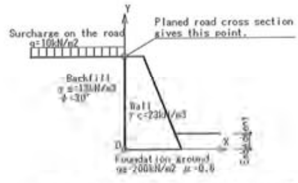


Figure 5.2 Example gravity retaining wall

(1) Given position of roadside wall top

Planed road cross section usually gives position of roadside wall top.

(2) Assumed elevation of wall bottom

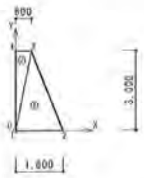
Elevation of wall bottom depends on foundation ground condition because the ground must bear the wall. Embedment depth which is distance between ground surface and wall bottom shall be larger than 0.5m.

(3) Shape of wall

You can select shape of wall from the common drawings. You also can set up an original shape. In this example type 1 H=3m is selected.

(4) Calculation of wall gravity center

The wall is divided into some simple figure such as triangle to calculate gravity center easily. The excel worksheet can calculate gravity center when you give coordinates of divided triangles with horizontal bases.

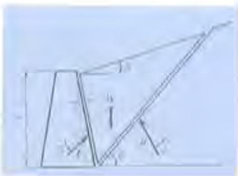


Element	Area A (m2)	Weight V (kN)	Arm length x (m)	Moment M (kNm)
1	2.70	62.1	0.800	49.7
2	0.90	20.7	0.200	4.1
Total		82.8		53.8

(5) Calculation of active earth pressure

Retaining wall folds backfill soil then backfill soil gives active earth pressure to the retaining wall. There are some methods to calculate active earth pressure, here we use Coulomb's formula.

$$K_A = \frac{\cos^2(\varphi-\alpha)}{\cos^2\alpha\cos(\alpha+\delta)\left\{1+\sqrt{\frac{\sin(\varphi+\delta)\sin(\varphi-\beta)}{\cos(\alpha+\delta)\cos(\alpha-\beta)}}\right\}^2}$$



KA: Active earth pressure coefficient

α: Angle between back surface of the wall and vertical line

β: Angle between ground surface and horizontal line

φ: Internal friction angle

δ: Friction angle between back surface of the wall and the soil

α degree	β degree	φ degree	δ degree	KA
0.0	0.0	30.0	20.000	0.297

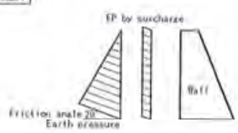
$$P_A = K_A\left(\frac{1}{2}\gamma h^2 + qh\right)$$

PA: Active earth pressure acting on the wall

γ: Unit weight of the backfill

h: Height of the wall

q: Surchargeload on the road



Active Earth Pressure Coefficient	Backfill Unit Weight	Wall Height	Surcharge on the Road	Load Name	Load	Friction Angle of Wallback	Vertical Load	Arm Length	Moment	Horizontal Load	Arm Length	Moment
KA	γ kN/m3	h m	q kN/m2		PA kN	δ degree	V kN	x m	M kNm	H kN	y m	M kNm
0.297	19	3.000		Earth Pressure	25.4	20.000	8.7	0.000	0.0	23.9	1.000	23.9
0.297		3.000	10	EP by Surcharge	8.9	20.000	3.0	0.000	0.0	8.4	1.500	12.6
						Total	11.7		0.0	32.3		36.5
											ΣM=	36.5

(6) Summary table for loads and moments

Each load and moment are summarized into total vertical load, total horizontal load and total moment in the summary table as below.

Load Name	Vertical Load kN	Horizontal Load kN	Moment kNm
Wall Weight	82.8		53.8
Earth Pressure	11.7	32.3	36.5
Total	94.5	32.3	90.3

(7) Three check points of stability index

Retaining wall must pass three check points of stability index. They are over-turning, sliding and bearing capacity of foundation ground. They are checked by eccentricity of resultant, safety factor against sliding and reaction stress at wall toe and heel.

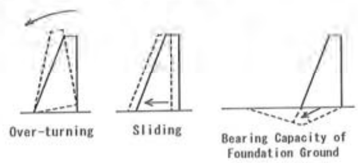


Figure 5.3 Three check points of stability index

(8) Calculation of eccentricity of resultant

X-coordinate of resultant is given as below.

$$X = \frac{\Sigma M}{\Sigma V} = \frac{90.3}{94.5} = 0.956m$$

Eccentricity of the resultant is given as below.

$$e = X - \frac{B}{2} = 0.956 - 0.900 = 0.056m$$

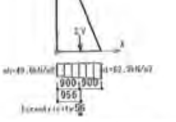
Allowable eccentricity is B/6=0.300m, therefore the resultant drops within the middle third. check point against over-turning is passed.

$$e = 0.056\text{m} < \frac{B}{6} = 0.300m \quad \text{OK}$$

(9) Calculation of safety factor against sliding

Safety factor against sliding is given as below. The factor is bigger than 1.5 then check point against sliding is passed.

$$F_S = \frac{\mu\Sigma V}{\Sigma H} = \frac{0.6\times94.5}{32.3} = 1.76 > 1.5 \ \text{OK}$$



(10) Calculation of reaction stresses at wall toe and heel

Reaction stresses at wall toe and heel are given as below.

$$q_t = \frac{\Sigma V}{B}\left(1+\frac{6e}{B}\right) = \frac{94.5}{1.800}\times\left(1+\frac{6\times0.056}{1.800}\right) = 62.3\,kN/m^2$$

$$q_h = \frac{\Sigma V}{B}\left(1-\frac{6e}{B}\right) = \frac{94.5}{1.800}\times\left(1-\frac{6\times0.056}{1.800}\right) = 49.6\,kN/m^2$$

The stresses are smaller than allowable stress 200kN/m2 then check point against bearing capacity is passed.

5.3 Active Earth Pressure by Backfill

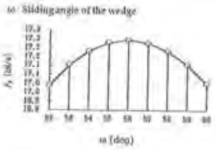
When a slope stands just behind of the wall trial wage method is applied for active earth pressure calculation instead of Coulomb's equation. The earth pressure is presented as next equation. W is weight of the wage, when sliding angle ω is assigned then W can be calculated. Maximum value of PA is targeted earth pressure value.

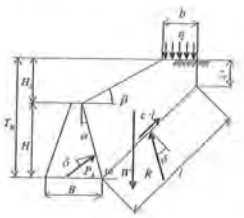
$$P_A = \frac{W\sin(\omega-\varphi)}{\cos(\omega-\varphi-\alpha-\delta)}$$

P_A: Active earth pressure

W: Weight of soil wedge

ω: Sliding angle of the wedge





Adapted from bibl. [4]

We must determine unit weight and shear strength of backfill for earth pressure calculation. We can refer next table for it.

Table 5.1 Unit weight and shear strength of backfill

Type of Soil	Unit weight	Internal friction angle	Cohesion
	(kN/m³)	(degree)	(kN/m²)
Gravelly soil	20	35	0
Sandy soil	19	30	0
Clayey soil	18	25	0

Adapted from bibl. [8]

5.4 Foundation Ground

We also need to determine allowable bearing capacity and friction coefficient between wall and foundation ground. We can refer table 5.2 for it. If you face more weak ground then you can refer Table 5.3 and 5.4.

Most of all failed retaining walls are due to shortage of bearing capacity of foundation ground. Estimating bearing capacity is one of the most difficult matter for engineer. Durable ground such as base rock layer or diluvium layer has no problem. In contrast weak ground such as colluvium or heavily weathered rock requires us correct evaluation. Geological information through investigation help us to evaluate the ground. Classification, oldness and SPT-N (Standard penetration test N-value) are reliable information. Direct observation of foundation ground during working is last chance for evaluation.

Table 5.2 Allowable bearing capacity and friction coefficient of foundation ground

Type of foundation ground		Allowable bearing capacity	Friction coefficient between wall and foundation	[illegible]	
				Unconfined compressive strength	SPT N vale
		(kN/m²)	-	(kN/m²)	-
Base rock layer	Homogeneous hard rock with few cracks	1,000	0.7	10,000 and up	-
	Hard rock with a lot of cracks	600		10,000 and up	-
	Soft rock, Mudstone	300		1,000 and up	-
Gravel layer	Dense one	600	0.6	-	-
	Not dense one	300		-	-
Sandy layer	Dense one	300	0.6	-	30 to 50
	Medium one	200		-	20 to 30
Clayey layer	Very stiff one	200	0.5	200 to 400	15 to 30
	Stiff one	100		100 to 200	10 to 15

Adapted from bibl. [8]

Table 5.3 Index on site to estimate bearing capacity for sandy layer

Type	Condition	Index on Site	Allowable Bearing Capacity kN/m²	SPT N-value
Sandy Layer	Very loose	Reinforcement bar ϕ13mm easily penetrates by the hand.	0	Less than 4
	Loose	Scoop-able by the hand with shovel	50	4 to 10
	Medium	Reinforcement bar ϕ13mm easily penetrates by the hand with 2.2kgf hammer.	100	10 to 15
		Same as above Some effort is required.	200	15 to 30
	Dense	Same as above Depth reaches approx. 30cm.	300	30 to 50
	Very dense	Same as above Emitting metallic sound Depth reaches approx. 5cm.	300	Greater than 50

Table 5.4 Index on site to estimate bearing capacity for clayey layer

Type	Condition	Index on Site	Allowable Bearing Capacity kN/m²	SPT N-value
Clayey Layer	Very soft	Fist easily penetrates about 10cm depth.	0	Less than 2
	Soft	Thumb easily penetrates about 10cm depth	20	2 to 4
	Medium	Thumb penetrates about 10cm with medium effort.	50	4 to 8
	Stiff	Thumb dents the surface with normal effort and penetrates with much effort	100	8 to 15
	Very stiff	Remove-able with spade	200	15 to 30
	Hard	Removing requires pickax	200	Greater than 30

6 Gravity Retaining Wall in the Common drawings

DRBFC has the common drawings which frequently appear in many projects for labor-saving about drainage, cross culvert, retaining wall, gabion, pavement and so on. This chapter treats gravity retaining wall in the common drawings.

6.1 Shape of the Walls

There are two types of gravity retaining wall in the common drawings, these shapes are shown as below. Type1 has vertical backside and around 1:0.4 gradient on front side. In contrast Type 2 has inverse 1:0.45 to 0.49 gradient on back side and 1:0.1 gradient on front side. Width of top is 0.6 m for both type.

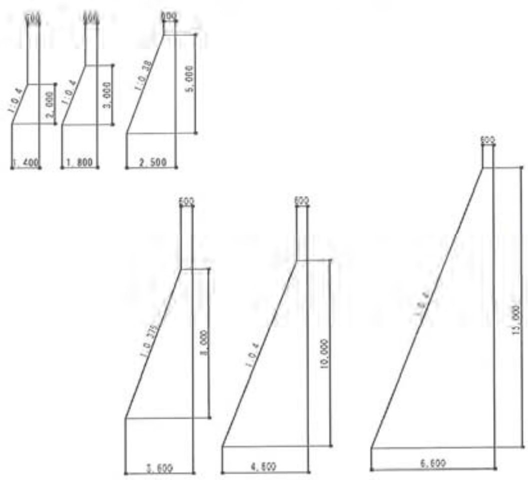


Figure 6.1 Shape of the Type 1 walls

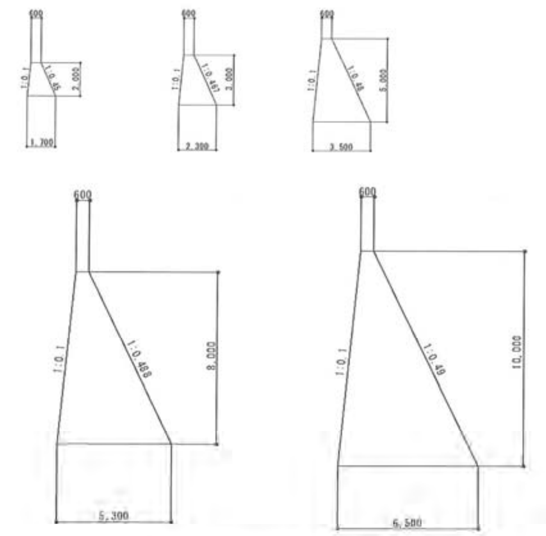


Figure 6.2 Shape of the Type2 walls

6.2 Result of stability calculation

These tables show the results of stability calculations on the Type1 and Type2. Calculation conditions are; backfill height is as same as wall top, backfill surface is horizon, earth pressure is calculated under backfill unit weight 19kN/m³ and friction angle 30deg, road surcharge 10kN/m² on road surface.

Table 6.1 Result of Type1 stability calculation

Wall Body			Earth Pressure			Load Summary			Eccentricity		Bearing Capacity
Wall Height H m	Base Width B m	CS_Area A m2	Total EP PA kN/m	Vertical EP PAV kN/m	Horizontal EP PAH kN/m	Sigma_V ΣV kN	Sigma_H ΣH kN	Sigma_Moment ΣM kNm	Eccentric Length e m	6e/B	Max Reaction Stress qmax kN/m2
2	1.40	2.60	17.24	5.90	16.20	31.90	16.20	37.43	-0.031	-0.09	40.4
3	1.80	3.60	34.34	11.74	32.27	91.51	32.27	84.08	0.011	0.04	54.5
5	2.50	7.75	85.48	29.24	80.32	207.54	80.32	279.60	0.144	0.35	111.2
8	3.60	16.80	204.55	69.96	192.22	456.36	192.22	654.39	0.366	0.61	204.1
10	4.60	26.00	312.18	106.77	293.35	704.77	293.35	1,332.30	0.410	0.53	235.2
15	6.60	51.00	680.11	232.61	639.09	1,474.61	639.09	3,779.74	0.737	0.67	373.1

Table 6.2 Result of Type2 stability calculation

Wall Body			Earth Pressure			Load Summary			Eccentricity		Bearing Capacity
Wall Height H m	Base Width B m	CS_Area A m2	Total EP PA kN/m	Vertical EP PAV kN/m	Horizontal EP PAH kN/m	Sigma_V ΣV kN	Sigma_H ΣH kN	Sigma_Moment ΣM kNm	Eccentric Length e m	6e/B	Max Reaction Stress qmax kN/m2
2	1.70	2.30	30.90	21.56	22.15	74.46	22.15	52.27	0.147	0.52	66.5
3	2.30	4.35	62.80	44.42	44.39	144.52	44.39	129.99	0.251	0.66	104.0
5	3.50	10.25	158.85	113.57	111.06	349.37	111.06	448.93	0.465	0.80	179.4
8	5.30	23.60	383.56	275.86	266.50	818.66	266.50	1,520.93	0.792	0.90	297.0
10	6.50	35.50	587.13	423.00	407.08	1,259.59	407.08	2,786.91	1.002	0.93	363.1

6.3 Over-turning Condition

Safety against over-turning is evaluated that resultant force drops within the middle third area of the wall bottom base. This criterion means that there is no tension zone in the base as shown in Figure 6.3.

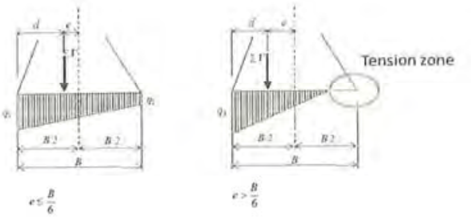


Figure 6.3 Correlation between eccentricity and distribution of ground reaction stress

It can be given by next equation.

$e \le \frac{B}{6}$ $\qquad \frac{6e}{B} \le 1$

6e/B which should be called ratio of eccentricity is shown in next figure. All walls pass check point for middle third. This check point does not relate foundation ground but shape of wall and backfill earth pressure. Minus zone of the ratio means that the resultant force drops within heel half side of the wall base.

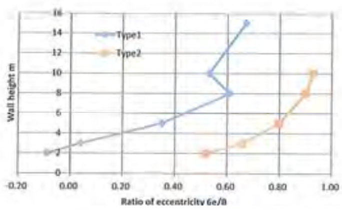


Figure 6.4 Over-turning condition of the walls

6.4 Sliding Condition

Safety factor against sliding is given by next equation.

$F_S = \frac{\mu \Sigma V}{\Sigma H} \ge 1.5 \qquad \mu \ge \frac{1.5 \Sigma H}{\Sigma V}$

Requested friction coefficient between wall and foundation can be calculated by the equation as below figure. Refer table 5.2 friction coefficients are; base rock layer 0.7, gravel and sandy layer 0.6, clayey layer 0.5. Therefore Type1 with over 7m height must stand on base rock layer, with 3m to 6m height must stand on more than sandy layer and with 2m height can stand on even clayey layer. In contrast Type2 with all height has no problem about sliding condition.

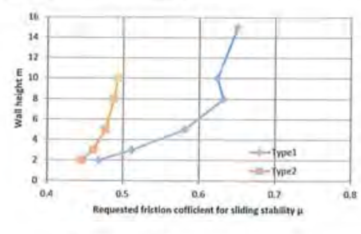


Figure 6.5 Sliding condition of the walls

6.5 Bearing Capacity Condition

Reaction stress must be smaller than allowable bearing capacity of foundation ground. Maximum reaction stress of foundation ground usually arises at wall toe. It can calculated by next equation.

$q_t = \frac{\Sigma V}{B}\left(1 + \frac{6e}{B}\right)$

Type1 has an advantage in this point because the stress is smaller than Type2 at the same wall height. Refer table 5.2 to 5.4 allowable bearing capacities are; base rock layer 300 to 1,000kN/m², gravel layer 300 to 600kN/m², sandy layer 0 to 300kN/m² and clayey layer 0 to 200kN/m². In mountain area we very often meet colluvial deposit which consists of clayey matrix and gravel. Clayey matrix can reach to stiff stage at the best condition so that bearing capacity stays around 100kN/m². We can roughly say that soil ground in mountain area can bear Type1 H≤4m and Type2 H≤2m only. Therefor high wall H>5m in mountain area should stand on base rock layer because of bearing capacity.

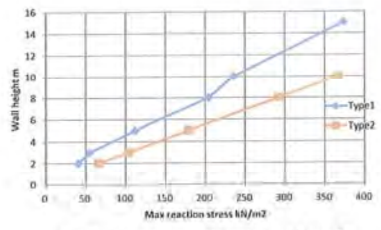


Figure 6.6 Bearing capacity condition of the walls

6.6 Adequacy of the Types

When you choose the type of gravity wall you shall pay attention below items about adequacy of the types.

(1) Cross section area

Next figure presents comparison of cross section area between Type1 and Type2. Type1 has advantage in this point, more specifically Type1 is cheaper than Type2 at the same wall height.

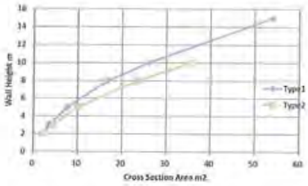


Figure 6.7 Comparison of cross section area

(2) Foundation ground

Type2 has advantage on sliding condition as we studied in section 6.4 but Type1 has advantage on bearing capacity condition as section 6.5. These two conditions are trade off relation. Type1 has smaller ΣV than Type2, it can be advantage because of smaller reaction stress qt against bearing capacity and can be disadvantage because of smaller resistance force against sliding.

(3) Land form

Figure 6.7 presents adequacy for slope ground. When wall is on horizontal ground necessary wall height is 5m same for both types. For instance how about on 30deg slope? Type1 needs additional 1.952m to touch the ground at the toe. Type2 can touch the ground with 0.647m addition. Therefore Type2 has adequacy for slope ground.

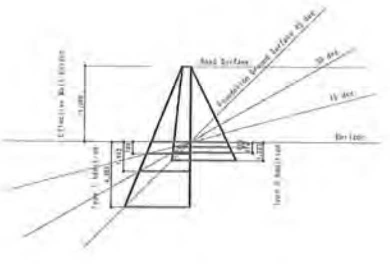


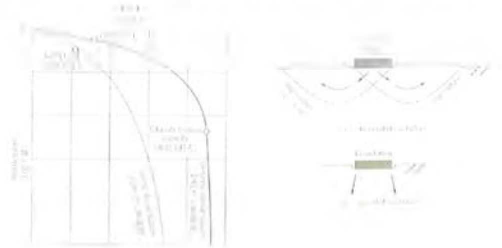
Figure 6.8 Adequacy for slope ground

7 Bearing Capacity

As described in section 5.4 estimation of bearing capacity of foundation ground is one of the most difficult matter for engineer. Reference values are given in table 5.2 to 5.4 in section 5.4. This chapter presents another approach for bearing capacity.

7.1 Terzaghi's Ultimate Bearing Capacity

When a load is applied to a horizontal ground there are two type of load-settlement relationships as show next figure. Ground which has middle level strength such as dense sandy layer or stiff clayey layer performs "General shear failure". Ultimate bearing capacity can be identified on this failure relationship.



Adapted from bibl. [3]

Figure 7.1 Load-settlement relationship

Terzaghi who seems the father of soil mechanics made up an equation for ultimate baring capacity as below.

$$\frac{Q}{B} = cN_c + q_s N_q + \frac{1}{2}\gamma_t B N_\gamma$$

Q: Ultimate bearing capacity of the foundation ground
B: Width of Base
c: Cohesion of the foundation ground
qs: Uniform load on the foundation ground (Surcharge loads)
γt: Unit weight of the foundation ground
Nc, Nq, Nγ: Coefficient of bearing capacity

$$N_c = 2\left(K_p^{1.5} + K_p^{0.5}\right) \qquad N_q = K_p^2 \qquad N_\gamma = \frac{1}{2}\left(K_p^{2.5} - K_p^{0.5}\right)$$

$$K_p = tan^2\left(\frac{\pi}{4} + \frac{\varphi}{2}\right)$$

7.2 Influence of shear strength for ultimate bearing capacity

When we calculate ultimate bearing capacity by Tergaghi's equation we need to set unit weight, cohesion and internal friction angle of the ground. Here we try to know how these values influence the result on two example.

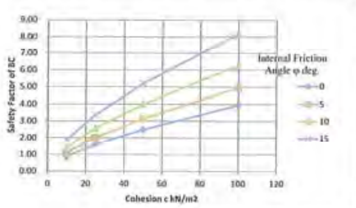
Example1; Type1, H=2m, ΣV=51.90kN, ΣH=16.20kN, e=-0.021m Result Figure 7.2

Example2; Type1, H=3m, ΣV=94.54kN, ΣH=32.27kN, e=-0.011m Result Figure 7.3

$$F_s = \frac{q_u}{\Sigma V} \geq 3$$

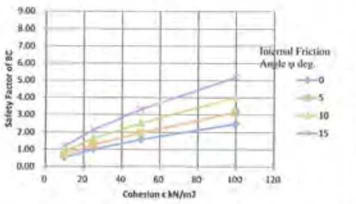
Fs: Safety factor of bearing capacity
Qu: Ultimate bearing capacity
ΣV: Total vertical load

Influence of ground shear strength values is big. Therefore we should be careful for setting the values. If the ground allows Dokenbo shear strength test, we can get some hint from the test result.



Foundation Ground			Result	
Internal Friction Angle φ degree	Cohesion c kN/m2	Unit Weight γ kN/m3	Ultimate Bearing Capacity Qu kN	Safety Factor Fs -
0	10	18	445	0.86
	25		824	1.59
	50		1,292	2.49
	100		2,049	3.95
5	10		564	1.09
	25		1,037	2.00
	50		1,621	3.13
	100		2,568	4.95
10	10		728	1.40
	25		1,328	2.56
	50		2,068	3.99
	100		3,262	6.29
15	10		951	1.83
	25		1,743	3.36
	50		2,697	5.20
	100		4,241	8.17

Figure 7.2 Influence of c and ϕ for Qu Type1 H=2m



Foundation Ground			Result	
Internal Friction Angle φ degree	Cohesion c kN/m2	Unit Weight γ kN/m3	Ultimate Bearing Capacity Qu kN	Safety Factor Fs -
0	10	18	345	0.54
	25		952	1.01
	50		1,443	1.58
	100		2,308	2.50
5	10		651	0.69
	25		1,199	1.27
	50		1,876	1.98
	100		2,971	3.14
10	10		835	0.88
	25		1,539	1.63
	50		2,396	2.53
	100		3,783	4.00
15	10		1,127	1.19
	25		2,035	2.15
	50		3,121	3.30
	100		4,911	5.19

Figure 7.3 Influence of c and ϕ for Qu Type1 H=3m

7.3 Influence of front side slope for ultimate bearing capacity

In mountain area we often have no other choice but setting wall near slope. Here we try to know how front side slope influence the bearing capacity on two example.

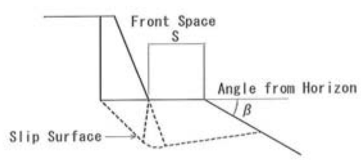


Figure 7.4 Front space and slope angle in case of wall stands near slope

[Calculation conditions]

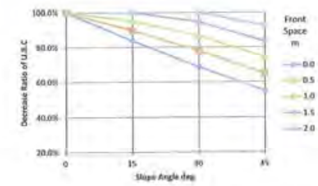
Resultant forces and eccentricity come from Type1 H=3m

Example1; Clayey foundation ground, φ=15deg, c=50kN/m², γ=18kN/m³

Example2; Sandy foundation ground, φ=30deg, c=10kN/m², γ=19kN/m³

(1) Case of clayey foundation ground

Under S=0m and β=45deg ultimate bearing capacity decreases 55% of horizontal ground in case of clayey ground. Under S=2m Qu stays over 90% therefore we can say 2m front space is effective against influence of front slope in case of clayey ground.

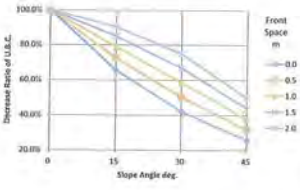


Slope Shape		Result		
Front Space S m	Angle from Horizon β degree	Ultimate Bearing Capacity Qu kN	Decrease Rate of U.B.C %	Safety Factor Fs -
0.0	0	3,195.0	100.0	3.38
	15	2,670.8	83.6	2.83
	30	2,187.6	68.5	2.31
	45	1,746.2	54.7	1.85
0.5	0	3,195.0	100.0	3.38
	15	2,864.5	89.7	3.03
	30	2,485.9	77.8	2.63
	45	2,055.0	64.3	2.19
1.0	0	3,195.0	100.0	3.38
	15	3,039.9	95.2	3.21
	30	2,758.8	86.4	2.92
	45	2,367.8	74.2	2.50
1.5	0	3,195.0	100.0	3.38
	15	3,195.0	100.0	3.38
	30	3,016.0	94.3	3.19
	45	2,655.1	83.1	2.81
2.0	0	3,195.0	100.0	3.38
	15	3,195.0	100.0	3.38
	30	3,195.0	100.0	3.38
	45	2,945.9	92.2	3.11

Figure 7.5 Influence of front side slope on clayey foundation ground

(2) Case of sandy foundation ground

Under S=0m and β=45deg ultimate bearing capacity decreases 26% of horizontal ground in case of sandy ground. Under S=2m and β=45deg Qu still decreases 50%. Sandy ground is more sensitive to the influence of front side slope than clayey ground. Therefore we should pay more attention to this case.

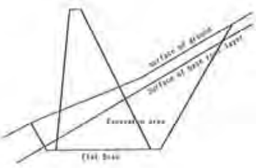


Slope Shape		Result		
Front Space S m	Angle Slope Horizon β degree	Ultimate Bearing Capacity Qu kN	Decrease Ratio of U.B.C %	Safety Factor Fs -
0.0	0	4,135.0	100.0	4.35
	15	2,695.1	65.3	2.83
	30	1,729.8	42.0	1.82
	45	1,065.5	25.8	1.12
0.5	0	4,135.0	100.0	4.35
	15	2,981.8	72.5	3.15
	30	2,068.4	50.3	2.19
	45	1,310.6	31.8	1.39
1.0	0	4,135.0	100.0	4.35
	15	3,245.6	78.5	3.41
	30	2,430.1	58.5	2.55
	45	1,551.0	37.5	1.65
1.5	0	4,135.0	100.0	4.35
	15	3,497.5	84.9	3.69
	30	2,748.4	66.5	2.91
	45	1,806.6	43.8	1.91
2.0	0	4,135.0	100.0	4.35
	15	3,716.2	90.1	3.93
	30	3,065.2	75.0	3.26
	45	2,050.1	49.6	2.16

Figure 7.6 Influence of front side slope on sandy foundation ground

7.4 Step Cut Foundation

As described in section 6.5 High wall H>5m in mountain area should stand on base rock layer because of bearing capacity. In such case flat foundation requires huge excavation as show right.



Step cut foundation can solve this problem. Examples are shown in figure 7.7.

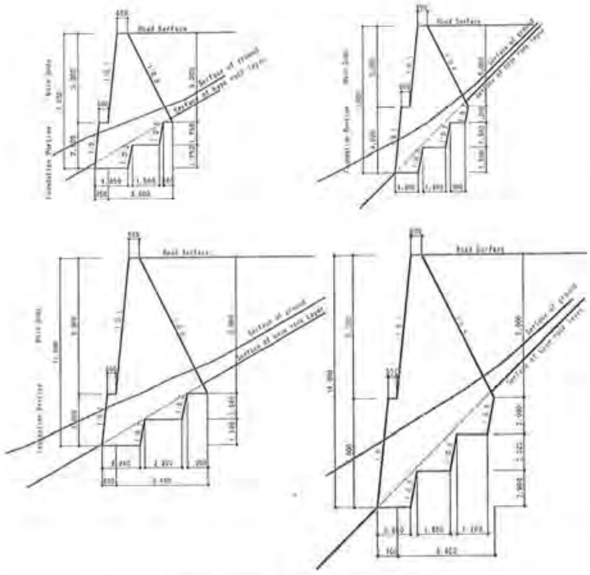


Figure 7.7 Examples of step cut foundation

8 Slope

8.1 Classification of Slope

What is a slope? Slope is not flat but inclined plane. Land in mountain area consists of a lot of slopes. In contrast water surface is not inclined but flat plane. What is the difference between land and water? Water has no shear strength. Land, it means soil and rock mass, can keep its sloped shape against gravity tangential force by its own shear strength. In other word, land bears gravity at all times.

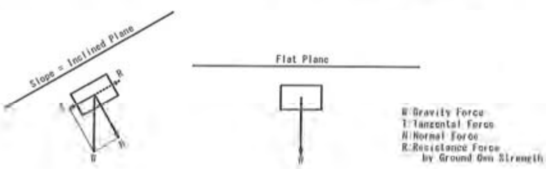


Figure 8.1 Difference between slope and flat plane

Slope primarily can be classified natural slope and embankment slope. Natural slope can be divided original, collapsed and cut slopes. The table shows characteristics of slopes. Only embankment slope consists of banking material therefore we can control its strength in construction.

Table 8.1 Slope classification and characteristics

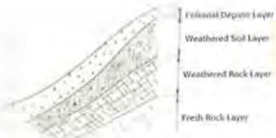
Classification	Shape	Geology	
Natural Slope	Natural Terrain	Natural Ground	Complexity Inhomogeneous
Collapsed Slope	Collapsed Gradient		
Cut Slope	Cut Gradient		
Embankment Slope	Embankment Gradient	Banking Material	Random –Selected material Homogeneous

8.2 Natural Slope

Mountain is ordinary made of rock mass except thin soil surface layers. In contrast alluvial plane has thick soil layers. Typical natural slope surface composition is shown in Figure 8.2. Colluvial deposit and weathered soil are surface soil layers. Colluvial deposit has moved by collapse in the past however weathered soil stays on the original position. Collapse often occurs within soil layers because of its weakness.

When collapse occurs in rock layer rock mass almost always brakes along cracks. Strength along the cracks dominate over rock layer collapse.

Ground water stays in void of soil layers and cracks of rock layers. Increase of ground water very often triggers collapse.



Adapted from bibl. [2]

Figure 8.2 Natural slope surface composition

8.3 Cut Slope

Cut slope is weaker than original slope because of below reasons. Frist, cutting makes ground stress condition change. Compression stress sometimes changes into tension stress. This phenomenon is called as stress-release. Another, cut gradient must be steeper than original natural slope.

Figure 8.3 Stress release on the cut slope

Cut slope is exposed to the air as naked. Rain run off erodes and weathering goes on little by little. Slaking makes mudstone be broken into pieces. Drainage and slope protection are countermeasures against them.

Erosion Slaking

Figure 8.4 Erosion and weathering on the cut slope

8.4 Embankment Slope

8.4.1 Embankment Body

We can select embankment material and compaction procedure. Necessary conditions for strong embankment are; material has good grain size distribution, water content is near the optimum water content and compaction energy is suitable. Then embankment can get high density near maximum dry density. It means the embankment has high shear strength near maximum strength.

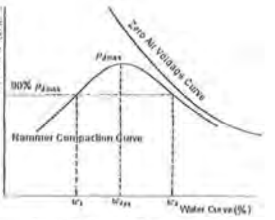
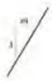


Figure 8.5 Curve of soil compaction

Adequate gradients for embankment are shown in table 8.2. Erosion and weathering occur on embankment slope as same as cut slope.

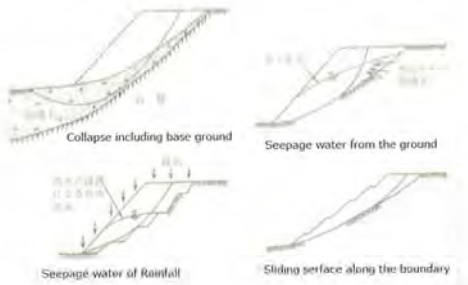
Table 8.2 Adequate gradients for embankment

Banking materials	Height of embankment (m)	Standard gradient	Remarks
Well-graded Sand (S), gravel, and sand mixed with gravel (G)	Less than 5m	1:1.5 to 1: .8	To be applied to embankments with sufficient bearing capacity at foundation ground, which is not affected by inundation. Typical unified soil classification are shown in ( ) for reference.
	5m to 15m	1:1.8 to 1:2.0	
Poorly-graded Sand (SG)	Less than 10m	1:1.8 to 1:2.0	
Rock masses (including muck)	Less than 10m	1:1.5 to 1:1.8	
	10m to 20m	1:1.8 to 1:2.0	
Sandy soil (SF), hard clayey soils and hard clay (hard clayey soils and clay of alluvium, loam, etc.)	Less than 5m	1:1.5 to 1:1.8	In case of exception of standard slope is needed the stability calculation.
	5m to 10m	1:1.8 to 1:2.0	
Volcanic cohesive soils (V)	Less than 5m	1:1.8 to 1:2.0	



8.4.2 Boundary between embankment and foundation ground

Cause for collapse on embankment slope very often come from boundary between embankment and foundation ground. Typical collapses on embankment are shown in figure 8.6. Key points against the collapses are bench cut (step cut), underground drainage and surface drainage.



Adapted from bibl. [2]

Figure 8.6 Typical collapse on the embankment slope

9 Slope Disaster

9.1 Classification of Slope Disaster

Figure 9.1shows one of classification on slope disaster. Classification gives you first step to understand what happing at the disaster site. Table 9.1 gives characteristics of each types. Main subject of this guideline is T1 slope collapse.

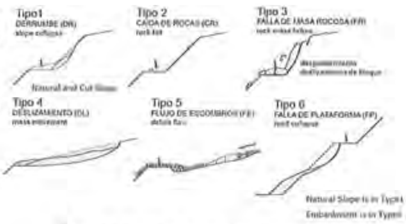


Figure 9.1 Classification on slope disaster

Table 9.1 Characteristics of each disaster

Disaster Type		Move -ment	Topography	Moving Material	Moisture	Scale	Speed
T1	Slope collapse	Slide	Mild - Steep, Low - High slope	Weathered Rock, Soil	Moist	Small-Medium (<5,000m³)	Rapid
T2	Rock fall	Fall	Steep, High slope	Rock	Dry	Very Small (<5m³)	Extremely rapid
T3	Rock mass failure	Topple, Slide, Fall	Steep, Very high slope	Rock	Dry	Medium-Large (>100m³)	Rapid
T4	Mass movement	Slide	Gentle slope with characteristic landform	Soil, Debris, Rock	Moist	Large (>5,000m³)	Slow
T5	Debris flow	Flow	Stream Mountainside	Debris, Mud	Liquid form	Medium-Large (>1,000m³)	Rapid
T6	Road collapse	Slide	Embankment slope	Fill material	Moist-Wet	Small (<1,000m³)	Rapid

T2 rock fall is common phenomena you have seen somewhere. T3 rock mass failure is special and large scale disaster not often occurs. T4 mass movement (land slide) is commonly the largest scale. Moving body keeps its shape but breaks into pieces and moving speed is very slow as millimetre per day. However it can be finally changed into collapse and run down.T5 debris flow consists of very thick mud water and debris. Large size debris concentrate to the top of flow and it shows high destructive capability. T6 road collapse is special because it occurs in artificial embankment.

T3 Rock mass failure

T5 Debris flow

Figure 9.2 Example photograph of rare disasters

9.2 Principle of Slope Disaster Countermeasure

There are 4 principles against slope disaster as shown table 9.2. Control work and deterrence work try to make the slope be stable directly. Control work expects the slope to get stability by itself. Deterrence work gives structural force to get balance with moving force. Traffic protection work try to protect traffic and let the slope be. When you face huge size obstruction, there is a possibility that avoidance plan is the best answer.

Table 9.2 Principle of slope disaster countermeasure

Classification	Principle
Control work	Control work makes the ground itself be stable. This is basic means of countermeasure. Represented by adoption of adequate slope gradient, subsurface drainage and so on.
Deterrence work	Structure deters soil mass movement by proportioning force. This work is broadly classified two. One counteracts moving force by structure's own weight as retaining wall. Another counteracts by structure's tension or stiffness as anchor or pile.
Traffic Protection work	Instead of treating disaster phenomenon directly, protection work protects road / traffic solely. Represented by catch wall, rock fall protection fence, rock shed and so on.
Avoidance plan	When size of disaster phenomenon is too large to treat from technical point or cost, road avoids disaster point by route change, bridge, tunnel etc. Avoidance plan must be reasonable than countermeasure works.

9.3 Representative Countermeasure

Representative countermeasure is shown in table 9.3. Each disaster type has a column and each principle has a row.

Table 9.3 Representative Countermeasure

Classification	T1 Slope collapse	T2 Rock fall	T3 Rock mass failure	T4 Mass movement	T5 Debris flow	T6 Road collapse
Control work	Cutting with adequate slope gradient Subsurface drainage	Removing of source rock	Removing of source rock mass	Surface water drainage Shallow groundwater drainage Deep groundwater drainage Earth removal works Counter weight embankment works	Mountainside works Valley works	Embankment with adequate slope gradient Groundwater drainage
Deterrence work	Shotcrete frame Sewing bar works Anchor works	Mortar spraying Concrete pitching Cover type rock fall prevention net Shotcrete cirb Rock bolt works	Wire rope works Adhesive bonding works Rock bolt works	Pile works Anchor works	None	Retaining wall Reinforced soil retaining wall Anchor works
Protection work	Catch wall	Rock fall protection fence Pocket type rock fall protection net Rock shed	None	None	Keeping of enough flow section Debris flow shed Opened check dam	None

9.4 Countermeasure NDRBFC shall introduce at the First

9.4.1 Target disaster type

Target disaster type at the first shall be T1 slope collapse because;

T1 slope collapse occurs frequently everywhere. Existing countermeasure recut has limitation and cannot reach definitive solution.

T2 rock fall can be solved by introduce metallic structures such as rock fall protection fence or rock fall prevention net. Rock fall phenomenon is simpler than slope collapse phenomenon therefore civil engineer can solve rock fall problem easier than slope collapse problem.

T3 rock mass failure, T4 mass movement and T5 debris flow occur at certain points not everywhere and not so frequent. Countermeasures against these types generally need high level technology and high cost. Introduction priority seems lower than T1 countermeasure.

T6 road collapse can be solved by construction methodology such as density control by suitable compaction, bench cut on the foundation ground and underground drainage.

9.4.2 Existing countermeasure against slope collapse

Domestic contractor has heavy earth work machines so earth work is the existing methods in Timor-Leste. Countermeasure by earth work against slope collapse is recut. Re-cutting with adequate slope gradient is representative way of control works. There are two ways for recut; recut with gentler gradient and recut on the deeper line. When the road stands near the ridge line these methods can adopt. However the road locates on mountainside then this method application becomes impossible because recut line cannot touch the ground surface line till top of the slope.

Figure 9.3 Two ways for recut

Table 9.4 Adequate gradient for cut slope

Soil classification		Cut Slope Height	Gradient
Hard rock			1:0.3 to 1:0.8
Soft rock			1:0.5 to 1:1.2
Sand	Not dense, and poorly graded		1:1.5 to
	Dense	Less than 5m	1:0.8 to 1:1.0
		5 to 10m	1:1.0 to 1:1.2
Sandy soil	Not dense	Less than 5m	1:1.0 to 1:1.2
		5 to 10m	1:1.2 to 1:1.5
	Dense, or well graded	Less than 10m	1:0.8 to 1:1.0
Sandy soil mixed with gravel or rock masses		10 to 15m	1:1.0 to 1:1.2
	Not dense, or poorly grade	Less than 10m	1:1.0 to 1:1.2
		10 to 15m	1:1.2 to 1:1.5
Clayey soil		0 to 15m	1:0.8 to 1:1.2
Clayey soil mixed with rock masses or cobble-stone		Less than 5m	1:1.0 to 1:1.2
		5 to 10m	1:1.2 to 1:1.5

Adapted from bibl. [8]

9.4.3 Prospective countermeasure against slope collapse

Combination of sewing bar and surface cover structure is representative countermeasure of deterrence works. The bars sew unstable soil to stable one and the cover structure distributes sewing effect all around. This method can adopt where recut cannot adopt. This method has wide coverage and so many actual achievement in Japan. Most popular casting is deform reinforcing bar for sewing bar and shotcrete frame for surface cover structure.

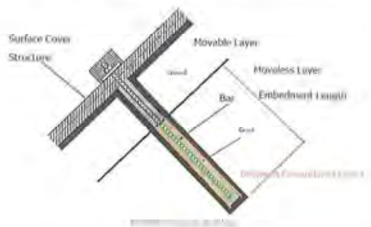


Figure 9.4 Basis of sewing bar and surface cover structure

Figure 9.5 Example of most popular casting

10 Slope Stability Calculation

10.1 Calculating Formula

Calculating formula of slope stability is necessary in order to treat the problem in a quantitative way. We use the simplest one named "Simplified formula" as shown below.

$$F_S = \frac{\sum[c_i l_i + (W_i - u_i b_i)\cos\alpha_i \tan\varphi_i]}{\sum W_i \sin\alpha_i}$$

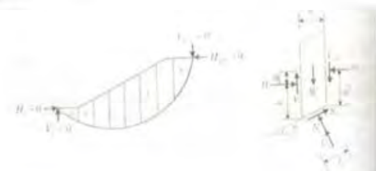


Figure 10.1 Explanation of simplified formula

Sliding surface is supposed as circular arc. Sliding body is divided into n slices by vertical slice lines and slices are treated as rigid bodies. Assumed condition " Acting forces on both side of the slices are even" changes the problem into statically determinate one. That is why named simplified.

10.2 Calculating Conditions

10.2.1 Shape Information

When we execute the slope stability calculation we need to set up shape information; ground surface line, groundwater surface line, soil layer boundary line and sliding surface line.Cross section survey gives ground surface line. Geological investigation such as outcrop observation and drilling gives hint for groundwater surface line and soil layer boundary line. Groundwater surface line is supposed higher position than usual when collapse occurs. Sliding surface is estimated from shape of actual collapse.

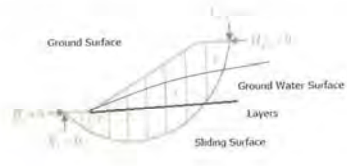


Figure 10.2 Shape Information

10.2.2 Soil Characteristics

Soil characteristics are also necessary for the calculation. They are unit weight of sliding body and shear strength of sliding surface.

You can set up unit weight easily because the value stands narrow range. Wet unit weight γ_t takes 17 to 19 kN/m³ and saturated unit weight γ_{sat} takes 18 to 20 kN/m³.

In contrast setting up shear strength is very difficult problem. There are tests to get shear strength such as Dokenbo vane cone test on site and tri-axial compressive strength test in laboratory. However value by test distributes wide range and compatibility between test-value and stability calculation is not so good. Therefore in practical problem reverse calculation method is applied to set shear strength very often.

When collapse occurs the safety factor is estimated as 1.0. It means that the collapse is just on balance so sliding force equals to resistance force. Before reverse calculation one of shear strength factor c (cohesion) or ϕ (internal friction angle) should be set on some reason. Then another strength factor ϕ or c can be get by calculation because there is only one unknown in the formula.

10.3 Excel worksheets for slope stability calculation

In the project excel worksheets for slope stability calculation are prepared for training and practical works.

You input slope gradient and collapse size (height and vertical depth), the worksheet calculates sliding circle (radius and theta). After that other worksheet divides sliding body into 6 slices and calculates values in the slope stability calculation formula with summary table. You can get not only safety factor but also cohesion c or inner friction angle φ in reverse calculation.

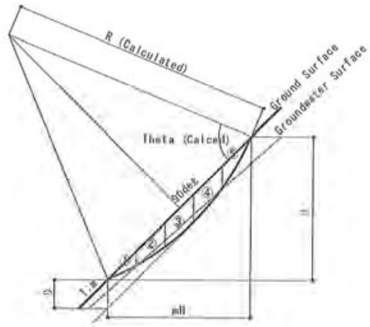


Figure 10.3 Sliding circle arc in the excel sheet

11 Influence of factors in slope stability calculation formula

Before you face actual problem you should know how each factor in the formula influences on safety factor.

11.1 Slope Gradient

When collapse occurs on some cut slope, re-cutting with milder gradient comes into countermeasure candidate at first. Figure 11.1 shows how slope gradient influences safety factor. When slope gradient is 1:1.2 safety factor becomes 1.05. When 1:1.5 safety factor becomes 1.15. Milder slope gradient unexpectedly gets small increase on safety factor.

Collapse conditions; slope gradient 1:1.0, all saturated (ground water surface equals ground surface), φ=30deg, c=7.23kN/m² (reverse calc.), γ_{sat}=20kN/m³,size (height=5m, vertical depth=2.07m)

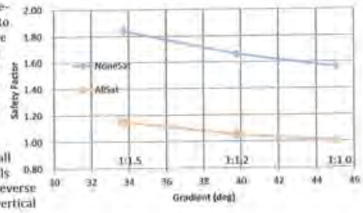


Figure 11.1 Influence of slope gradient

11.2 Shear Strength

Shear strength of sliding surface consists of cohesion c and inner friction angle φ. Both of them has direct influence to safety factor. C has stronger influence than φ. This fact indicates when you execute reverse calculation φ should be set and c should be calculated.

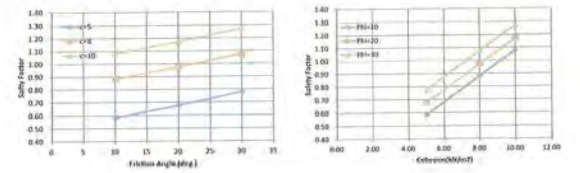


Figure 11.2 Influence of shear strength

Conditions; slope gradient 1:1.0, all saturated (ground water surface equals ground surface). γ_{sat}=20kN/m³,size (height=5m, vertical depth=2.07m)

11.3 Ground Water

Shape of groundwater surface also has influence to safety factor. Here 6 variations of water shape are calculated. None of slices is under groundwater, all of slices are under groundwater and medium portion as shown in figure 11.3.

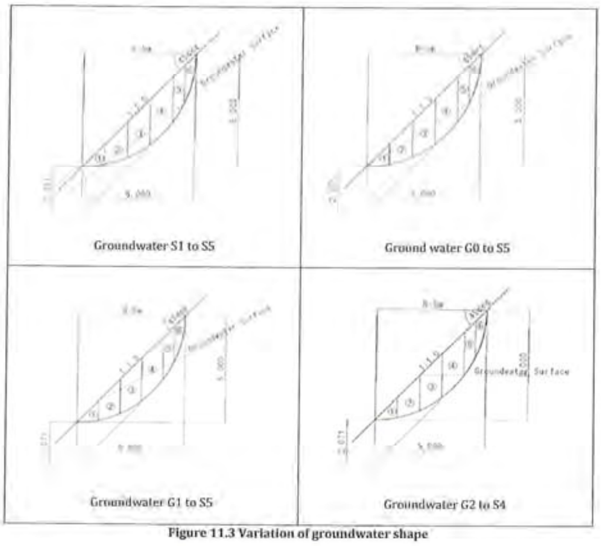
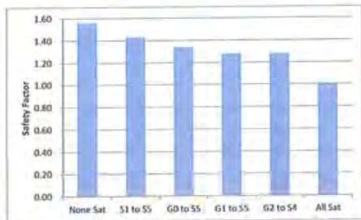


Figure 11.3 Variation of groundwater shape

Result is shown in figure 11.4. Safety factor goes down along groundwater rising. Lower portion of sliding body works for resistance. When buoyancy by groundwater acts these portion resistance force by friction decreases then safety factor gets down. Lateral borehole drainage can be effective countermeasure when they are set at adequate position.



Groundwater	Safety Factor
None Sat	1.56
S1 to S5	1.43
G0 to S5	1.34
G1 to S5	1.28
G2 to S4	1.28
All Sat	1.00

Figure 11.4 Influence of groundwater

12 Design Example of Countermeasure against Shallow Slope Collapse

12.1 Design Procedure

Figure 12.1 presents design procedure of sewing bar and surface cover structure.

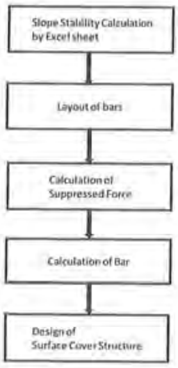


Figure 12.1 Design procedure of sewing bar and surface cover structure

12.2 Slope Stability Calculation

In the example slope stability calculation is executes as below.

Input data of Slope Stability Calculation

Shape of ground surface	Height	m	10.00
	Gradient ratio		1.20
Movable layer depth	ML depth	m	2.603
Groundwater depth	Groundwater level is as same as ground surface		
Unit weight	Wet UW	kN/m3	18.0
	Saturated UW	kN/m3	20.0
	Water UW	kN/m3	9.8
Calculation Type	Calc Type		B
Input slip surface strength	IP cohesion	kN/m2	
	IP IF angle	deg	30.0
Existing safety factor	ES Fs		1.00

Summary Table

Element	Angle Alpha	Length l	Area	Weight W	Wcos Alph -ul	Wsin Alph
#	deg	m	m2	kN	kN	kN
1	13.5	2.490	1.603	32.06	15.19	8.55
2	24.5	2.638	4.291	85.82	36.02	35.65
3	34.3	2.905	5.812	116.21	39.07	65.50
4	45.5	3.423	5.718	114.36	24.34	81.55
5	55.2	2.905	2.157	43.14	0.00	35.44
6	63.7	2.712	0.860	17.21	0.00	15.43
Total		16.273			114.42	242.12

A. Given c and Phi, Target is Fs

IP cohesion	kN/m2	0
IP IF angle	deg	30
Fs		–

B. Given Phi and Fs, Target is c

IP IF angle	deg	30
ES Fs		1
c	kN/m2	10.83

C. Given c and Fs, Target is Phi

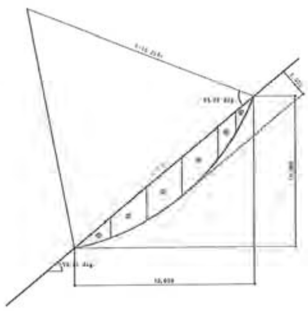


Figure 12.2 Cross section of Slope stability calculation

12.3 Layout of bars

Interval of bars are trade-off relationship between bar diameter and number of bars. Long interval of bars leads larger diameter and smaller number of bars. Short interval leads opposite result. Interval of bars generally distributes 1.5m to 3m. 2m can be applied for broad cases.

In the example horizontal interval "m" is 2 meters and number of sewing bars on the collapse "n" equals 7.

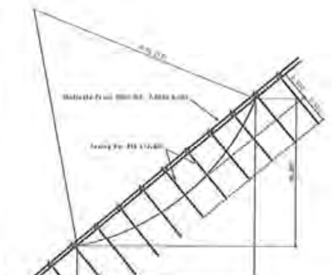


Figure 12.2 Layout of bars

12.4 Calculation of Suppressed Force

Suppressed force is calculated on below formula.

$$F_{SA} = \frac{\sum (c_i l_i + (W_i - u_i b_i)\cos\alpha_i \tan\varphi_i)}{\sum W_i \sin\alpha_i} = 1.00$$

$$F_{SP} = \frac{\sum (c_i l_i + (W_i - u_i b_i)\cos\alpha_i \tan\varphi_i) + P_T \tan\varphi_i}{\sum W_i \sin\alpha_i} = 1.20$$

$$F_{SP} - F_{SA} = \frac{P_T \tan\varphi_i}{\sum W_i \sin\alpha_i} = \Delta F_S = 0.20$$

$$P_T = \frac{\Delta F_S \sum W_i \sin\alpha_i}{\tan\varphi_i}$$

$$P_{sB} = \frac{m}{n} P_T$$

F_{SA}: Actual Safety Factor
F_{SP}: Planed Safety Factor
ΔF_S: Additional Safety Factor 0.2 commonly
P_T: Total Suppressed Force
m: Horizontal Interval of Sewing Bars
n: Number of Sewing Bars on the Collapse
P_{sB}: Suppressed Force of each Sewing Bar
We suppose collapse occurs on F_{SA}=1.00.
It means limit of the balance between resistance and sliding forces.

In the example calculation executes as below. we get ΣWsinα=242.12kN from the summary table of the excel worksheet.

$$P_T = \frac{\Delta F_s \sum W \sin\alpha}{\tan\varphi} = \frac{0.2 \times 242.12}{\tan 30} = 83.87kN$$

$$P_{eB} = \frac{m}{n} P_T = \frac{2}{7} \times 83.87 = 23.96kN$$

12.5 Calculation of Bar

12.5.1 Selection of sewing bar

Reinforcing bar D16 is selected as sewing bar. There is possibility that bar will corrode and lose its cross section in the future. Diameter 1mm is margin for corrosion then cross section is A=176mm². Tension stress is calculated as below. The value is smaller than allowable value.

$$\sigma = \frac{P_{sB}}{A} = \frac{23.96 \times 10^3}{176} = 136 < 200N/mm^2$$

12.5.2 Embedment length

The bar is fixed in moveless layer. It is called embedment. If embedment length of the bar passes two check points then the bar can bear against drawing out. They are friction between ground and grout and friction between grout and bar.

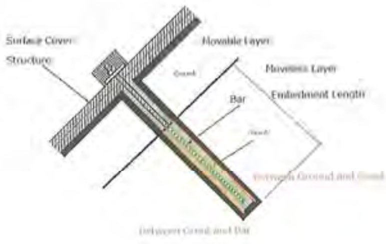


Figure 12.3 Check points of embankment length

12.5.2.1 Calculation of embedment length between ground and grout

Necessary embedment length between ground and grout is calculated on below formula.

$$l_b = \frac{P_{eB} F_{sb}}{\pi \cdot d \cdot \tau} = \frac{23.96 \times 10^3 \times 2.0}{\pi \times 65 \times 0.14} = 1676mm \rightarrow 2.0m$$

l_b: Necessary embedment length between ground and grout to not draw out

Fsb: Safety factor for draw out; Standard value 2.0

d: Drilling diameter; 65mm is popular diameter

τ: Ultimate skin friction resistance;

Assumption condition: Gravel layer N-value=20

Then τ= 0.14 N/mm²

Standard value of ultimate skin friction resistance is shown in table 12.1.

Table 12.1 Estimated ultimate skin friction

Ground type			USFR N/mm^2
Base rock	Hard rock		1.2
	Soft rock		0.8
	Weathered rock		0.5
	Hard pan		0.5
Gravel Layer	N-value	10	0.08
		20	0.14
		30	0.20
		40	0.28
		50	0.36
Sandy soil	N-value	10	0.08
		20	0.14
		30	0.18
		40	0.23
		50	0.24
Clayey soil			0.8×C

12.5.2.2 Calculation of embedment length between grout and bar

Necessary embedment length between grout and bar is calculated on below formula.

$$l'_b = \frac{P_{eB}}{\pi \cdot D \cdot \tau_{0a}} = \frac{23.96 \times 10^3}{\pi \times 15.9 \times 1.4} = 343mm < 1676mm$$

l'_b: Necessary embedment length between grout and bar to not draw out

D: Diameter of bar D16 → D=15.9mm

τ_{ba}: Ultimate skin friction resistance τ_{ba}=1.4N/mm²

Standard value of allowable adhesion stress between grout and deformed bar is shown in table 12.1.

Table 12.2 Allowable adhesion stress between grout and bar

DRSG σ_{ck}(N/mm²)	18	24	30	Over 40
AAS τ_{ba}(N/mm²)	1.4	1.6	1.8	2.0

DRSG: Design reference strength of grout

AAS: Allowable adhesion stress

12.6 Design of surface cover structure

In the example shotcrete frame applies as surface cover structure. Figure 12.4 shows design procedure.

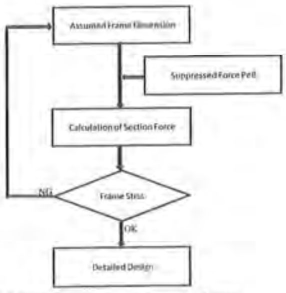


Figure 12.4 Design procedure of shotcrete frame

In the example assumed frame dimension is ;

frame interval 2.0 × 2.0m and frame cross section 300 × 300mm

12.6.1 Calculation of section force

Section forces of the frame are calculated on below formulas.

$$W_x = W_y = \frac{P}{l_x + l_y - b} = \frac{23.96}{2.0 + 2.0 - 0.3} = 6.48\ kN/m$$

$$M_{max} = \frac{1}{10} wl^2 = \frac{1}{10} \times 6.48 \times 2.0^2 = 2.59kNm$$

$$S_{max} = \frac{3}{5} wl = \frac{3}{5} \times 6.48 \times 2.0 = 7.78kN$$

P: Tension of sewing bar

w: Uniformly-distributed subgrade reaction

l: Interval of frame

b: Width of frame

M_{max}: Maximum bending moment

S_{max}: Maximum shearing force

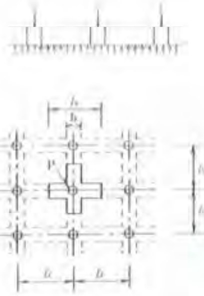


Figure 12.5 Calculation model of frame

12.6.2 Check for frame stress

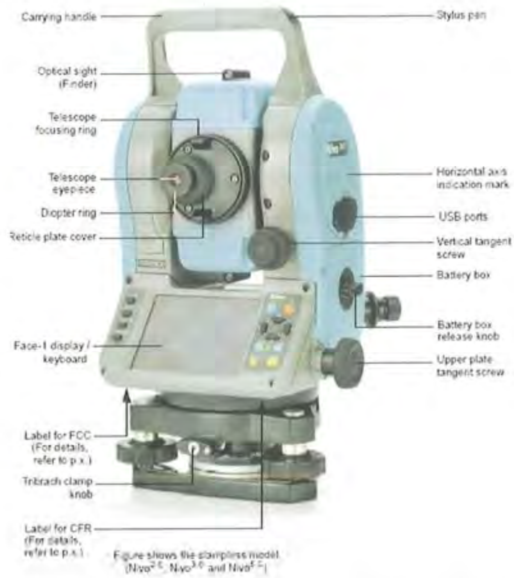
Check for frame stress is implemented in conditions as rectangular cross section, single reinforcement concrete and allowable stress design method. All of three stresses pass the check as below.

Frame cross section					
Item		Unit	Value	Memo	
Member width		cm	30.0		
Member height		cm	30.0		
effective height		cm	23.5		
Cross-section area of reinforcing bar		mm2	253.4	D13 * 2 Standard Layout	
Result of calculation					
Item		Unit	Calculated	Allowed	Judgement
Stress	Compression of concrete	N/mm2	1.24	6.00	OK
	Tension of R.F. bar	N/mm2	47.95	180.00	OK
	Avelage shear	N/mm2	0.110	0.400	OK

Annex A
(informative)

How to use the Total Station

A.1 Part names



Adapted from bibl. [6]

Adapted from bibl. [6]

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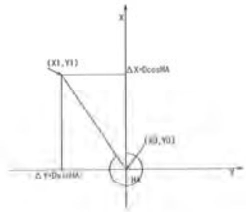
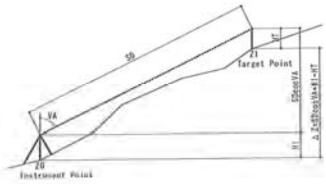
A.2 What values are measured by the total station

The total station measures horizontal angle, vertical angle and slope distance. In another words, all in one instrument to get a target coordination at once.

- HA: Horizontal Angle
- VA: Vertical Angle
- SDx: Slope Distance

Coordination of the target can be calculated from HA, VA and SDx as below figures.





A.3 Setting up the instrument

Setting up the instrument means centering and leveling.

- Centering: The TS must be set just on the station point mark.
- Leveling: Upper plate (tribranch) must be set as level.

DNEPCC

[Procedure]

① The surveyor sets the tripod head as level as and as central as possible.

② He places the instrument on the tripod head.

③ He inserts the tripod mounting screw into the instrument.

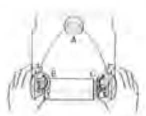
④ He levels the instrument adjusting tripod leg length after that using leveling screw.

⑤ He slides instrument on the tripod head by loosening mounting screw to centering with checking by optical plummet.

⑥ He repeats leveling and centering till both conditions are within allowable circles.

⑦ If there is only one station point in simple survey such as one cross section, then centering can be skipped.

[How to use the leveling screws]



- Two leveling screws are turned at one time by both thumbs and first fingers to different direction. It means both thumbs go inside or go outside. Slow and Gentle.
- Left thumb reads level bobble.

A.4 General procedure of simple survey

① The surveyor establishes two station points one for instrument another for back sight.

② He sets the instrument on the station point, measures instrument height.

③ He focuses on the back sight station point, and sets HA=0. Then X axis is set from the station point to the back sight point.

④ He orders the pole-man to put the pole on first target point.

⑤ He focuses on the reflector or the target and pushes the button to measure the slope distance.

⑥ He pushes the button to record and write down target name, target height and the values HA, VA, SD on the field note.

⑦ He returns the procedure ④ to ⑥ for all other target points.

⑧ If there is only one station point in simple survey such as one cross section only, then the procedure ① to ③ can be skipped.

DNEPCC

A.5 Calculation of coordination from field Note

The project provides an excel worksheet for calculation of coordination from field note.

[Input table]

Station Name	Instrument Height	Target Name	Target Number	Target Height	Horizontal Angle deg	Horizontal Angle minute	Horizontal Angle second	Vertical Angle deg	Vertical Angle minute	Vertical Angle second	Slope Distance
—	m	—	—	m	deg	minute	second	deg	minute	second	m
Room1	1.21	Corner A	1	0.95	33	32	3	91	58	24	8.273
	1.21	Corner B	2	1.07	318	44	48	93	23	23	2.431
	1.21	Clock	3	2.49	27	35	8	70	10	41	3.768
	1.21	Corner C	4	3.23	50	7	2	74	33	18	7.598
	1.21	Corner D	5	3.23	95	35	41	75	21	31	7.991

[Output table]

Target Number	X	Y	Z
	m	m	m
1	6.728	4.805	-0.025
2	1.840	-1.614	-0.005
3	3.142	1.642	-0.002
4	4.696	5.620	0.003
5	-0.754	7.695	0.000

A.6 Target points of cross section survey

What kind of points do you need when you draw a cross section. The answer is points where the gradient of ground surface is changing.

Boundary of materials is also needed, asphalt, concrete, soil and so on.

Small structure such as drainage, guard wall and so on can be measured by tape except one point of it instead of survey all.

A.7 Station point

Role of station point is to connect site and drawings. Surveyor makes survey products. Design engineer makes design drawing on the survey products. Contractor constructs along the design drawings. If there is no station point at the site the contractor cannot decide position of works.

There are two types of station point, one is temporary and another is permanent station. Temporary station is made with such as wood peg and pins for striking into pavement. In contrast permanent station is made with durable concrete peg or block to keep the position. Permanent station is often point of reference.

Peg and Pin for Station

- Wood pegs for temporary stations
- Plastic pegs for boundary marks
- Pins for striking into pavement

Point of Reference

Point of reference has authorized coordination.

Administrative agencies maintain them.

Annex B
(informative)

How to use the Dokenbo

B.1 General Information of Dokenbo

- What is Dokenbo?

Equipment for Soil layer prospection consists of

1)Cone 2)Rod 450mm 3)Rod 500mm ×9
4)Handle 5)Vane cone 6)Load meter
7)Dial torque wrench 8)Open-end wrench ×2
9)Connection sleeve 10)Carry bag

Kanji Letters	Pronunciation	Meaning	Abbreviation
土層	doso	Soil Layer	Do
強度	kyoudo	Strength	
検査	kensa	Prospection	Ken
棒	bou	Rod	Bo

[Developer and patent]

Public Works Research Institute PWRI in Japan developed Dokenbo and got patent in Japan. Anyone can use Dokenbo but only permitted one can make Dokenbo

B.2 Usage of Dokenbo

① Soil layer depth prospection
② Penetration test by spring load meter
③ Shear strength test by dial torque wrench with vane cone

B.3 Important caution

Dokenbo has two strict prohibitions;

The rods connects each other by right-screw.
Therefore,

Never turn anticlockwise

when the Dokenbo is in the soil layer.
If you do connection screw is released and apical end is lost in the soil layer.

Dokenbo is designed for static use.
Therefore,

Never hit top by hammer

to penetration.
If you do Dokenbo would buckle up or get broken.

B.4 Soil layer depth prospection

B.4.1 Procedure

- Apical end is the cone, top end is the handle.
- Set Dokenbo on prospect point, push the handle statically and slowly by investigator's own power.
- Dokenbo penetrates no more, then rod length from the surface is depth of soil layer. Investigator can read using 10cm scale mark on the rod.

B.4.2 Distribution of prospect points

- Random way; Investigator choices prospect points where soil layer seems deep. Maximum depth represents soil layer depth of the target slope.
- Regular way; Prospect points are distributed along preset line such as cross section line, contour line or fall line. All prospect points must have position information such as coordinate values.

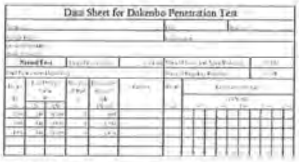
B.5 Penetration test

B.5.1 Procedure

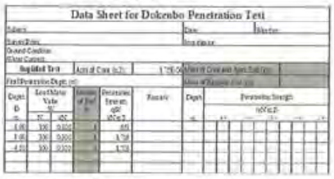
① Investigator penetrates Dokenbo till measurement depth.
② Investigator push Dokenbo through load meter slowly, when Dokenbo goes into action then investigator reads load meter.
③ Investigator fills data on 'Data Sheet for Dokenbo Penetration Test'.

B.5.2 Data sheet

- There are two ways of DPT. One is Normal Test.
- Weight of Rods is counted in calculation of penetration strength qdk.

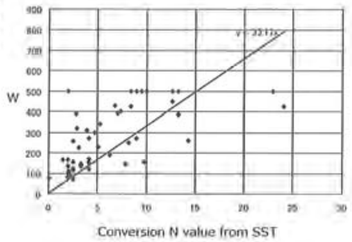


- Another is simplified Test.
- Weight of rods is not counted in calculation of apparent penetration strength qdk'.



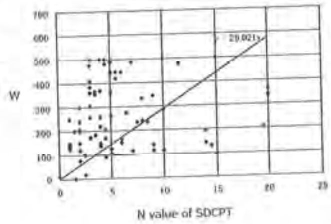
B.5.3 Correlation of other tests' result

Next graph shows correlation of observed values between Dokenbo's W and conversion N value from Swedish Sounding Test. Dokenbo can roughly penetrate N ≤ 10 ground under W≤300N.



Adapted from bibl. [7]

Next graph shows correlation of observed values between Dokenbo's W and N value from Simplified Dynamic Cone Penetration Test. Dokenbo can roughly penetrate N≤10 ground under W≤300N



Adapted from bibl. [7]

B.6 Shear strength test

B.6.1 Member component

① Vane cone and Apex rod
② Rods
③ Dial torque wrench
④ Load meter and connection sleeve

① Load Meter
② Dial Torque Wrench
Maximum load of LM is 300N (30.5kgf)
Maximum torque of DTW is 7Nm (0.71kgfm)

B.6.2 Procedure

This test needs two persons, operator is the leader of the test and turner is the assistant.

① The operator penetrates Dokenbo to target depth with vaneless normal cone.

② The turner turns Dokenbo slowly with dial torque wrench for clockwise under the load mater indicates 0. Maximum value shall be recorded as Torque by skin friction **T0**.

③ The operator replaces normal cone to vane cone.

④ The operator sets Dokenbo again at the same depth and adds some load to penetrate vane only into unbroken soil.

⑤ The operator loads vertical planned step load **Wi** through the load mater.

⑥ The turner turns Dokenbo slowly with the dial torque wrench for clockwise under the load mater indicates vertical load **Wi**. Maximum torque value is **Ti**.

⑦ The turner records test depth, **Wi** and **Ti** on the data sheet.

⑧ The operator pulls Dokenbo out and checks condition of vane cone.

⑨ The turner write remark about attached soil, influence of gravel, and so on.

⑩ This procedure is repeated till getting 5sets, at least 3 sets, of Wi and Ti. Each test must be executed at unbroken soil a little deeper portion of ex-step.

When the penetrated hole cannot stand alone then test procedure should change as below.

① The operator try to set vane cone similar depth at other new hole near the skin friction test hole.

② The operator does not pull out Dokenbo each step of the test in order to continue the test and to get 5 sets of **Wi** and **Ti**.

③ The operator sets the vane cone at 3 to 5cm deeper than ex step test to get unbroken soil.

B.6.3 Process to get shear strength

There are two ways to get shear strength from the test result. One is empiric formula way and another is correlation formula way. Correlation formula way needs 3 couples of triaxial compressive CU test and Dokenbo test at least. Therefore the guideline introduces empiric formula way only.

The empiric formula ties the test result to shear strength as below.

$$\sigma = 2.4\times10^{2}\cdot W'_{VC}$$
$$\tau = 1.5\times10^{4}\cdot T_{VC}$$
$$W'_{VC} = W + (m_c + n\cdot m)\cdot g$$
$$T_{VC} = T - T_0$$

① Investigator makes chart of Sigma and Tau.
② He makes linear regression formula.
③ Y-intercept is **Cohesion**.
④ Gradient is tangent Phi.
⑤ Phi is **internal friction angle**.

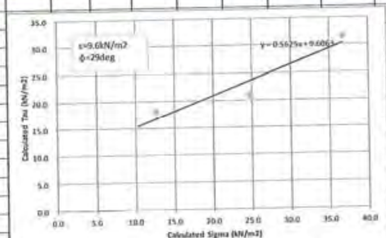
A3-214

B.6.4 Data sheet

The project provides data sheet for Dokenbo shear strength test. Example is shown as below with chart of σ and τ.

Data Sheet for Dokenbo Shear Strength Test

Subject:	Aitito Landslide Monitoring OJT			Date:	1-Dec-17		Weather:	Fine	
Survey Point:	Anaand No 3 BH			Investigator:	Mangishi and Trainer				
Ground Condition Water Content:	Colluvium, clayey soil mixed with angulated gravel, gravel mean size is 10 to 30 cm								
Empiric Formula	Height of Vane (m):	7.00E-03		Mass of Vane Cone and Apex Rod (kg):				0.310	
Final Test Depth (m):				Mass of Number Rod (kg):				0.309	
Depth	Load Mater Value	Number of Rod	Vertical Load on Vane	Torque by Skin	Dial Torque Wrench	Torque on Vane	Calculated Normal Stress	Calculated Shear Stress	Remark
D	W	n	Wvc	T0	T	Tvc	Sigma	Tau	
m	cN		kN	Nm	Nm	kNm	kN/m2	kN/m2	
0.30	5,000	0	0.053	0.0	1.2	0.0012	12.7	18.0	
0.35	10,000	0	0.103	0.0	1.4	0.0014	24.7	21.0	
0.40	15,000	0	0.153	0.0	2.1	0.0021	36.7	31.5	
0.45	20,000	0	0.203	0.0					Dokenbo go into motion by vertical load



Remark:
Matrix is clayey soil
However the result indicates sandy soil characteristics
Without check of maximum vertical load, we failed the test when vertical load at 20,000cN.

Annex C
(informative)

Excel worksheets for Stability calculation of gravity retaining wall

C.1 Outline

The worksheets execute stability calculation of gravity retaining wall, consist of 4sheets, In_put, wall, earth pressure, and summary.

- Wall shape is trapezoid with 4 node points. Backfill is horizontal.
- Coordinate origin is heel of the wall, front side of the wall is plus direction of x axis and top side of the wall is plus direction of y axis.
- Earth pressure is calculated with Coulomb's formula.
- Earthquake is out of coverage.

C.2 Worksheets

[In_put]

Name of Conditions			Symbol	Nuit	Valu	
Wall	Shape	Node1	X, Y	m	0.000	0.000
		Node2	X, Y	m	1.800	0.000
		Node3	X, Y	m	0.600	3.000
		Node4	X, Y	m	0.000	3.000
	Unit weight		γc	kN/m3	23	
Backfill	Unit weight		γs	kN/m3	19	
	Internal friction angle		φ	deg.	30	
Foundation	Allowable bearing capacity		Qa	kN/m2	200	
	Friction coefficent walll and foundation		μ	ND	0.6	
Road	Surcharge on the Road		q	kN/m2	10	

[Wall]

Element	Area A (m2)	Weight V (kN)	Arm length x (m)	Moment M (kNm)
1	2.70	62.1	0.800	49.7
2	0.90	20.7	0.200	4.1
Total		82.8		53.8

[Earth pressure]

α degree	β degree	φ degree	δ degree	KA
0.0	0.0	30.0	20.000	0.297

Active Earth Pressure Coefficient	Backfill Unit Weight	Wall Height	Surcharge on the Road	Load Name	Load	Friction Angle of Wallback	Vertical Load	Arm Length	Moment	Horizontal Load	Arm Length	Moment
KA	γ kN/m3	h m	q kN/m2		PA kN	δ degree	V kN	x m	M kNm	H kN	y m	M kNm
0.297	19	3.000		Earth Pressure	25.4	20.000	8.7	0.000	0.0	23.9	1.000	23.9
0.297		3.000	10	EP by Surcharge	8.9	20.000	3.0	0.000	0.0	8.4	1.500	12.6
						Total	11.7		0.0	32.3		36.5
											ΣM=	36.5

[Summary]

Summary table for loads and Moments

Load Name	Vertical Load kN	Horizontal Load kN	Moment kNm
Wall Weight	82.8		53.8
Earth Pressure	11.7	32.3	36.5
Total	94.5	32.3	90.3

Three check points of stability index

1) Over-turnig

X-coordinate of resultant	X=	0.956	m
X-coordinate of bottom center	B/2=	0.900	m
Eccentricity of resultant	e=	0.056	m
Allowable eccentricity	B/6=	0.300	m
Judgment		OK	

2) Sliding

Total vertical load	ΣV=	94.5
Total hrizontal load	ΣH=	32.3
Friction coefficient	μ	0.6
Safety factor of sliding	Fs=	1.76
Judgment		OK

3) Bearing capacity

Reaction stress at wall's toe	qt=	60.3
Reaction stress at wall's heel	qh=	49.6
Allowable stress (Bearing capacity)	qa=	200.0
Judgment		OK

Annex D
(informative)

Excel worksheets for slope stability calculation

D.1 Outline

The worksheets execute slope stability calculation, consist of 3sheets, In_put, Cal_EUT and Calc

- Slope collapse is presumed as circular sliding.
- The slope is flat face with uniform gradient.
- Sliding size is given through height and depth of sliding.
- Sliding body is divided into 6 slices automatically.
- Ground water is flat face, it is handled as running through the node point.
- Simplified formula is applied for safety factor calculation .
- There are 3 types of calculation combination of given condition and target.

$$F_s = \frac{\sum \left(c_i l_i + (W'_i - u_i b_i)\cos\alpha_i \tan\phi_i\right)}{\sum W'_i \sin\alpha_i}$$

Calculation type	Given condition	Target
A	c, φ	Fs
B	φ, Fs	c
C	c, Fs	φ

D.2 Worksheets

[In_put]

Input data of Slope Stabilty Calculation

Shape of ground surface	Height	m	10.00
	Gradient ratio		1.20
Movable layer depth	ML depth	m	2.603
Groundwater depth	Grandwater level is as same as ground surface		
Unit weight	Wet UW	kN/m3	18.0
	Saturated UW	kN/m3	20.0
	Water UW	kN/m3	9.8
Calculation Type	Calc Type		B
Input slip surface strength	IP cohesion	kN/m2	
	IP IF angle	deg	30.0
Existing safety factor	ES Fs		1.00

[Cal_EUT] Calculation of slip circular equation

Theta_d	Theta	Sine Theta	Cosine Thet	Left	Right	DFR
85	1.4835299	0.9961947	0.0871557	0.0436609	0.2560328	-0.212371844
45	0.7853982	0.7071068	0.7071068	0.4142136	0.2560328	0.158180775
70	1.2217305	0.9396926	0.3420201	0.176327	0.2560328	-0.079705806
60	1.0471976	0.8660254	0.5	0.2679492	0.2560328	0.011916406
65	1.134464	0.9063078	0.4226183	0.2216947	0.2560328	-0.034338124
62	1.0821041	0.8829476	0.4694716	0.249328	0.2560328	-0.006704784
61	1.0646508	0.8746197	0.4848096	0.2586176	0.2560328	0.002584797
61.3	1.0698868	0.8771462	0.4802235	0.2558264	0.2560328	-0.000206412
61.2	1.0681415	0.8763067	0.4817537	0.2567564	0.2560328	0.000723573
61.28	1.0695378	0.8769785	0.4805296	0.2560123	0.2560328	-2.04485E-05
61.27	1.0693632	0.8768946	0.4806827	0.2561053	0.2560328	7.25397E-05
61.28	1.0695378	0.8769785	0.4805296	0.2560123	0.2560328	-2.04485E-05

Slip circular

nH/2	6
H/2	5
R-t	14.2544
xc	-3.1254
yc	15.9505
R	16.2541

[Calc]

Summary Table

Element	Angle	Length	Area	Weight	WcosAlpha	WsinAlph
	Alpha	l		W		
#	deg	m	m2	kN	kN	kN
1	15.5	2.490	1.603	32.06	15.19	8.55
2	24.5	2.638	4.291	85.82	36.02	35.65
3	34.3	2.905	5.812	116.23	39.07	65.50
4	45.5	3.423	5.718	114.36	24.14	81.55
5	55.2	2.105	2.157	43.14	0.00	35.44
6	63.7	2.712	0.860	17.21	0.00	15.43
Total		16.273			114.42	242.12

A. Given c and Phi, Target is Fs

IP cohesion	kN/m2	0
IP IF angle	deg	30
Fs		-

B. Given Phi and Fs, Target is c

IP IF angle	deg	30
ES Fs		1
c	kN/m2	**10.82**

C. Given c and Fs, Target is Phi

IP cohesion	kN/m2	0
ES Fs		1
Phi		-

Annex E
(informative)

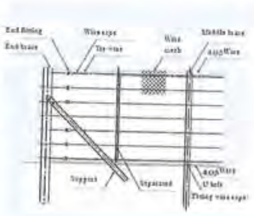
Catch wall

E.1 General information of catch wall

Catch wall which is introduced here is combination of gravity retaining wall and rock fall protection fence. Catching capacity is decided based on mass of collapsing soil. The wall has durability against impact force of collapsing soil.

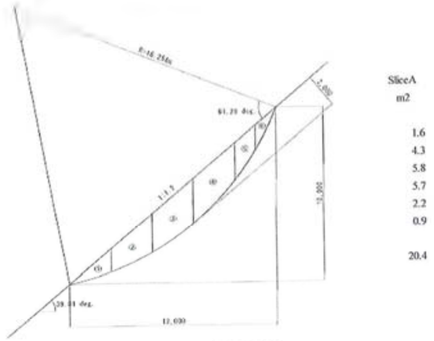
[Characteristics]

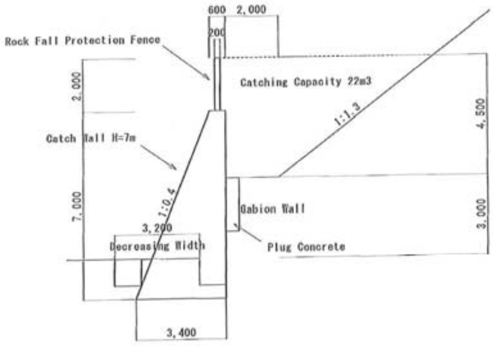
- Classified into traffic protection works
- Steel fence can reduce weight of top portion.
- Catching capacity must be bigger than collapsing soil.
- The wall must bear impact force by collapsing soil.



E.2 Catching capacity

Catching capacity is decided based on mass of collapsing soil. In this example scale of slope collapse is estimated as the drawing. Mass (Cross section) is 20.4m², Catching capacity becomes 22m² when additional height is 4.5m as below. Rock fence H=2m is often adopted for the combination.





E.3 Design procedure

① Catching capacity decides elevation of the fence top.

② Elevation of the wall top is often decided 2m down from the fence top.

③ Wall shape can be selected from Type1 of the common drawings. Original shape is also adoptable.

④ Calculation of impact force.

⑤ Same as stability calculation of ordinary gravity retaining wall

E.4 Stability calculation

[Calculation conditions]

Calculation conditions of catch wall consists of local values which is decided case by case and standard values which is used commonly.

Calculation Conditions of Catch Wall

Items	Symbol	Unit	Local Value	Standard Value
Items for Calculation of Impact Force				
Possible Collapsing Height	H	m	40	
Slope Gradient	θu	deg.	35	
Gradient between Slope-end and Wall	θd	deg	0	
Distance between Slope-end and Wall	Xb	m	2	
Height of Moving Soil	hsm	m		1.0
Density of Moving Soil	ρs	t/m³		1.8
Specific Weight of Moving Soil	σ	DL		2.6
Volumetric Concentration of Moving Soil	c	DL		0.5
Acceleration of Gravity	g	m/s²		9.8
Coefficient of Fluid Resistance	fb	DL		0.025
Coefficient of Impact Force absorption	α'	DL		0.5
Internal Friction Angle of Moving Soil	Φd	deg	35	
General Items				
Unit Weight of Wall Concrete	γc	kN/m³		22.56
Unit Weight of Backfill Soil	γb	kN/m³	18	
Unit Weight of Moving Soil	γ	kN/m³	15	
Internal Friction Angle of Backfill Soil	Φb	deg	35	
Friction Angle between Wall and Soil	δ	deg	23.3	2/3Φb

[Allowable value on stability check]

Stability checks are implemented on three situations as normal, impact force acting (collapse just occurring) and collapsed soil earth pressure acting (after collapse occurred). Each situation has different allowable value as below.

Allowable Value on Stability Check

	Over turning Eccentric Length e ≤	Sliding Safety Factor ≥	Bearing Capacity Reaction Force ≤
Normal	Smaller than B/6 Middle Third	Bigger than 1.5	Smaller than qu/3=300 kN/m²
Impact Force Acting	Smaller than B/3	Bigger than 1.0	Smaller than qu=900 kN/m²
Collapsed Soil Earth Pressure Acting	Smaller than B/3	Bigger than 1.2	Smaller than qu/2=450 kN/m²

[Calculation of impact force]

Impact force is calculated by below equation. Excel worksheets are provided.

$$F = \alpha' \cdot F_{sm}$$

F : Impact Pressure on the Wall (kN/m2)

F_{sm} : Pressure by Moving Soil

α' : Coefficient of Impact Pressure absorption

$$F_{sm} = \rho_s \cdot g \cdot h_{sm}\left\{\left[\frac{b_u}{a}\left(1-\exp\left(\frac{-2\cdot a\cdot H}{h_{sm}\cdot \sin\theta_u}\right)\right)\cos^2(\theta_u-\theta_d)\right]\exp\left(\frac{-2\cdot a\cdot X_b}{h_{sm}}\right) + \frac{b_d}{a}\left(1-\exp\left(\frac{-2\cdot a\cdot X_b}{h_{sm}}\right)\right)\right\}$$

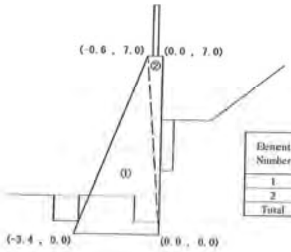
$$a = \frac{2}{(\sigma-1)C+1} f_b$$

$$b_u = \cos\theta_u\left(\tan\theta_u - \frac{(\sigma-1)C}{(\sigma-1)C+1}\tan\phi_d\right)$$

$$b_d = \cos\theta_d\left(\tan\theta_d - \frac{(\sigma-1)C}{(\sigma-1)C+1}\tan\phi_d\right)$$

Item	Symbol	Unit	Value
Coefficient	a	DL	0.027778
	bu	DL	0.370430
	bd	DL	-0.311203
Pressure of Moving Soil	Fsm	kN/m2	106.39
Impact Pressure on the Wall	F	kN/m2	53.20
Impact Pressure Acting Area	Asm	m2	1.00
Impact Force	Fc	kN	53.2

[Wall body weight and gravity center]



Element Number	Area A (m2)	Weight V (kN)	Arm Length x (m)	Moment M (kNm)
1	11.90	268.5	-1.333	-357.9
2	2.10	47.4	-0.200	-9.5
Total		315.9		-367.4

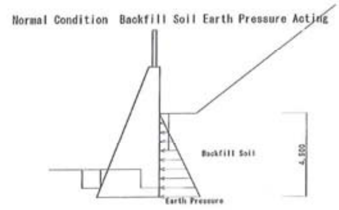
[Coulomb's active earth pressure]

Earth pressure is calculated by Coulomb's formula. One is earth pressure in normal situation. Another is in collapsed soil earth pressure acting situation.

α degree	β degree	φ degree	δ degree	KA	γ kN/m3	h m	PA1 kN/m	q kN/m2	PA2 kN/m	ΣPA kN/m	PAH kN/m	PAV kN/m
0.0	0.0	35.0	23.333	0.244	18	4.5	44.47	0	0.00	44.47	-40.8	17.6
0.0	0.0	35.0	23.333	0.244	18	9	177.88	0	0.00	177.88	163.3	70.4

[Stability calculation in normal situation]

Normal Condition Backfill Soil Earth Pressure Acting



Summary of Load and Moment

Condition	Normal				
Loads	Vertical Loads V (kN)	Arm Length x (m)	Horizontal Loads H (kN)	Arm Length y (m)	Moment M (kNm)
Wall Body	315.9		0.0		-367.4
Earth Pressure	17.6	0.000	-40.8	1.500	-61.2
	333.5		-40.8		-428.6

Three Check Points of Stability Index

1) Over-turning

X coordinate of ΣV	X=	-1.285
X coordinate of Wall Toe	Xt=	-3.400
X coordinate of Wall Heel	Xh=	0.000
Width of Base	B=	3.400
X coordinate of Limit for ΣV	Xa=	-2.833
Judgment		**OK**
Eccentric Length	e=	-0.415
Middle-third/2		0.567
Shape of Reaction Force		**Trapezoidal Shape**

2) Sliding

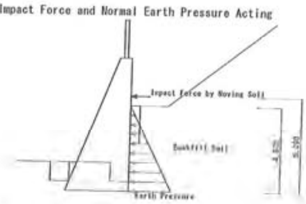
Friction Coefficient	μ=	0.6
Sliding Safety Factor	Fs=	4.90
Needed Safety Factor	Fsn=	1.50
Judgment		**OK**

3) Bearing Capacity of Foundation Ground

Reaction Force at Wall Toe	qt=	26.3
Reaction Force at Wall Heel	qh=	169.9
Allowable Bearing Capacity	qa=	300
Judgment		**OK**

[Stability calculation in impact force acting situation]

Impact Force and Normal Earth Pressure Acting



Summary of Load and Moment

Condition	Impact Force Acting				
Loads	Vertical Loads V (kN)	Arm Length x (m)	Horizontal Loads H (kN)	Arm Length y (m)	Moment M (kNm)
Wall Body	315.9		0.0		-367.4
Earth Pressure	17.6	0.000	-40.8	1.500	-61.2
Impact Force			-53.2	5.000	-266.0
	333.5		-94.0		-694.6

Three Check Points of Stability Index

1) Over-turning

X coordinate of ΣV	X=	-2.081
X coordinate of Wall Toe	Xt=	-3.400
X coordinate of Wall Heel	Xh=	0.000
Width of Base	B=	3.400
X coordinate of Limit for ΣV	Xa=	-2.833
Judgment		**OK**
Eccentric Length	e=	0.383
Middle-third/2		0.567
Shape of Reaction Force		**Trapezoidal Shape**

2) Sliding

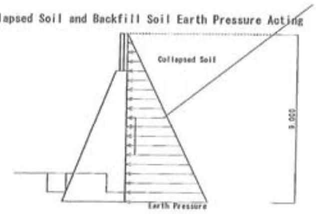
Friction Coefficient	μ=	0.6
Sliding Safety Factor	Fs=	2.13
Needed Safety Factor	Fsn=	1.00
Judgment		**OK**

3) Bearing Capacity of Foundation Ground

Reaction Force at Wall Toe	qt=	164.4
Reaction Force at Wall Heel	qh=	31.8
Allowable Bearing Capacity	qa=	900
Judgment		**OK**

[Stability calculation in collapsed soil earth pressure acting]

Collapsed Soil and Backfill Soil Earth Pressure Acting



Summary of Load and Moment

Condition	Collapsed Soil Earth Pressure Acting				
Loads	Vertical Loads V (kN)	Arm Length x (m)	Horizontal Loads H (kN)	Arm Length y (m)	Moment M (kNm)
Wall Body	315.9		0.0		-367.4
All Earth P.	70.4	0.000	-163.3	3.000	-489.9
	386.3		-163.3		-857.3

Three Check Points of Stability Index

1) Over-turning

X coordinate of ΣV	X=	-2.219
X coordinate of Wall Toe	Xt=	-3.400
X coordinate of Wall Heel	Xh=	0.000
Width of Base	B=	3.400
X coordinate of Limit for ΣV	Xa=	-2.833
Judgment		**OK**
Eccentric Length	e=	0.519
Middle-third/2		0.567
Shape of Reaction Force		**Trapezoidal Shape**

2) Sliding

Friction Coefficient	μ=	0.6
Sliding Safety Factor	Fs=	1.42
Needed Safety Factor	Fsn=	1.20
Judgment		**OK**

3) Bearing Capacity of Foundation Ground

Reaction Force at Wall Toe	qt=	217.7
Reaction Force at Wall Heel	qh=	9.6
Allowable Bearing Capacity	qa=	450
Judgment		**OK**

E.5 Comparison of other countermeasure

This catch wall design example is competitive countermeasure to combination of sewing bar and shotcrete frame presented in clause 12. Comparison table is shown as below.

Item	A. Sewing Bar and Shotcrete Frame	B. Catch Wall
Principle Classification	Deterrence Work	Traffic Protection Work
Out line	The bar sews the collapsing soil to unmoving ground, the frame distributes the bar force to collapsing soil.	Catch wall protects traffic from collapsed debris by own catching capacity. Catch wall must bear impact force by the debris
Quantity per 10m	Shotcrete frame: 370m Sewing Bar: 100, 400m	Wall concrete: 140m3 Rock fence: 10m
D.C. cost per 10m in Japan	USD 86,000.-	USD 36,000.-
Others	No loss	Road width 3.2m loss
Maintenance	Nothing	Debris shall be removed after collapse.
Selection	No demerits but high cost.	Low cost but some demerits.

Characteristics of catch wall can be summarized as below.

- Catch wall can be lower cost than other countermeasure in many cases.
- A certain level of space to place the wall base is required along foot of the slope. Therefore catch wall is not adequate to place a narrow place such as foot of steep slope.
- A certain level of bearing capacity of foundation ground is required along slope side of the road. This is the absolute requirement.
- Debris shall be removed after collapse to keep space for next collapse.
- If the target slope collapse is expansive to upper portion of slope, impact force can increase because of higher potential to the catch wall. Possible collapsing height in the design conditions must be decided with deep consideration.

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Attachment 7

The Coordinate System Training on 12 September 2018

The Project for Capacity Development of Road Services
in the Democratic Republic of Timor-Leste (CDRS)

The coordinate system training

12/09/2018
Database expert : Takashi Saito

Trainee: Name ____________
Department ____________

Two types of Coordination Expression

- **Sexagesimal divisions system**

  Ex. S 8° 49' 35.79 N 126° 32' 28.99

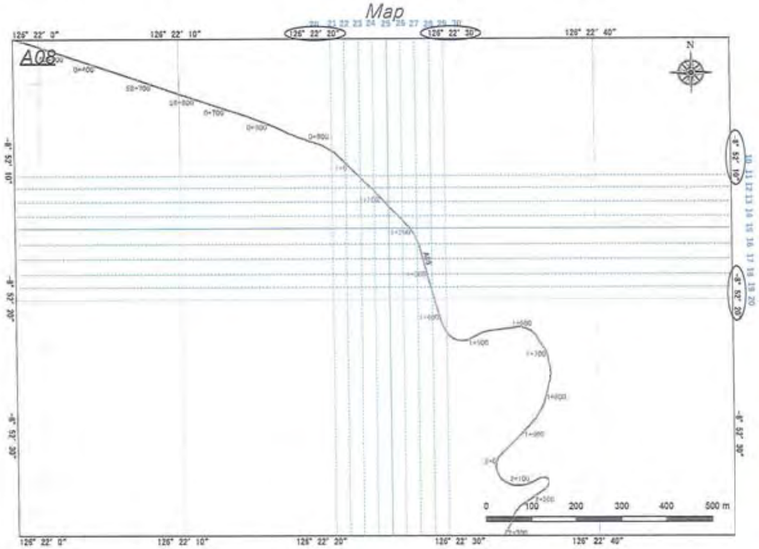
  (Degrees; Minutes 0~59; Seconds 0~59.99)

- **Decimal divisions system**

  Ex. S8.53287 N126.38742

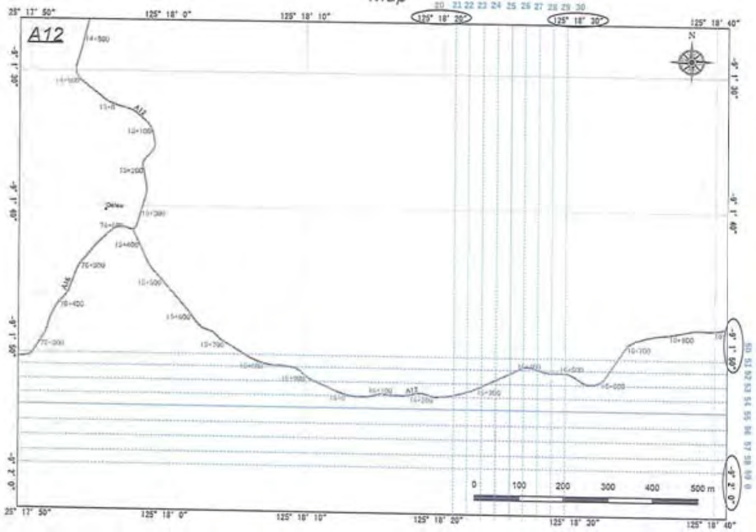
  (Degrees)

Map

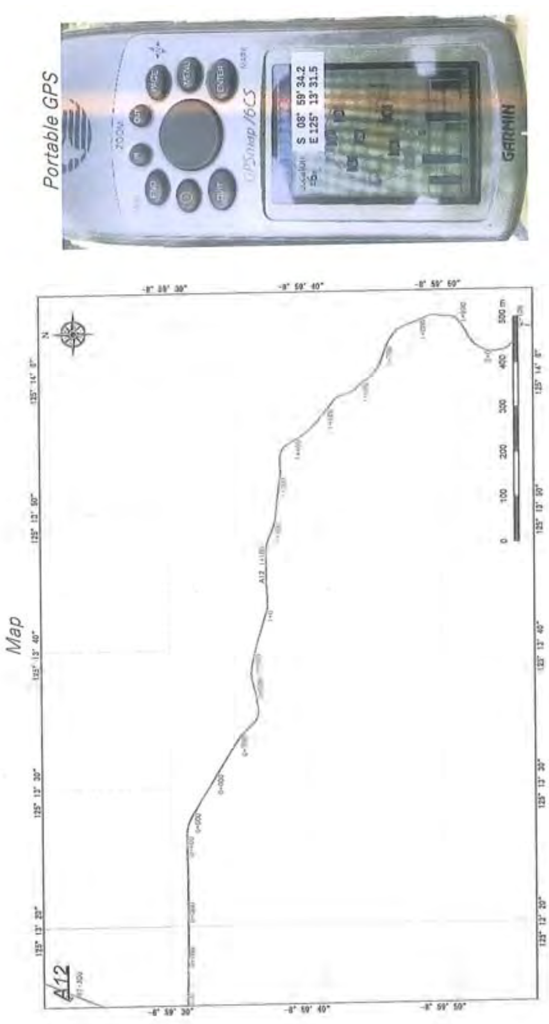


Portable GPS

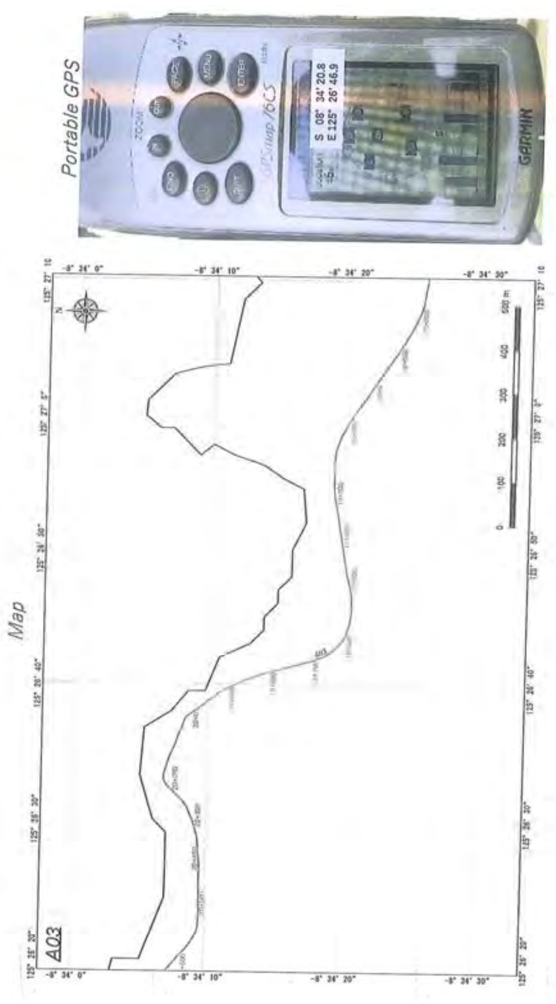
Map



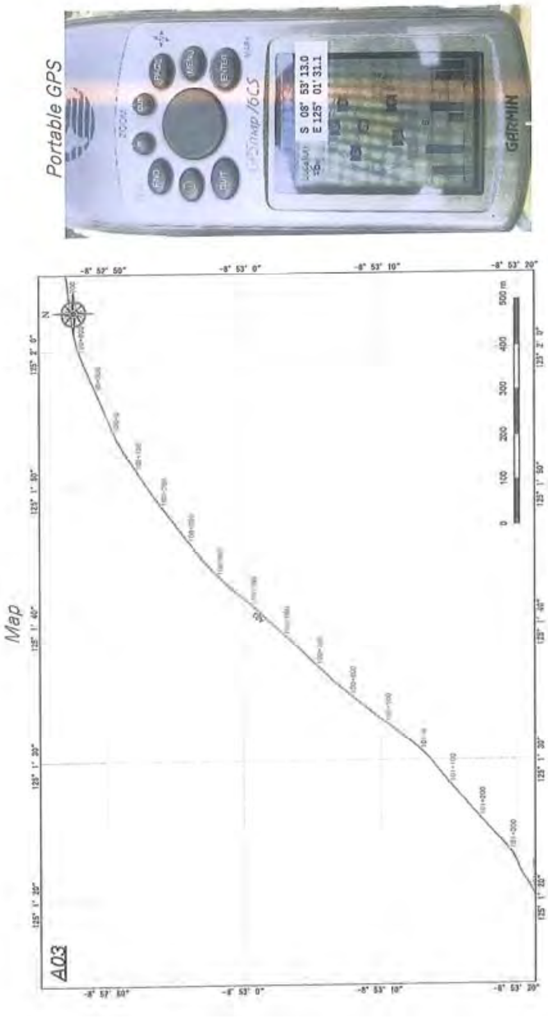
Portable GPS



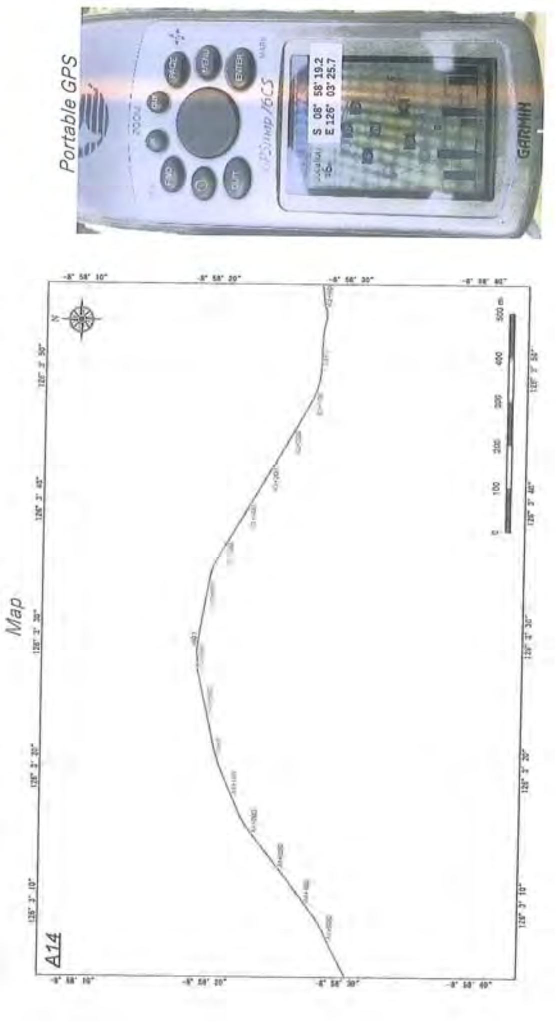
Map
A12
Portable GPS
S 08° 59' 34.2
E 125° 13' 31.5
GARMIN



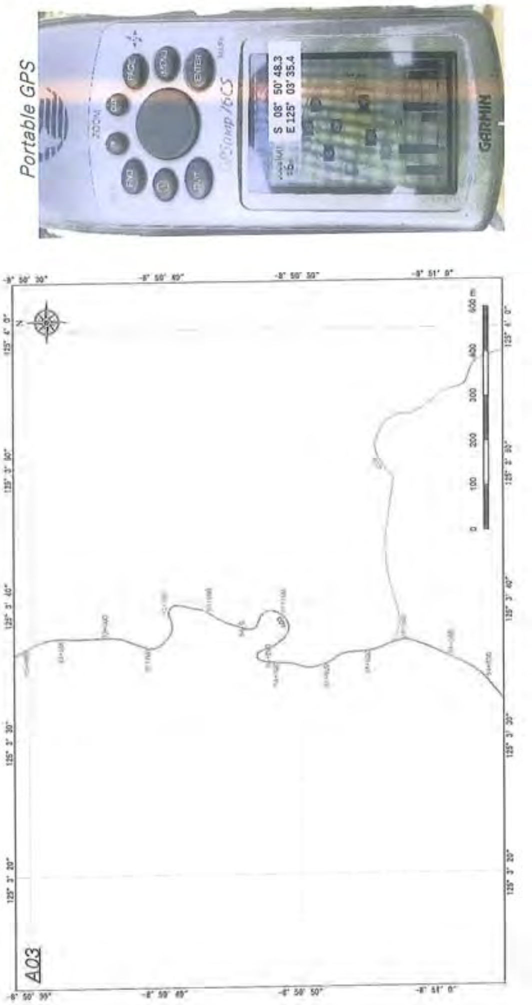
Map
A03
Portable GPS
S 08° 34' 20.8
E 125° 26' 46.9
GARMIN

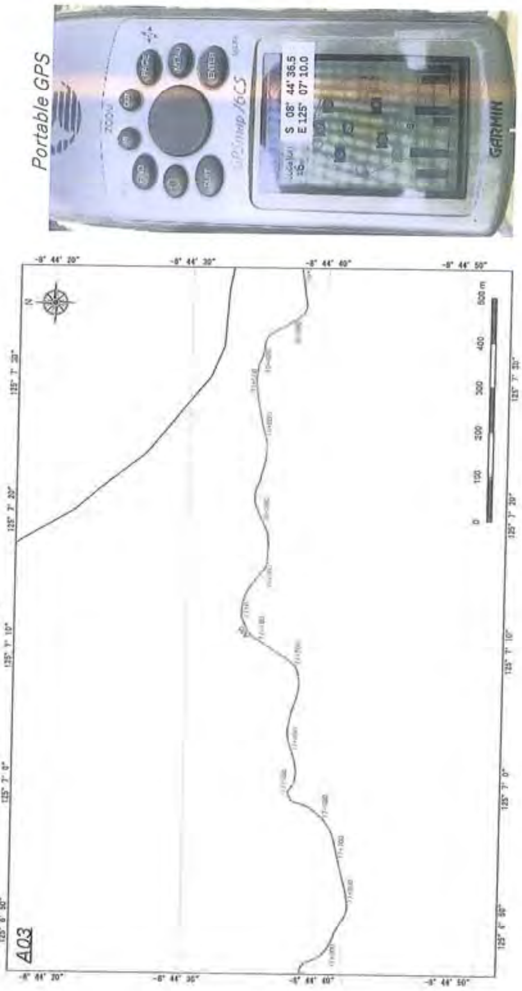


Map
A03
Portable GPS
S 08° 53' 13.0
E 125° 01' 31.1
GARMIN



Map
A14
Portable GPS
S 08° 58' 19.2
E 126° 03' 25.7
GARMIN


Portable GPS
S 08° 50' 48.3
E 125° 03' 35.4
GARMIN
Map
A03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S 08° 44' 36.5
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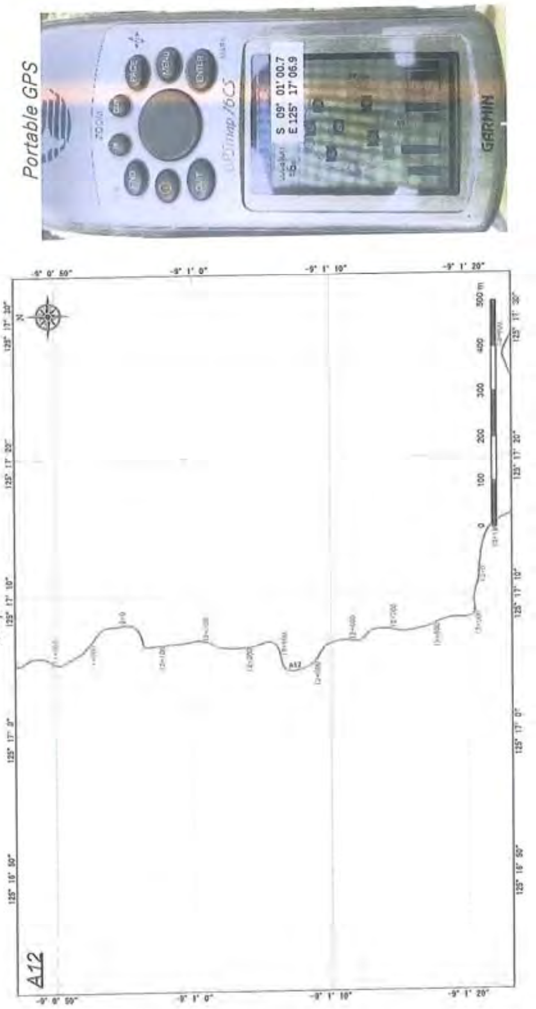
GARMIN
Map
A03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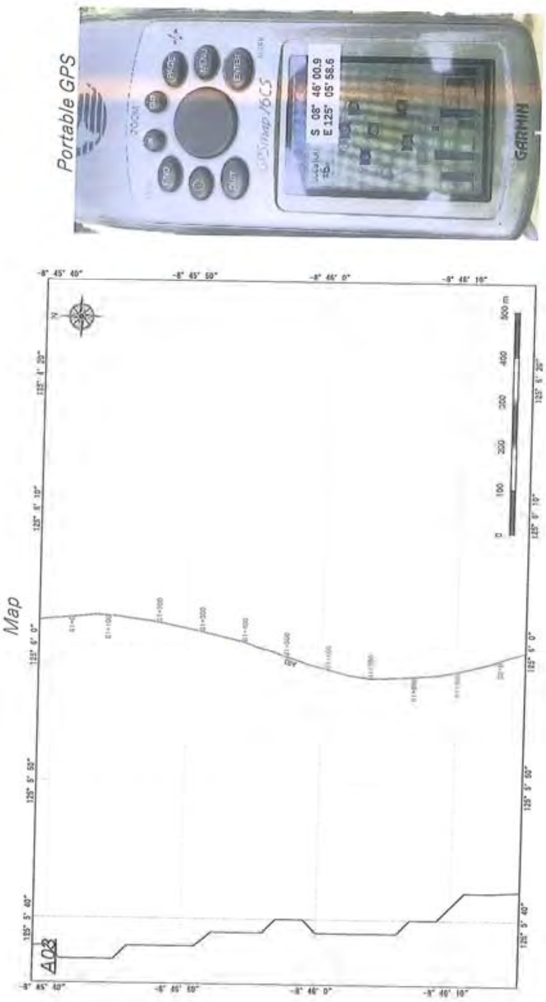
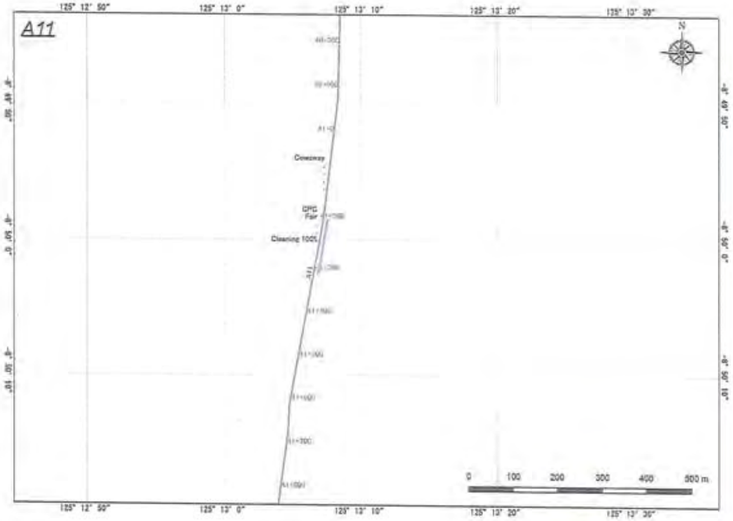
E 125° 17' 06.9
GARMIN
Map
A12

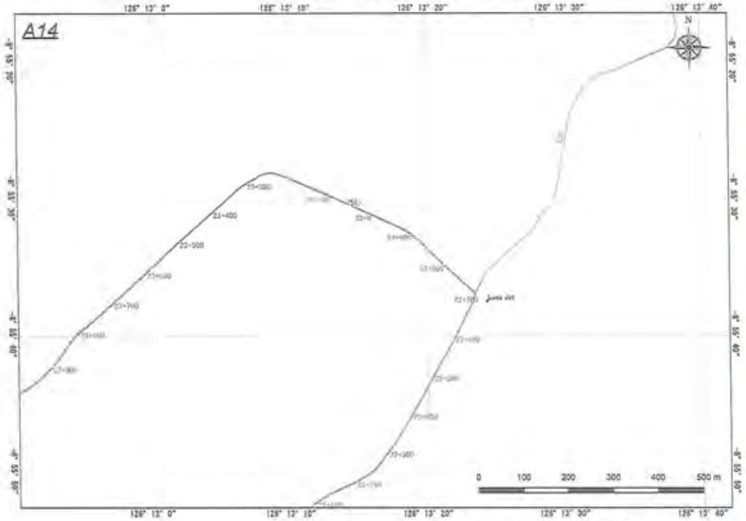

Portable GPS
S 08° 46' 00.9
E 125° 05' 58.6
GARMIN
Map
A03

Map



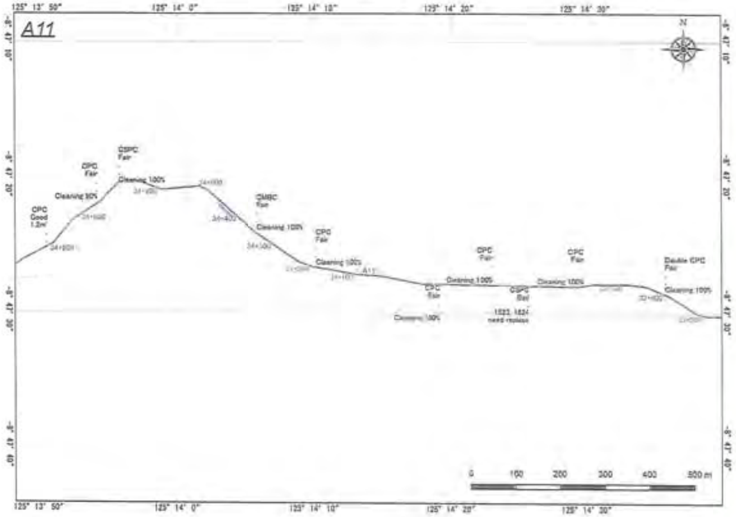
Portable GPS

Map



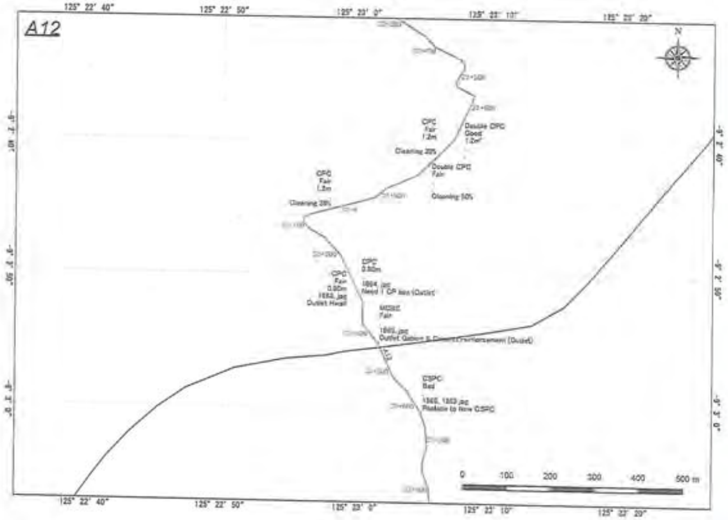
Portable GPS

Map



Portable GPS

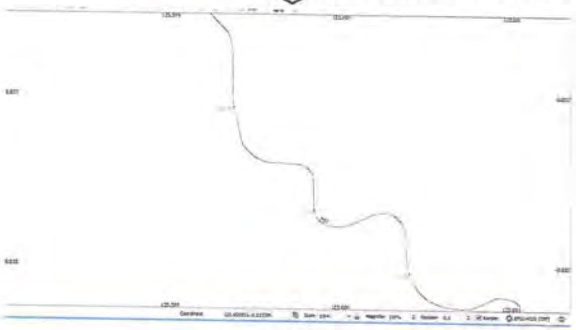
Map



Portable GPS

S8.817462 E125.599902

Where is the point in the Map?



S8.894658 E125.006283

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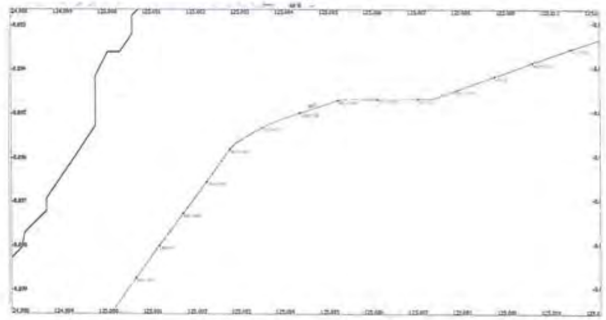
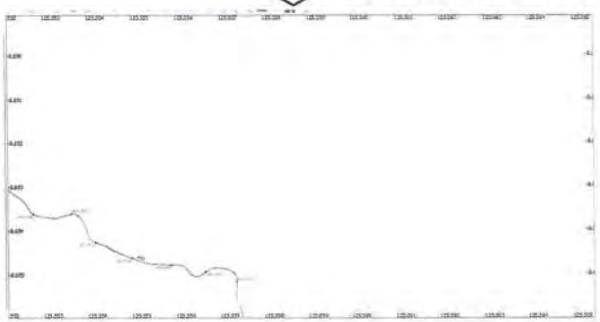


S8.694698 E125.55498

Where is the point in the Map?



S8.797098 E125.570833

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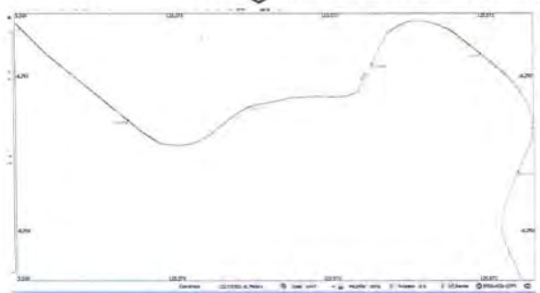

S8.843827 E125.060238

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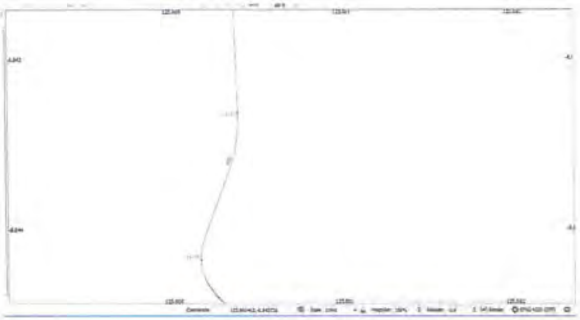
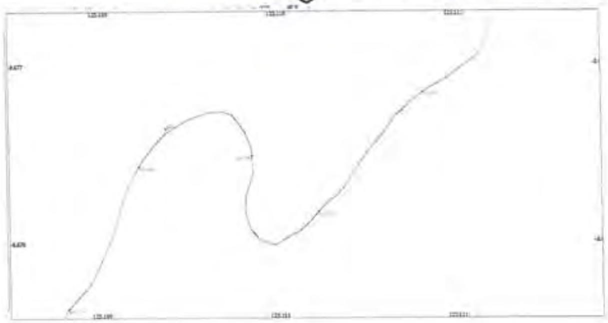


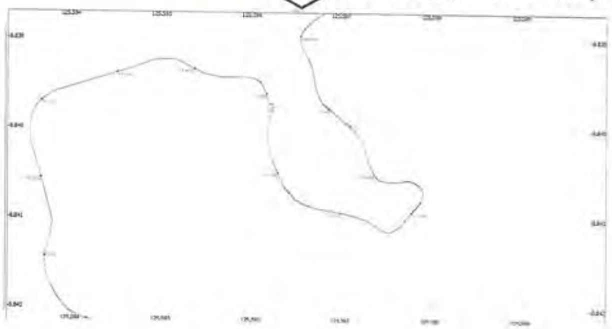
S8.677832 E125.110091

Where is the point in the Map?



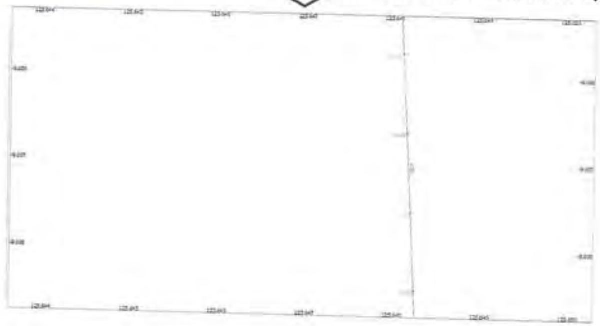
S8.84027 E125.596305

Where is the point in the Map?

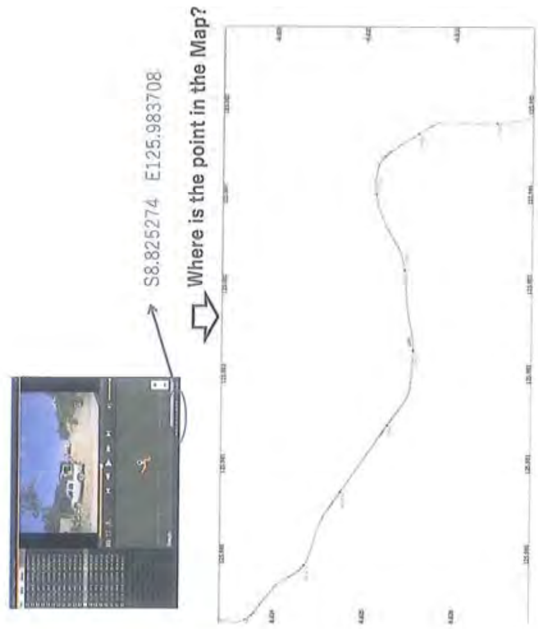


S9.007649 E125.648324

Where is the point in the Map?




S8.773389 E125.561149
Where is the point in the Map?


S8.825274 E125.983708
Where is the point in the Map?


S8.739823 E125.975488
Where is the point in the Map?


S8.564385 E125.998633
Where is the point in the Map?


S8.860177 E125.584147
Where is the point in the Map?

Attachment 8

Explanation procedure Guideline for Landslide by IPG Geologist on 17 September 2018

Workshop training between Instituto do Petróleo e Geologia (IPG), Divisaun Risco Geológicos and Ministério das Obras Públicas, Direcção Nacional de Estradas, pontes e Controlo de Cheias (DRBFC)

on

Procedure Guideline for:

LANDSLIDE

Dili, 17 September, 2018

1

CONTENTS

2

ABOUT IPG...

- The Institute of Petroleum and Geology (IPG), established in 2012 based on Decree-Law nº 33/2012 of July 18, is public institution of the Timor-Leste Government, under the supervision of the Ministry of Petroleum and Mineral Resources (MPRM).
- With the objective of developing geological studies of mineral resources, including Timor-Leste's oil and gas, using modern technical and scientific basis, enabling the development of the country.
- The mission of the IPG'S firmly focused on mineral and petroleum resources, it has experienced a growing demand for geoscience information to address issues of groundwater, geothermal, infrastructure planning, environment and related **geological risks including earthquake, landslide, and coastal erosion and flooding.**

TIMOR GAP, E.P.

3

INTRODUCTION

WHAT IS LANDSLIDE?

4

WHAT IS LANDSLIDE?

- Landslide:
  - Phenomenon where mountain slopes move in a large scale.
- Downward movement of earth masses causing by the action of gravity.
  - Rainfall-Induced
  - Earthquake-Induced

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INTRODUCTION

- Timor-Leste is a mountainous country, most of the major roads are constructed by cutting hillshades.
- Landslide are large-scale movement phenomena of the ground, and their movement are slow, that it is generally difficult to recognize their existence at the initial stage of the activity.
- Landslide and slope failures has damage many of he roads in Timor-Leste.
- Different Protection from general slope protection are required for the investigation and the countermeasures of landslide.
- The geological hazard impacts in the population are in the level of Moderate-High based on some official data from IPG, Timor-Leste.
- As studied/identified and observed by the IPG-Geological Hazard Division, there are numbers of areas which are prone to the geological hazard.

6

MAIN CAUSES OF LANDSLIDE

- Geological Condition
  - Lithology, Topography/Geomorphology
- Earthquake/Seismic Activity
- Rain
- Man-Made

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VARIOUS TYPES OF LANDSLIDE

- Rotational Landslide:
  - The surface of rupture is curved and the slide movement is roughly rotational about an axis that is parallel to the ground surface.
- Translational Landslide:
  - In this type of slide, the landslide mass moves along a roughly planar surface with little rotation or backward tilting.
- Block Slide:
  - A block slide is a translational slide in which the moving mass consist of a single unit or a few closely related units that move downslope as a relatively coherent mass.
- Rockfall:
  - Falls are abrupt movements of masses of geologic materials, such as rocks and boulders that become detached from steep slopes or cliffs.
- Topple:
  - Toppling failures are distinguished by the forward rotation of a units about some pivotal point, below or low in the unit, under the actions of gravity and forces exerted by adjacent units or by fluids in cracks

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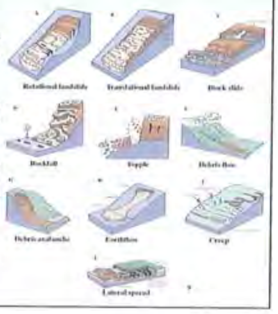
VARIOUS TYPES OF LANDSLIDE

- Debris Flow:
  - Is a form of rapid mass movement in which a combination of loose soil, rock, organic matter, air, and water mobilize as a slurry that flows downslope.
- Earthflow:
  - Earthflows have characteristic "hourglass" shape. The slope material liquefies and runs out, forming a bowl or depression at the head.
- Creep:
  - Is the imperceptibly slow, steady, downward movement of slope-forming soil or rock. Movement is caused by shear stress sufficient to produce permanent deformation, but too small to produce shear failure.
- Lateral Spread:
  - Are distinctive because they usually occur on very gentle slopes or flat terrain. The dominant mode of movement is lateral extension accompanied by shear or tensile fractures.

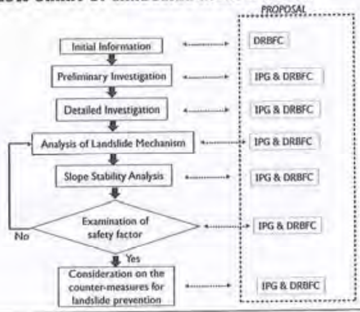


WHAT IS A LANDSLIDE WARNING SIGNS?

- Crack

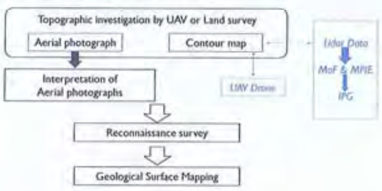
- Tree Bending

PROPOSAL OF FLOW CHART OF LANDSLIDE INVESTIGATION



PROPOSAL OF PRELIMINARY INVESTIGATION

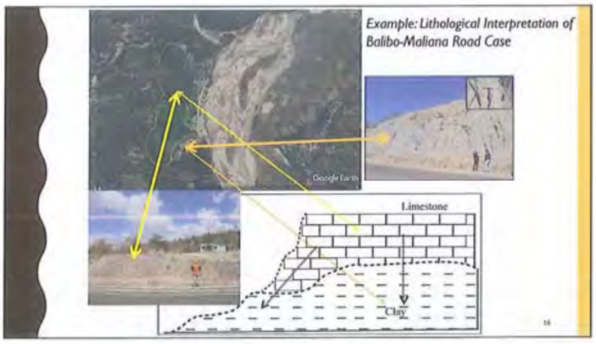
- The overall topographic feature of the site slopes
- Understanding the topographic characteristic of the site slope
- Estimating the regional geologic structure of the site

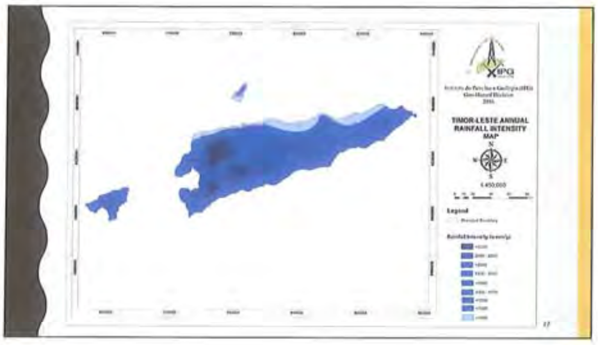


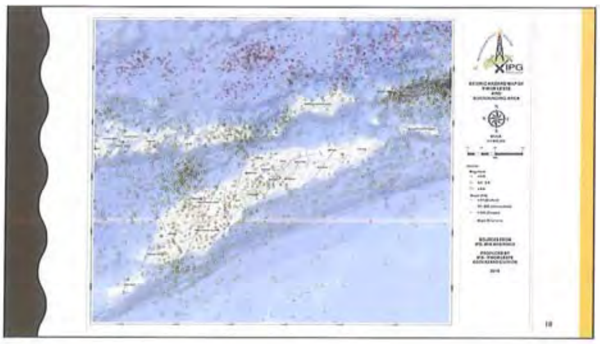
PRELIMINARY INVESTIGATION

Geological Map of Timor-Leste. Source: IPG, 2014

Example: Lithological Interpretation of Balibo-Maliana Road Case







Field Tools/Materials

- Geological Compass
- Geological Hammer
- Schmidt Hammer
- GPS
- Hand Lenses
- Roll Meter
- Camera
- Field Note Book, Pencil, Ruler, Clipboard
- HCL
- Bags

Field Tools/Material, IPG.

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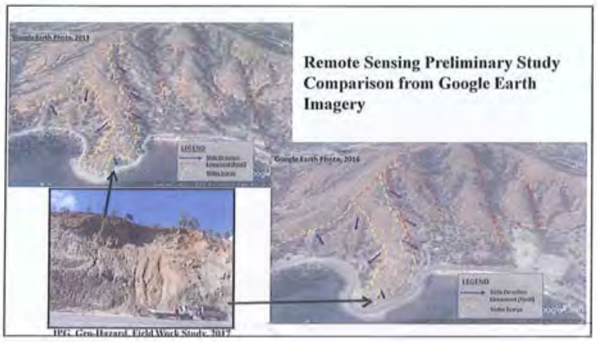
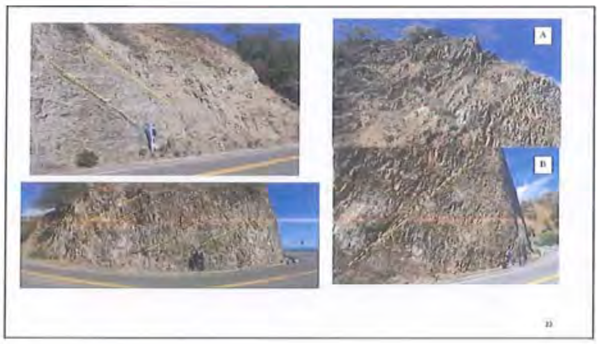
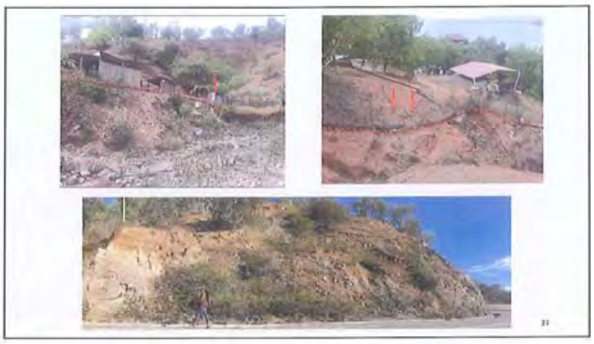
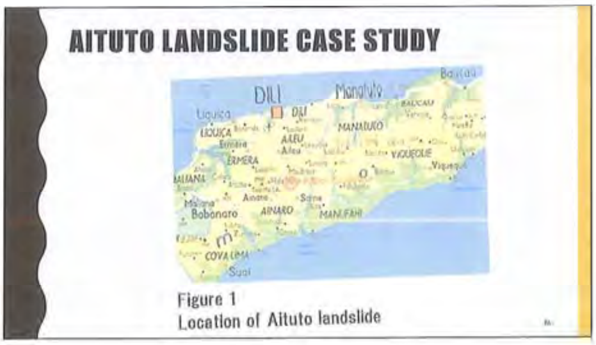
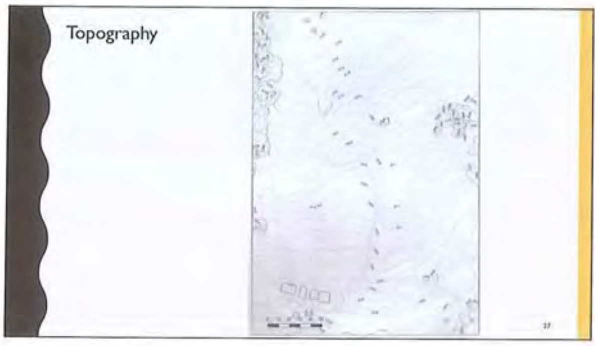
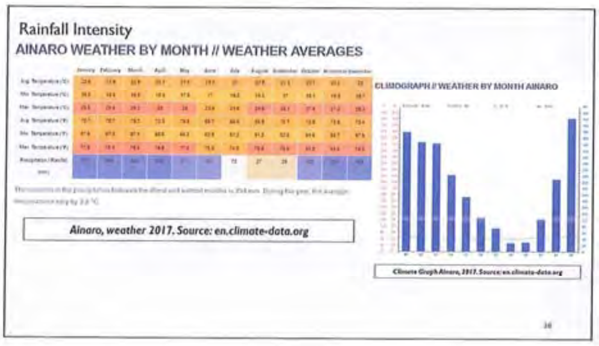


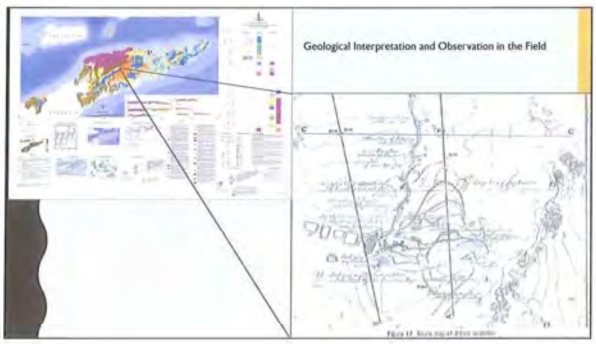




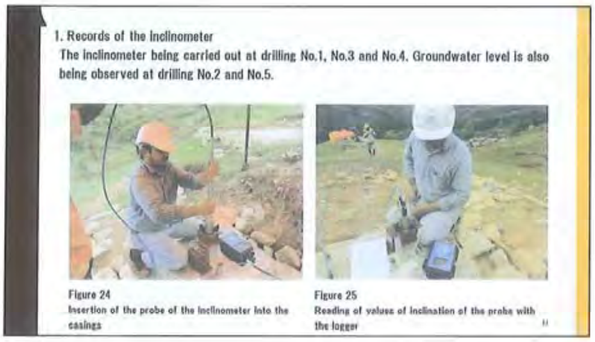


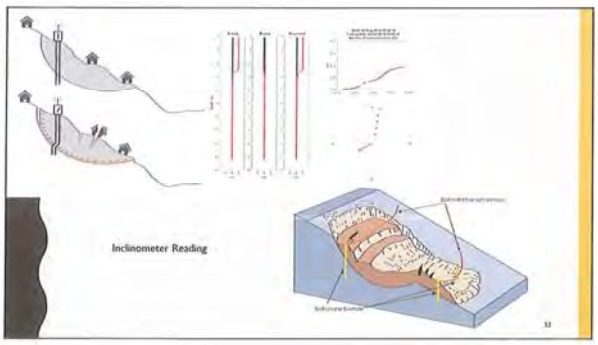






DETAIL INVESTIGATION





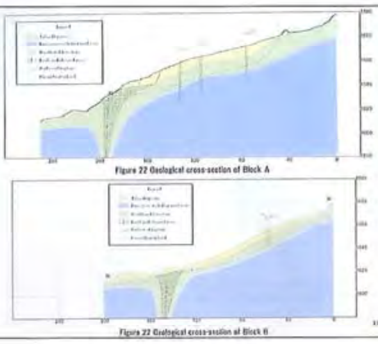


Figure 22 Geological cross-section of Block A

Figure 22 Geological cross-section of Block B

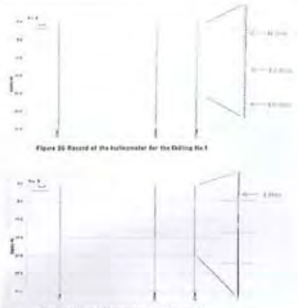


Figure 26 Record of the Inclinometer for the Drilling No.1

Figure 28 Record of the Inclinometer for the Drilling No.8

10/30/2018

Equipment Installation

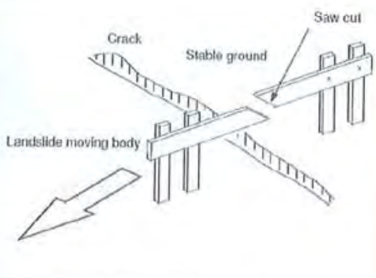


Figure 17 Simple method to measure movement

SLOPE STABILITY ANALYSIS

Fellenius Method (1927) is applied for the calculation of the safety factor.

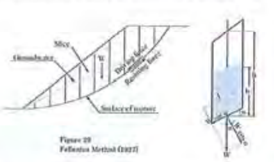


Figure 29
Fellenius Method (1927)

The landslide mass is divide into several slices, and resistance force and driving force is calculated for each slice.

$$Fs = \frac{Resistance\ force}{Driving\ force}$$

$$Driving\ force = W \sin\alpha$$

$$Resistance\ force = cl + (W \cos\alpha - ul)\tan\emptyset$$

10/30/2018

－Focused on Aituto Landslide－

Prepared excel file for slope stability analysis. The Excel file is prepared for the slope stability analysis.

I. Cross-section of the sliding mass for slope stability analysis
Cross-sections of Block A and Block B are shown in Figure 30 and 31.

Figure 30 Cross-section of Block A for slope stability analysis

Figure 31 Cross-section of Block B for slope stability analysis

10/30/2018

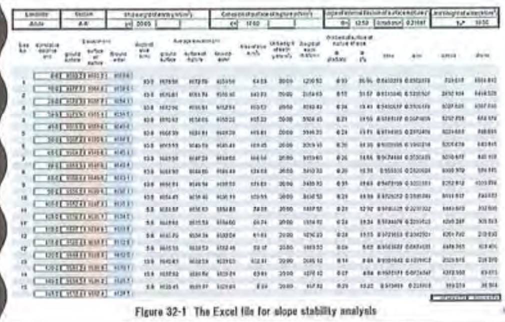


Figure 32-1 The Excel file for slope stability analysis

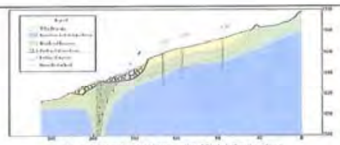


Figure 33 Assumed geological cross-section of Block A after the collapse

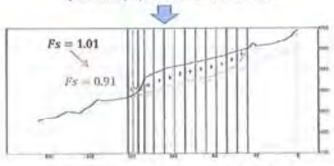
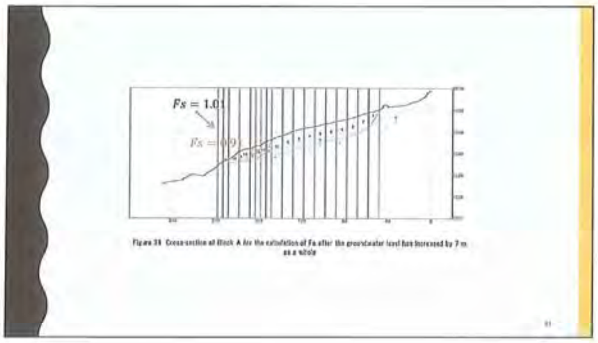
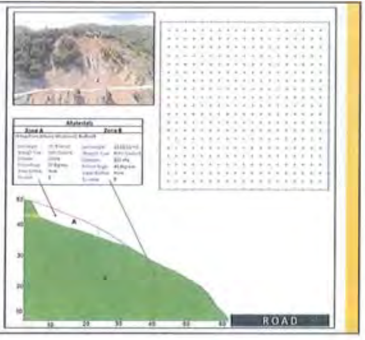
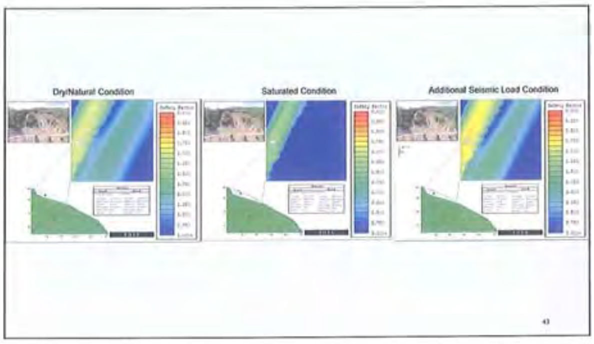


Figure 34 Cross-section of Block A for the calculation of Fs after the collapse

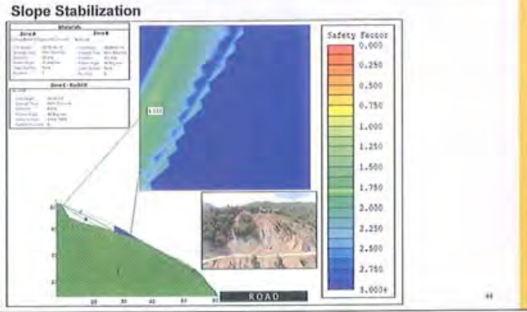


SLOPE STABILITY STUDY DONE BY IPG

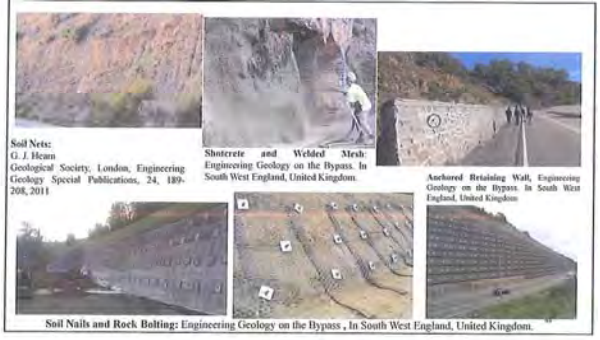




Slope Stabilization



POSSIBLE FUTURE MITIGATION?

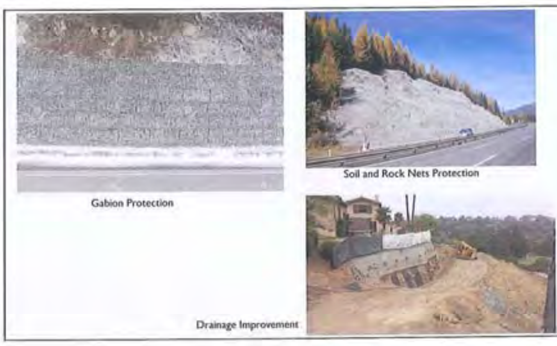


Soil Nets: G. J. Hearn Geological Society, London, Engineering Geology Special Publications, 24, 189-208, 2011

Shotcrete and Welded Mesh: Engineering Geology on the Bypass. In South West England, United Kingdom.

Anchored Retaining Wall, Engineering Geology on the Bypass. In South West England, United Kingdom.

Soil Nails and Rock Bolting: Engineering Geology on the Bypass , In South West England, United Kingdom.



Gabion Protection

Soil and Rock Nets Protection

Drainage Improvement

THANK YOU

OBRIGADO

Attachment 9

Training about the Culvert planning and case study sarlala box culvert Ex-japan road project sta. 3+100 by DRBFC Engineer on 18 and 28 September 2018

REPUBLICA DEMOCRATICA DE TIMOR-LESTE
MINISTÉRIO DAS OBRAS PÚBLICAS
DIRECÇÃO GERAL DAS OBRAS PÚBLICAS
DIRECÇÃO NACIONAL DE ESTRADAS, PONTES E CONTROLO DE CHEIAS

TRAINING ABOUT THE CULVERT PLANNING

EX-JAPAN ROAD PROJECT
SARLALA BOX CULVERT STA 3+100

BY:
1. MANUEL SOARES (Department of Projects & Administration)
2. CELESTINO E. XIMENES (Department of Highways)

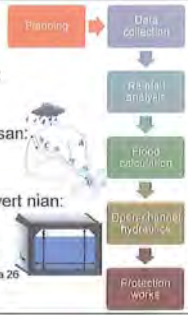
Lokasi nebe planu atu halo Box Culvert (Ex-Japan Road - Sarlala Sta 3+100)

Generalidade proposito ba Culvert

- Objectivo husi Design drainajem atu garante capacidade drainajem nebe apropriado ba facilidade drainajem nian, nebe signifika katak culvert nian spesifikasi suficiente atu akumula kemungkinan volume be'e husi Limpasan no kusto konstrusaun nebe razoavel compara ho ninia benefisiu no aktividade economia (*"The purpose of drainage design is to ensure reasonable capacity of drainage facilities, which means specifying culverts with sufficient drainage capacity to accommodate probable volumes of stormwater and at reasonable construction costs compared to their benefit to economic activities."*)
- iha kontekstu hakur Estrada,Objectivo husi Box Culvert atu garante protesaun ba Estrada nia estrutura no ba sira nebe usa Estrada. (*"Within the context of road crossings, the purpose of box culverts is to ensure the protection of road structures and road users."*)

— Introduction, pagina vii

Methodology



- Controlo ba design Culvert:
(Check of culvert design)

$$Q > Q_P$$

- Metodo Estimasaun Limpasan:
(Method of runoff estimation)

$$Q_P = \frac{1}{3.6} \times C \times i \times A$$

- Design ba capasidade Culvert nian:
(Design of culvert capacity)

$$Q = V \times A = \frac{A^{5/3} \times S_0^{1/2}}{P^{2/3} \times n}$$

— Section 8.4, Design capacity of culverts, pajina 26
— Equation 9, Rational Method, pajina 21
— Equation 11, Manning discharge, pajina 26

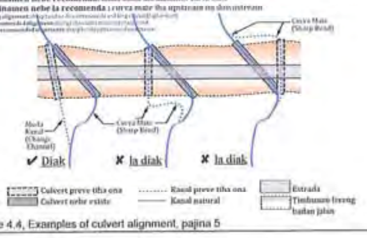
Planning: limitasaun nebe recomenda ba structura culvert

Property	Minimum	Maximum
Altura do cais (interno), D Tinggi gorong-gorong	0.75 m (750 mm)	5.0 m (5000 mm)
Largura (interna), B Lebar	0.45 m (450 mm)	6.5 m (6500 mm)
Kedalaman material take ne'e to iha culvert nia placa	0.5 m (500 mm)	—
Perbandingan (D : B) (Perbandingan)	1 : 1	1 : 3
Gradiente / Kemiringan ba culvert	0.005 m/m (0.5%)	0.100 m/m (10%)

— Table 4.1, Recommended limits for a concrete box culvert, pajina 4

Planning: proposta apropriado liu ba muda culvert nian alinamen

Alinamen nebe existe: Curva mate iha area downstream no culvert nebe naruk liu (canto nebe as tebes)
✔ **Alinamen nebe recomenda:** muda kanal atu minimiza curva mate
✘ **Alinamen nebe la recomenda :** curva mate iha upstream no downstream



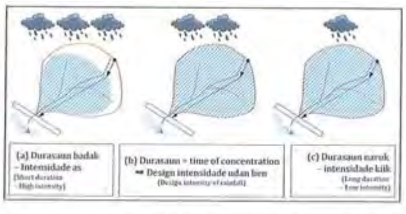
— Figure 4.4, Examples of culvert alignment, pajina 5

Prosesu dezeñu

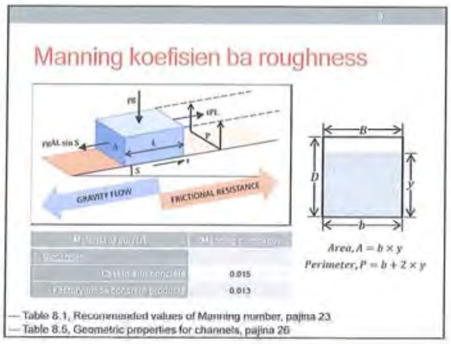
Koleksaun dadus (Data collection)	Informasaun kondisaun bazilu iha Tereno (Foto) Dadus Topografiku Dadus mapa / dadus geospatial Dadus udan ben	Section 5
Analiza dadus udan ben (Rainfall analysis)	Analiza Frekuensia Kalkulasaun udan ben diaria ba design	Section 6
Kalkulasaun ba inundasaun (Flood calculation)	Kalkulasaun ba catchment area Kalkulasaun ba tempu konsentrasaun Kalkulasaun ba udan ben nian intensidade avaliasaun cofisien Limpasan Kalkulasaun debit banjir	Section 7
Saluran terbuka hydraulic (Open-channel hydraulics)	Seleksaun ba Culvert nia dimensaun Kalkulasaun capacidade culvert ba debit air Kalkulasaun ba tipe arus no velocidade be nian	Section 8
Servisu Protesaun (Protection works)	Seleksaun ba medida protesaun no dimensaun	Section 9

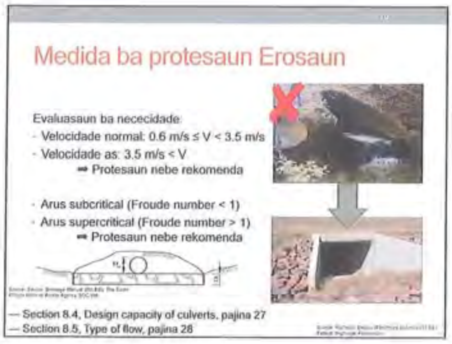
— Figure 4.5, Outline of process for design, pajina 6

Design intensidade depende ba tempu konsentrasaun ba catchment



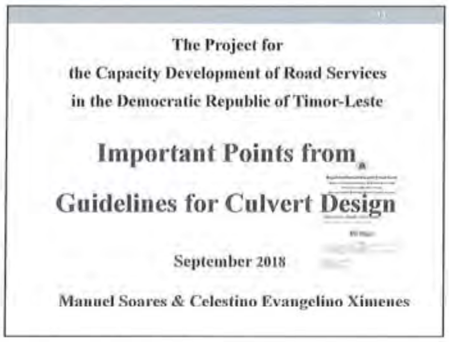
— Figure 7.8, Design intensity of rainfall for maximum probable discharge, pajina 19


Manning koefisien ba roughness
GRAVITY FLOW
FRICTIONAL RESISTANCE
0.015
0.013
Area, A = b × y
Perimeter, P = b + 2 × y
— Table 8.1, Recommended values of Manning number, pajina 23
— Table 8.5, Geometric properties for channels, pajina 26


Medida ba protesaun Erosaun
Evaluasaun ba nececidade:
- Velocidade normal: 0.6 m/s ≤ V < 3.5 m/s
- Velocidade as: 3.5 m/s < V
➡ Protesaun nebe rekomenda
- Arus subcritical (Froude number < 1)
- Arus supercritical (Froude number > 1)
➡ Protesaun nebe rekomenda
— Section 8.4, Design capacity of culverts, pajina 27
— Section 8.5, Type of flow, pajina 28


Esplikasaun
ba dezeñu Culvert


OBRIGADO


The Project for
the Capacity Development of Road Services
in the Democratic Republic of Timor-Leste
Important Points from
Guidelines for Culvert Design
September 2018
Manuel Soares & Celestino Evangelino Ximenes

Attachment 10

Record of 2nd Coordination Meeting of Site safety patrol and record of 2nd safety patrol by DRBFC on 19 September 2018

Enclosure

27 September, 2018

Record of 2nd Coordination Meeting of Site Safety Committee and 2nd Safety Patrol by DRBFC (For Case Study activity of CDRS project; Safety Patrol by DRBFC)

Nazario De Jeus Freitas,
Coordinator of Site Safety Committee,
Engineer of Construction Department

This is the record of 2nd Coordination Meeting of Site Safety Committee and 2nd Safety Patrol by DRBFC for said Case Study of CDRS project.
Date/places and the record of the discussions in the Meeting and Finding of dangerous points are follows. Reference information is shown herewith in the attachments.

1. Date and Places

1) 2nd Coordination Meeting of Site Safety Committee

Time and Date : 14:30 – 15:00, Wednesday 19 September, 2018

Venue : Conference room of DRBFC, Dili

2) 2nd Safety Patrol by DRBFC

Time and Date : 15:00 – 17:00, Wednesday 19 September, 2018

Places ①: STA 17+850 – STA 18+100, Aggregate Base Course
Constructed by "Sunrise" management by "NTN"
②: STA 7 – 8km. Stone Masonry Retaining Wall
Constructed by "Mejori" management by "Jonise"
③: STA 6+270,RC double (910 dai) Pipe Culvert
Constructed by "Jonise"

2. Minutes of 2nd Coordination Meeting of Site Safety Committee

Opening Address:

Mr. Joao Gregorio de Carvalho, Chief of Dep. Construction of DRBFC and Chairman of pilot Site Safety Committee, made an opening speech;

- Thank you very much for attending the Meeting however you are so busy.

This Meeting is to be held for Safety Activities, such as Safety Patrol at the site of Ex-Japan Road construction, where is located from the middle stream of Comoro River to the junction point with National Road A02.

- First of all, member of the Site Safety Committee are introduced;

Coordinator : Nazario, Martinho
Sub-coordinator : Pricilla
Observer : Alfredo, Angelo, Lourenco, Julius, Mousinho, Altino, Fernando, Celestino
Contractor: Jonise, NTN, Mejori, Sunrise
CDRS Advisor: Mr. Koizumi, Ms.Teresa

- Secondary, Explanation for Safety equipment (goods) are made by the Chair Man;

We are instructing that workers on the construction site must wear safety helmet through Contractor. And also, it is recommended to wear the safety vest which is colored and have reflection tape.
Each safety goods have each functions and objectives. For example, safety helmet aim to protect the head of worker when worker is hit by dropping material or he falls down at the place high incidentally. However, it is hot at construction site and many workers do not wear safety helmet and color vest.
What we can do are i) letting the workers know the objectives of color vest, safety helmet, masks and goggles and ii) making the workers wear such safety goods, at least, if they are provided such safety goods.

Place and work items for 2nd Safety Patrol

Eng. Nazario De Jesus Freitas, Coordinator of the Committee, explained the status quo of the site and following working site are decided the inspection points for 2nd Safety Patrol as stated as above 1. Date and Place 2).
Engineers from the Contractor in charge of each works also participate in the Safety Patrol.

Question / Answer and Discussions

Q/Comments: Mr. Fernando F. F. C. Freitas, Observer / Highway Department:
-These activities are the activity as a Case Study (C/S) of the Project?
-Safety Patrol and Meetings have been already conducted several times. However outstanding matter had been pointed out at the previous Patrol, but such pointed out safety issue has not improved on the site yet. In such case, it will be better to discuss regarding counter-measures, such as which kind of penalties would be imposed to the Contractor by the DRBFC as an Employer of the Works, isn't it?
-One example of Safety issue of one Highway Project, which he is in charge of, were explained: in the Contract of that Project, i) there is a certain work item that the Contractor should provide "Officer of Environmental Social Impact" and the cost of which is allocated and ii) implementation of safety activities are clearly stated in the

Contract Documents.
-Therefore, when SEPFOPE instructs the counter measures for safety during Safety Patrol, the Contractor may be imposed the penalty. Consequently, the awareness for safety at the site become increase and the Contractor takes more attention for safety measures in order not to be charged penalty.
-But, on the construction sites of Ex-Japan Road, work items for Environmental Social Impact and Safety Activities are not stated and no cost is allocated in the Contract. Therefore, carrying out of Safety Patrol again on the site like Ex-Japan Road cannot bring effective results regarding safety, isn't it ?

A/Comments: Mr. Angelo Riberiro, Observer /Training & Cooperation Department:
-On previous meeting for 1st Safety Patrol, the agenda were discussed already.
-We understand that the budget and Contract of our Works will not be changed.
-It is one idea that meaning and position of this Case Study, Safety Patrol by DRBFC, are the exercise in which the Employer, Contractor and Workers i) think of counter measure for Safety is important and ii) change their mind for Safety measures.

A/Comments: Mr. Joao Gregorio de Carvalho, Chairman / Chief of Dep.
-Objective of these activities for Safety is not "Imposing penalty against Contractor."
-As Mr. Angelo mentioned, the objective is that everybody's awareness for Safety will be enlightened in the activities of C/S
Through these activities; it is expecting that i) both the Employer, we DRBFC, and Contractors recognize the importance of the Safety and ii) implementation of safety activities will be stated and the cost of safety will be allocated in the Contract in our further Project.

3. Record of 2nd Safety Patrol by DRBFC

①: STA 17+850 – STA 18+100, Aggregate Base Course
Constructed by "Sunrise" management by "NTN"

Finding out dangerous point

1) There are Warning/precaution signboards are set both end of the working area, but the "Police Line" (temporary safety guard hence between the working area and the open lane for public transportation)
2) All the workers on the site does not wear helmet and safety vest.

Instructions / expecting counter- measures/ comments

1) To put "Police Line" for separation between working area and open public area.
2) To instruct contractor to let all workers to wear safety goods

* The Contractor are required that the Contractor recognize the importance of Safety Patrol on site because Safety Control is very essential issue.

(2): STA 7 – 8km. Stone Masonry Retaining Wall
Constructed by "Mejori" management by "Jonise"

Finding out dangerous point

1) Only three workers wear helmet and some of worker wear slip/ bare foot. 2) Workers don't wear safety helmet
2) There is no watchmen and warning sign board
3) the site is very dusty

Instructions / expecting counter- measures

1) The Contractor must provide safety goods, safety helmets and color vest and worker should wear some boots for protection of his foot
2) To put warning sign board and/or watchmen, especially near construction machines
2) To watering to reduce dusty condition

③: STA 6+270,RC double (910 dai) Pipe Culvert. Constructed by "Jonise"

Finding out dangerous point

1) Finishing works for the top of Retaining Wall is High Place (about 3-4m high from the bottom) and it is danger without working platform.
2) The Contractor provide helmets but actually worker does not wear helmet and some of them are bare foot.I
3) There is no warning board for open traffic go through just beside the working excavated hole.

Instruction Expecting counter- measures / comments

1) To prepare and use the scaffolding for the works where workers will work at the high place, such as top finishing Retaining Wall construction. 1-2) To wear musk preventing such dust from the workers
2) The Contractor must let all workers wear safety goods, safety helmets and color vest and worker should wear some boots for protection of his foot
3) To put warning sign board, watchmen and Police Line more clearly
* DRBFC, as the Employer of the Project, and Contractor must follow instructions /safety procedures by Safety Patrol.

Attachment1: Attendance List
2: Photos of 2nd Meeting & 2nd Safety Patrol
3: Check List for 2nd Safety Patrol used on the site on 19 September
4: Agenda and reference information for Safety Activities of the Meeting

Attachment1.

ATTENDANCE LIST

Date :19 September 2018
Subject :The Coordination Meeting for 2nd Safety Patrol
Venue :DNEPCC conference room

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
1	Mr	Joao Geregorio de Carvalho	Chief	Construction			[signature]
2	Mr	Nazario De Jesus Freitas	Engineer	Construction			[signature]
3	Mr	Martinho B. De Sousa	Engineer	Construction			[signature]
4	Ms	Pricilla I. Dos R. Gomes	Engineer	Construction			
5	Mr	Angelo Riberiro	Administrator	Training &Cooperation			[signature]
6	Mr	Lourenco Luis	Engineer	Project			[signature]
7	Mr	Julius L. Kaby,	Engineer	Project			[signature]
8	Mr	Mouzinho Tilman,	Engineer	Maintenance			[signature]
9	Mr	Altino Fernandes Da Costa	Engineer	Maintenance			[signature]
10	Mr	Fernando F. F. C. Freitas	Engineer	Highway			[signature]
11	Mr	Selestino E. Ximenes	Engineer	Highway			[signature]
12	Mr/Ms	[illegible]	Engineer	Sunrise/NTN			[signature]
13	Mr/Ms	Jose Carlos	Engineer	Sunrise/NTN			[signature]
14	Mr/Ms	[illegible]					
15	Mr/Ms	[illegible]	[illegible]				
16	Mr/Ms	Sughaul Akbar	G.M.	Jonise Const.			[signature]
17	Mr/Ms	Joji Kiyoshi	Road Construction SV	CDRS			[signature]
18	Mr/Ms	Teresa N. Tsujimura	M&E	CDRS			[signature]

ATTENDANCE LIST

Date :19 September 2018
Subject :2nd Safety patrol on Ex-Japan Road
Venue :Sta.18 Km and Sta 6.5 Km, Ex Japan Road Construction

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
1	Mr	Joao Geregorio de Carvalho	Chief	Construction			[signature]
2	Mr	Nazario De Jesus Freitas	Engineer	Construction			[signature]
3	Mr	Martinho B. De Sousa	Engineer	Construction			[signature]
4	Ms	Pricilla I. Dos R. Gomes	Engineer	Construction			
5	Mr	Angelo Riberiro	Administrator	Training &Cooperation			[signature]
6	Mr	Lourenco Luis	Engineer	Project			[signature]
7	Mr	Julius L. Kaby,	Engineer	Project			[signature]
8	Mr	Mouzinho Tilman,	Engineer	Maintenance			[signature]
9	Mr	Altino Fernandes Da Costa	Engineer	Maintenance			[signature]
10	Mr	Fernando F. F. C. Freitas	Engineer	Highway			[signature]
11	Mr	Selestino E. Ximenes	Engineer	Highway			[signature]
12	Mr/Ms	[illegible]		Sunrise/NTN			[signature]
13	Mr/Ms	Jose Carlos		SNR/NTN			[signature]
14	Mr/Ms	Sughaul Akbar	G.M.	Jonise			[signature]
15	Mr/Ms	Joji Kiyoshi	Advisor/ Road Construction SV	CDRS			[signature]
16	Mr/Ms	Teresa N. Tsujimura	M&E	CDRS			[signature]
17	Mr/Ms						
18	Mr/Ms						

Attachment2: Photos for the Meeting and 2nd Safety Patrol by DRBFC on 19 Sept., 2018

Ph1: 2nd Coordination Meeting of site Safety Committee were held at the conference room of DRBFC, Dili

Ph-2: Ditto but including Contractors, Sunrise/NTN and Jonise

Ph-3: Inspection site①: STA17+850-18+100, Aggregate Base Course, constructed by "Sunrise"/ management by "NTN"

Ph-4: Ditto but joint Inspection by site Safety Committee, including Contractor in charge of and using Check List for "Safety Patrol"

Ph-5: Ditto, there set Pre-caution signboards but no "Police Line" for separation working area and open public traffic area pointed out

Ph6: Inspection site②: STA 7 – 8km, Stone Masonry Retaining Wall, constructed by "Mejori" management by "Jonise"

Ph-7: Ditto but Inspection by site Safety Committee, including Contractor in charge of the works, using Check List for "Safety Patrol"

Ph-8: Ditto but also discuss about counter measures

Ph-9: Inspection site ②: STA 6+270 , RC double Pipe Culvert, constructed by "Jonise", half of the road open to Public Traffic

Ph-10: Ditto but Safety Inspection using Check List for "Safety Patrol" and points out dangerous point also discuss about counter measures, such as scaffolding for high place working

Ph-11: Ditto but needs of more clearly "Police line" and Precaution signboards for Public Traffic are pointed out during Inspection

Attachment 3: Check List for 2nd Safety Patrol used on the site on 19 September

① Check List for Safety Patrol
(① Daftar Periksa untuk Patroli Keselamatan)

Name of the Project (Nama Proyek): Ex-Japan Road Phase II, Pavement Works
Section of Contract/work Item (Bulan Kontrak Atau Pekerjaan): Aggregate Base Course
Date (Tanggal): 19/09/2018
Name of Contractor: Sunrise/[illegible] (Management by NTN)
Location: STA. 17+ 875 - STA. 17+[illegible]
Name of Inspector & Department: Julius L. Kaby

No.	Check Items (Item Pemeriksaan)	Judgements (Penilaian)		Remarks (Keterangan)
	Participants and interval of "Sfety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	No	whatter only one care safety helmet.
⑤	Workers wear safety color vests?	Yes	No	
⑥	Were workers explained today's work procedure?	Yes	No	once a weekly
⑦	Were workers explained today's dangerous points?	Yes	No	If good Explain every day.
⑧	Are there "watchman for Construction Machinery"?	Yes	No	Only one
⑨	Precaution Singboard for Safety are provided on site?	Yes	No	Two Signboard front and back
⑩	Procedure of works is correct or not?	Yes	No	
⑪	At same time, both works up/down are carried out or not?	Yes	No	
⑫	Cutting gradient is OK, with no danger?	Yes	No	
	Finding out Dangerous points			—
1)	no have police line in site.			
2)				
3)				
	Instructions and expecting counter-measures (if any)			
1)	every worker must be care helm and safety wear			
2)	Must use Police line in the site.			
3)				

Overall comments: (komentar secara keseluruhan)

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor Leste (CDRS)

① Check List for Safety Patrol
(① Daftar Periksa untuk Patroli Keselamatan)

Name of the Project (Nama Proyek): Ex-Japan Road Phase II, Pavement Works
Section of Contract/work Item (Bulan Kontrak Atau Pekerjaan): Aggregate Base Course
Date (Tanggal): 19/09/2018
Name of Contractor: Sunrise/[illegible] (Management by NTN)
Location: STA. 17+ 850 - STA. 18+100
Name of Inspector & Department: FERNANDO P.P.C. PROVIZ[illegible]

No.	Check Items (Item Pemeriksaan)	Judgements (Penilaian)		Remarks (Keterangan)
	Participants and interval of "Sfety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			only one from to use safety [illegible]
④	Workers wear safety helmets?	Yes	No	
⑤	Workers wear safety color vests?	Yes	No	[illegible]
⑥	Were workers explained today's work procedure?	Yes	No	[illegible]
⑦	Were workers explained today's dangerous points?	Yes	No	
⑧	Are there "watchman for Construction Machinery"?	Yes	No	
⑨	Precaution Singboard for Safety are provided on site?	Yes	No	
⑩	Procedure of works is correct or not?	Yes	No	Prosedure [illegible]
⑪	At same time, both works up/down are carried out or not?	Yes	No	This already flat area.
⑫	Cutting gradient is OK, with no danger?	Yes	No	This are is flat one
	Finding out Dangerous points			
1)	[illegible] kontraktor [illegible] police line [illegible]			
2)	para pengendara [illegible] pada site work [illegible]			
3)				
	Instructions and expecting counter-measures (if any)			
1)				
2)				
3)				

Overall comments: (komentar secara keseluruhan) [illegible] kontraktor harus [illegible]

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor Leste (CDRS)

(2) Check List for Safety Patrol
(Daftar Periksa untuk Patroli Keselamatan)

Name of the Project (Nama Proyek): Ex-Japan Road
Section of Contract/work Item (Bulan Kontrak Atau Pekerjaan): Stone Masonry Wall
Date (Tanggal): 19/09/2018
Name of Contractor: Majoni (Management by NDP Jonatas)
Location: STA 7+00 - STA 8+000
Name of Inspector & Department: Julius L. Kaby.

No.	Check Items (Item Pemeriksaan)	Judgements (Penilaian)		Remarks (Keterangan)
	Participants and interval of "Sfety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	No	only three site
⑤	Workers wear safety color vests?	Yes	No	
⑥	Were workers explained today's work procedure?	Yes	No	
⑦	Were workers explained today's dangerous points?	Yes	No	- Many good. - every day explain to worker.
⑧	Are there "watchman for Construction Machinery"?	Yes	No	
⑨	Precaution Singboard for Safety are provided on site?	Yes	No	
⑩	Procedure of works is correct or not?	Yes	No	
⑪	At same time, both works up/down are carried out or not?	Yes	No	
⑫	Cutting gradient is OK, with no danger?	Yes	No	
	Finding out Dangerous points			
1)	No Trappic wacth man			
2)				
3)				
	Instructions and expecting counter-measures (if any)			
1)	- Sign board [illegible]			
2)	- Water Crossing be kontroled			
3)	- Contractor must provide Safety Shoes, helmet			

Overall comments: (komentar secara keseluruhan)

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor Leste (CDRS)

(2) Check List for Safety Patrol
(Daftar Periksa untuk Patroli Keselamatan)

Name of the Project (Nama Proyek): Ex-Japan Road
Section of Contract/work Item (Bulan Kontrak Atau Pekerjaan): Stone Masonry
Date (Tanggal): 19/09/2018
Name of Contractor: MILFORD
Location: STA 8+000 - STA [illegible]
Name of Inspector & Department: Leonardo Luis

No.	Check Items (Item Pemeriksaan)	Judgements (Penilaian)		Remarks (Keterangan)
	Participants and interval of "Sfety Patrol"			
①	Have you received "Announcement" of today' Patrol?	Yes	No	
②	DRBFC staff in charge, attend the Patrol?	Yes	No	
③	Contractor's staff in charge, attend the Patrol?	Yes	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	No	only three person safety helmet
⑤	Workers wear safety color vests?	Yes	No	— " — " —
⑥	Were workers explained today's work procedure?	Yes	No	every day before working
⑦	Were workers explained today's dangerous points?	Yes	No	— " —
⑧	Are there "watchman for Construction Machinery"?	Yes	No	
⑨	Precaution Singboard for Safety are provided on site?	Yes	No	Don't have in the site
⑩	Procedure of works is correct or not?	Yes	No	
⑪	At same time, both works up/down are carried out or not?	Yes	No	
⑫	Cutting gradient is OK, with no danger?	Yes	No	only gradient is ok.
	Finding out Dangerous points			
1)	much material for lot in site near the masonry wall			
2)	Worker not wear boot / glove			
3)				
	Instructions and expecting counter-measures (if any)			
1)	instruks for worker / contractor have to use safety			
2)	like boat and glove			
3)				

Overall comments: (komentar secara keseluruhan)

② Check List for Safety Patrol
(② Daftar Periksa untuk Patroli Keselamatan)

Name of the Project: Ex-Japan Road Phase I (Nama Proyek)
Section of Contract/Work Item: RC double Pipe Culvert
Date: 10/09/2018 (Tanggal)
Name of Contractor: Jonlse/Mijoly
Location: STA 0+240
Name of Inspector & Department: [illegible]

No.	Check Items	Judgements		Remarks
	Participants and interval of "Safety Patrol"			
①	Have you received "Announcement" of today' Patrol?	(Yes)	No	
②	DRBFC staff in charge, attend the Patrol?	(Yes)	No	
③	Contractor's staff in charge, attend the Patrol?	(Yes)	No	Project Manager
	Inspection Points for Safety			
④	Workers wear safety helmets?	Yes	(No)	provide but worker not use
⑤	Workers wear safety color vests?	(Yes)	No	3 person
⑥	Were workers explained today's work procedure?	(Yes)	No	site engineer
⑦	Were workers explained today's dangerous points?	(Yes)	No	of cause
⑧	Are there "watchman for Construction Machinery"?	Yes	(No)	
⑨	Precaution Sing(board) for Safety are provided on site?	Yes	(No)	don't have police line
⑩	Procedure of works is correct or not?	(Yes)	No	
⑪	At same time, both works up/down are carried out or not?	(Yes)	(No)	[illegible] in bottom down
⑫	Cutting gradient is OK, with no danger?	(Yes)	No	depend [illegible] inside

Finding out Dangerous points
1) worker not use helmet and boot
2) worker not use mask
3)

Instructions and expecting counter-measures (if any)
1) recommended to contractor instruct to workers, how to use apparatus
2) for safety petrol.
3)

Overall comments:

② Check List for Safety Patrol
(② Daftar Periksa untuk Patroli Keselamatan)

Name of the Project: Ex-Japan Road Phase I (Nama Proyek)
Section of Contract/Work Item: RC double Pipe Culvert
Date: 19/09/2018 (Tanggal)
Name of Contractor: Jonlse Mijony
Location: STA 0+366
Name of Inspector & Department: Celestino E. Ximenes

No.	Check Items	Judgements		Remarks
	Participants and interval of "Safety Patrol"			
①	Have you received "Announcement" of today' Patrol?	(Yes)	No	
②	DRBFC staff in charge, attend the Patrol?	(Yes)	No	
③	Contractor's staff in charge, attend the Patrol?	(Yes)	No	
	Inspection Points for Safety			
④	Workers wear safety helmets?	(Yes)	No	have helmet maybe not use.
⑤	Workers wear safety color vests?	(Yes)	No	have safety color, only two [illegible]
⑥	Were workers explained today's work procedure?	Yes	(No)	
⑦	Were workers explained today's dangerous points?	Yes	(No)	
⑧	Are there "watchman for Construction Machinery"?	Yes	(No)	have watchman but no other fite
⑨	Precaution Sing(board) for Safety are provided on site?	Yes	No	only police line
⑩	Procedure of works is correct or not?	(Yes)	No	
⑪	At same time, both works up/down are carried out or not?	(Yes)	No	
⑫	Cutting gradient is OK, with no danger?	Yes	(No)	

Finding out Dangerous points
1) worker not use boots.
2) tidak ada [illegible] Campuran
3) ada helm tapi tidak pakai
4) tidak ada [illegible] karena [illegible]

Instructions and expecting counter-measures (if any)
5) minta kepada Contractor untuk menyediakan sepatu/boots-
7) karena tingkat berbahaya
8) [illegible]
9) [illegible]

Overall comments:
Minta kepada Companhia untuk mengikuti aturan safety patrol

Attachment 4: Agenda and reference information for Safety Activities of the Meeting

Attachment 4: Agenda and reference information for Safety Activities of the Meeting

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

Coordination Meeting
For
Site Safety Committee for 2nd "Safety Patrol by DRBFC"
(Rapat Koordinasi untuk Panitia Keselamatan di lokasi untuk "Patroli Keselamatan yang ke-2 oleh DNEPCC")

Date: Wednesday 19 September, 2018
Time: 10:00 – 11:00
Venue: Conference Room, DRBFC Head quarter, Dili

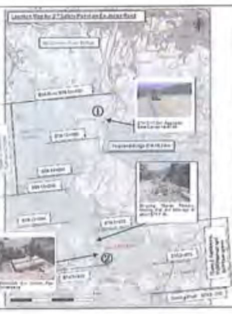
National Directorate of Road, Bridge and Flood Control (NDRBFC) and pilot Site Safety Committee

AGENDA

09:55 – 10:00	Arrival and Reception for proposed site Safety Committee member attendance
10:00 – 10:10	Opening Address (Wak Sambutan) and Introduction of the member Eng. Joao Gregorio de Carvalho Chief of Dep. Construction of DRBFC and Chairman of pilot Site Safety Committee See List of member of the Site Safety Committee *(Lihat daftar nama anggota panitia)*
10:10 – 10:25	1. Reporting the 1st Safety Patrol held on 26 June 2018 See the summary of Report of 1st Coordination Meeting and 1st Safety Patrol
10:25 – 10:40	2. Planning the place and work items for 2nd Safety Patrol held on the afternoon 19 September 2018 See the Location map for 2nd Safety Patrol
10:40 – 11:00	3. Q/A and discussion regarding Safety Activities: Safety Patrol
11:00	Adjourn (Closing)

Member of pilot "Site Safety Committee"
= For Case Study of "Safety Patrol by DRBFC" at pilot site on Ex-Japan Road =
Updated on 2018.09.10_a First wrote on 2018.03.01

Party	Role in the Committee	Title and Department	Name of member (Draft only)	Correspondence
DRBFC	Chair person	Chief of Construction Dept	Eng. Joao Gregorio de Carvalho	
	Coordinator	Engineer in charge of proposed site	Eng. Nazario De Jesus Freitas	78550598 narcio_freitas@icloud.com
	Coordinator	Engineer in charge of proposed site (Pavement works)	Eng. Martinho B. De Sousa	77253074 paty@ymail.com
	Sub-coordinator	Construction Dept.	Eng. Pricilla I. Dos R. Gomes	73391216 enchelia@yahoo.com
	Observer	Representative of Training & Cooperation Dept.	Mr. Alfredo E. Dos Santos	77131601
			Mr. Angelo Riberito	77243393
	Observer	Ditto but Project Dept	Eng. Lourenco, Chief of Planning	
			Eng. Julius L. Kehy, Planning Section	77491305
	Observer	Ditto but Maintenance Dept	Eng. Mouzinho Tilman, Coordinator of Region 2	
			Eng. Albino Fernandes Da Costa, Region 2	
	Observer	Ditto but Highway Dept	Mr. Fernando F. F. C Freitas	77051326
			Mr. Selestino E. Ximenes	77283549
Contrac-tor	**Jonlse**	Project Manager	Mr. Syahril Akbar	77553987
		engineer in charge of Safety	XX	
	NTN (NATUREZA TIMOR NABOMAS Lda)	Project Managers	Mr. Hartoill	73182969
			Mr. Januario	77239675
	Mijori	PM or Staff in charge Safety	cc	
	Sunrise	PM or Staff in charge Safety	dd	
CDRS	Advisor(Ad)	CDRS, Road Construction Supervisor	Mr. Johji Koizumi	76467974 johji.koizumi@ingerosec.com
	Assistant Ad and Interpreter	Civil Engineer	Ms. Leilchia Silveira A. Barreto	77717549 leilchiabarreto@gmail.com



2. Planning

the place and work items

for 2[st] Safety Patrol

held on the afternoon 19 September 2018

*Status quo of Ex-Japan Road as of 11 September 2018

I Progress and location Map 各工区進捗&位置図

1) Progress of each Contract as of May/Sept 2018 (according to each Monthly Report)

*Phase I Earth work, Retaining wall & Drainage and Sub-base Course

Section	Range (km)	Name of Contractor	contract date	MS	Progress May	Progress September
No 1	STA0+000 ~ 2+800	Aiostinh	12 Nov 2015	4.13	78.02%	88.47%
No 2	STA2+800 ~ 8+200	Jonize	12 Nov 2015	4.65	89.27%	89.27%
	One "Box Culvert" at STA2+800 & 3+100(as a Variation)-provided Box C/S					
No 3	STA8+200 ~ 8+200	Majori	25 Jul 2016	4.45	47.66%	82.01%
No 4	STA8+200 ~ 8+850	HARAKA UNIPESSON Lda	25 Jul 2016	3.19	95.46%	100.00%
			* Final Inspection was held on 11 September 2018			
No 5	STA8+500 ~ 11+275	NATUREZA TIMOR NAROMAN Lda	12 Nov 2015	3.29	100.00%	Retention
No 6	STA11+275 ~ 13+115	Fortune Star Lda	25 Jul 2016	3.26	100.00%	Retention
No 7	STA13+115 ~ 15+500	Writas Unipessoal Lda	25 Jul 2016	3.85	99.81%	Retention
No 8	STA15+500 ~ 17+000	Ruta Loos Unipessoal Lda	01 Aug 2016	3.47	99.72%	Retention
No 9	STA17+000 ~ 19+350	Sun Rise construction Pty Lda	14 Dec 2016	3.13	100.00%	Retention
			* Progress 100% = become "Retention Period"			

*Phase II Asphalt Paving Works, including aggregate Base Course

Section	Range (km)	Name of Contractor		contract date	MS	Progress May	Progress September
A(No 9)	17+000-19+250	Sunrise	Management by NTN	Sep 2017	2.49	0.27%	47%
B(No 7&8)	12+000-17+000	Fortune		Sep 2017	2.75	0.27%	47%

(1) STA19km; Foot Way works

Foot Pass using pre-cast curb and drains are under construction but another few weeks time the works will be finished.

(2) STA17-17.5km; Aggregate Base Course

Base Course works are carried out, with Motor Grader, vibration Roller at STA 17km～17.5km by Sunrise and management by NTN

(3) STA 7-8km; Stone Masonry Wall

On-going Stone Masonry Retaining Wall and Drainage at about STA 8km; it is the section No.3 of Phase I - Ex Japan Road by the Contractor, "Mejory" and management by "Jonise"

(4) STA 6+200; RC ϕ1000 × 2 Pipe Culvert

Double Pipe Culvert laying are carrying out at STA6+240, with the half of road is opening to traffic. It is the section No.2 of Phase I - Ex Japan Road by the Contractor, "Jonise"

Followings are reference for Safety Activities

Objective of DRBFC Safety Activities (Tujuan Aktivitas Keamanan dari DNEPCC)	・To minimize accident on the site (untuk meminimalisir kecelakaan di lokasi Proyek) ・To improve site Safety condition (Untuk meningkatkan Kondisi keamanan di lokasi Proyek)
Objective of Site Safety Committee (Tujuan dari komite keamanan)	・To organize the members concerned to the site management (untuk mengatur anggota yang berkaitan dengan manjemen lokasi proyek) ・Discuss about Safety Activities on the site (Mendiskusikan tentang aktivitas keamanan di lokasi proyek) ・Carry out the Safety Activities , including all workers on the site, such as "Safety Patrol" (Melaksanakan Aktivitas Keselamatan, dengan melibatkan semua pekerja di lokasi proyek, seperti "Patroli Keamanan")

1) Organization of Site Safety Committee

(organisasi dari Panitia Keselamatan di lokasi proyek)

2) Cycle of "Safety Patrol" activity
(Siklus dari aktivitas "Patroli Keselamatan)

- **Objective of Safety Patrol**
  - To find out dangerous works against workers
  - To Discuss about counter measure on the site
  - To improve the site safety conditions
- ***Tujuan dari Patroli Keamnan***
  - *Untuk mencari pekerjaan yang membahayakan pekerja*
  - *Mengdiskusikan tentang penaggulangan di lokasi proyek*
  - *Untuk meningkatkan kondisi keselamatan di lokasi proyek*

3) Procedure of Safety Patrol by DRBFC
(Prosedur dari Patroli keselamatan oleh DNEPCC)

(0) Organize the Site Safety Committee
(Mengatur Panitia keselamatan di Lokasi)

⇩

(1) Discussion and preparation meeting by Site Safety Committee
(Diskusi dan persiapan rapat dengan Panitia keselamatan di lokasi)

⇩

(2) Decision/Announcement for "Safety Patrol" on AA day and at BB site by the Site Safety Committee
(Keputusan /pengumuman untuk "Patroli Keselamatan pada hari AA dan di lokasi BB oleh Panitia Keselamatan di lokasi)

⇩

(3) Conduct "Safety Patrol", jointly site inspection and point out danger of works/ find out counter measures,
(Mengadakan "Patroli Keselamatan", melakukan inspeksi lokasi proyek Bersama dan menunjukkan titik-titik pekerjaan yang berbahaya/menentukan penanggulangannya

⇩

Procedure of Safety Patrol by DRBFC
(Prosedur dari Patroli keselamatan oleh DNEPCC)

⇩

4) Making record of Patrol and instructions are made, if necessary
(Membuat catatn dari Patroli tersebut dan membuta instraksi jika dibutuhkan!)

⇩

5) On next Patrol, checking improvement danger works which were pointed out previous Patrol
(Pada patroli selanjutnya, periksa kembali perbaikkan pekerjaan berbahaya yang ditunjukkan pada Patroli sebelumnya.)

Jointly Inspect for the line Drainage in-situ concrete at the access road in Comoro

☆ Obrigado Barak !!

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Subject:
Author: 今井 敏勝
Keywords:
Comments:
Creation Date: 9/27/2018 11:15:00 AM
Change Number: 3
Last Saved On: 9/27/2018 11:30:00 AM
Last Saved By: Ingerosee113
Total Editing Time: 16 Minutes
Last Printed On: 10/30/2018 11:51:00 AM
As of Last Complete Printing
Number of Pages: 22
Number of Words: 1,268 (approx.)
Number of Characters: 7,229 (approx.)

Attachment 11

Slope Collapse countermeasure dtudy base on site observation on 20 September 2018

Slope Collapse countermeasure Study Based on Site Observation

Survey Procedure in the Office
Evaluation of Countermeasure Idea
CDRS
20th Sep. 2018

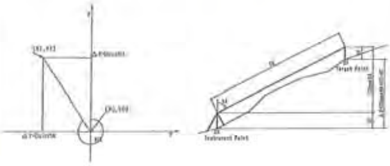
Isolated Cross Section Survey at the site on 14th Sep.

Survey Procedure in the Office to get Coordination on Way 1

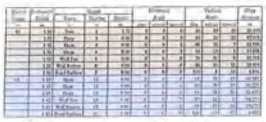
1	43.836	0	24.457
2	42.372	0	21.926
3	38.531	0	18.282
4	35.18	0	15.55
5	13.717	0	2.886
6	12.923	0	0.094
7	2.503	0	0.117
11	39.558	0	32.63
12	32.726	0.001	28.958
13	25.246	0	20.428
14	14.279	0	12.008
15	13.606	0	10.068
16	1.357	0	10.435

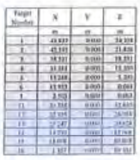
① Installation "Set up Windows Mobile Device Center" on your computer
② To output CSV file by the Total Station
③ To connect PC and TS by cable
④ To move the CSV file of X Y Z coordination to your computer

Relationship between HA VA SD and coordination



Survey Procedure in the Office to get coordination on Way 2





① To input surveyed values on the Excel sheet from field note
② The Excel sheet backs X Y Z coordination

Survey Procedure in the Office Arrangement on coordination

Station Number	X m	Z m
1	43.8	24.5
	42.4	21.9
	38.5	18.2
	35.2	15.6
	15.7	2.9
	13.7	2.8
	12.9	0.1
	2.5	0.1
	0.0	0.0
2	39.6	22.6
	32.7	17.0
	25.2	10.6
	14.3	2.0
	13.8	0.1
	1.4	0.4
	0.0	0.0

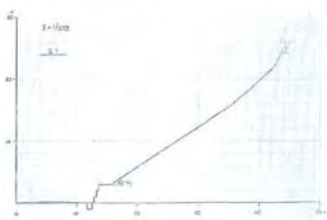
[Station 1]
- Addition of X0, Y0, Z0
- Addition of point at backside of wall top

[Station 2]
- Addition of X0, Y0, Z0
- Z=Z'-10

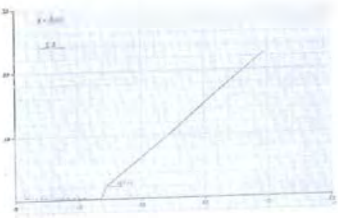
To Draw the Cross Section

- Section paper is convenience for drawing.
- Selection of scale: Paper must be bigger than cross section
- To draw X axis and Z axis
- To plot all points one by one
- To tie point to point by line

Surveyed Cross Section 1



Surveyed Cross Section 2



Station Number	[illegible]	[illegible]
1	43.8	24.3
	42.4	21.9
	34.5	18.3
	22.2	13.5
	15.7	7.9
	13.7	2.9
	12.8	0.1
	2.5	0.7
	0.0	0.0
2	34.6	27.8
	32.1	17.0
	21.8	10.6
	14.3	2.8
	12.6	0.1
	1.8	0.4
	0.0	0.0

13.8 13.1
Angle [illegible]

10.8 8.6
Angle [illegible]

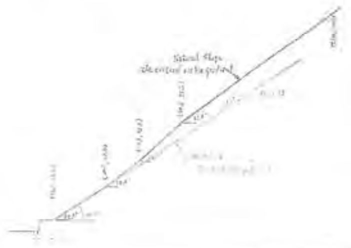
- Slope gradient can be calculated on coorCalculation of Slope Gradient
- dination

Calculation of Slope Gradient

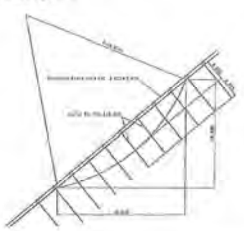
To draw your countermeasure idea on the surveyed cross section

- You must draw your idea on **correct scale**.
- Adequate gradient of recut seems 1:1.5 33.7deg
- Setting berm (Width is 1 to 2m) is recommended every 5 to 10m of height

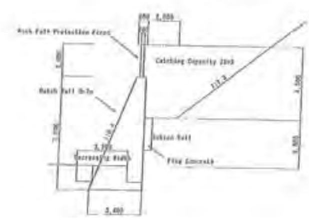
Recut Cross Section



Typical Cross Section of Sewing Bar and Shotcrete Frame



Typical Cross Section of Catch Wall



Comparison table

Item	A. Sewing Bar and Shotcrete Frame	B. Catch Wall
Principle Classification	Deterrence Work	Traffic Protection Work
Out line	The bar sews the collapsing soil to unmoving ground, the frame distributes the bar force to collapsing soil.	Catch wall protects traffic from collapsed debris by own catching capacity. Catch wall must bear impact force by the debris
Quantity per 10m	Shotcrete frame: 370m Sewing Bar: 100, 400m	Wall concrete: 140m3 Rock fence: 10m
D.C. cost per 10m in Japan	USD 86,000.-	USD 36,000.-
Others	No loss	Road width 3.2m loss
Maintenance	Nothing	Debris shall be removed after collapse.
Selection	No demerits but high cost.	Low cost but some demerits.

REVIEW FOR QUESTIONNAIRE

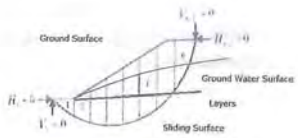
Slope Classification

Classification	Shape	Geology	
Natural Slope	Natural Terrain	Natural Ground	Complexity Inhomogeneous
Collapsed Slope	Collapsed Gradient		
Cut Slope	Cut Gradient		
Embankment Slope	Embankment Gradient	Banking Material	Depending on Q.C. Random -Selected Homogeneous

Slope Failure Countermeasure

Classification	T1 [illegible]	T2 Rock fall	T3 Rock mass failure	T4 [illegible]	T5 Debris flow	T6 [illegible]
Control work	Cutting with adequate slope gradient Subsurface drainage	Removing of source rock	Removing of source rock mass	Surface water drainage Shallow groundwater drainage Deep groundwater drainage Earth removal works Counter weight embankment works	Mountainside works Valley works	Embankment with adequate slope gradient Groundwater drainage
Deterrence work	Shotcrete crib Rock bolt works Insertion of reinforced bar Anchor works	Mortar spraying Concrete pitching Cover type rock fall prevention net Shotcrete crib Rock bolt works	Wire rope works Adhesive bonding works Rock bolt works	Pile works Anchor works	None	Retaining wall Reinforced soil retaining wall Anchor works
Protection work	Catch wall	Rock fall protection fence Pocket type rock fall protection net Rock shed	None	None	Keeping of enough flow section Debris flow shed Opened check dam	None

Necessary Conditions for the Calculation (1)



Necessary Conditions for the Calculation (2)

Soil characteristics

- Shear strength of sliding surface
  c: cohesion, ϕ: Internal friction angle
- Unit weight of sliping body
  γ_t : wet unit weight
  γ_{sat} : Saturated unit weight

States of Clayey Soil

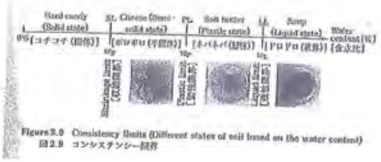
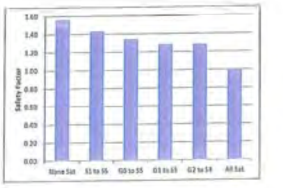
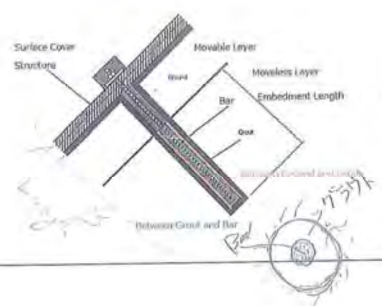


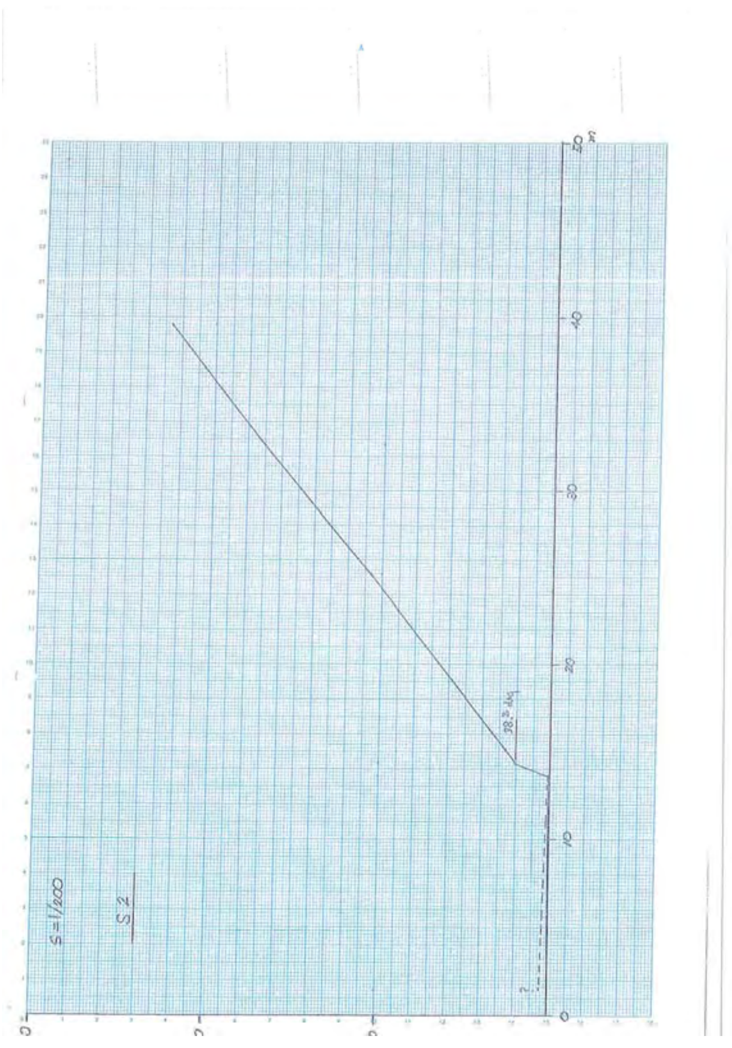
Figure 2.9 Consistency limits (Different states of soil based on the water content)
図2.9 コンシステンシー限界

Influence of Ground Water to Safety Factor



Necessary Embedment Length




S=1/200
S 2

Attachment 12

OJT for using Checklist of inspection for I. Final Payment and II. Interim Payment on 3rd October 2018

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

OJT for using Check List of Inspections for; I. Final Payment II. Interim Payment

Construction Dept. & Maintenance Dept. DRBFC

on 10:00- 11:30 3rd October 2018
at Conference Room, DRBFC Dili

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works (MOP) and JICA Expert Team (JET)

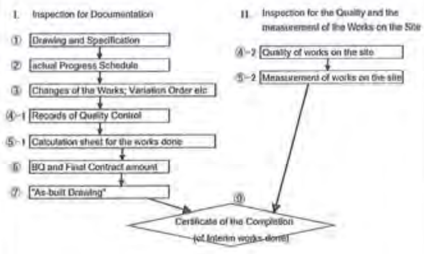


Figure: Flow of normal procedure for the Inspection

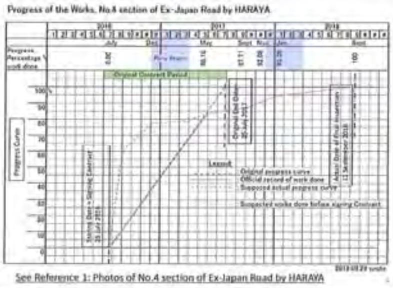
Case I: Inspection of Final Payment for No.4 section of Ex-Japan Road

1. Out-line of the Works

Project Name: Reconstruction of Road Ex. Japan
Location: Joint section Sucu Fatisi – Air Terjun/ Bandru, < Sarlala ---- Beduku >
STA 8+000 – 9+800 (by Staked STA 8+600 - 9+900)
Contract No.: SSS/104/MOPTC – 2016
Start / End Date: 25 July 2016 / 25 July 2017
Contract Price: USD $3,191,066.[36]
Contractor: HARAYA UNIPESSOAL, Lda
Supervision: Construction Dept. of DRBFC
Major works: Earth work, Stone Masonry, Sab-base Course

2. Progress of the Works

Progress of the Works, No.4 section of Ex-Japan Road by HARAYA



See Reference 1: Photos of No.4 section of Ex-Japan Road by HARAYA

3. Outstanding matters

1) The reason of delay of the Works
2) Planning for proposed Bridge or big Box Culvert at the place at Water Fall (staked STA 9+300)
3) Date of Final Payment of the Works
4) Procurement for Pavement works as Phase II of the Ex-Japan Road

Practice: Simulation of the Inspection

- Use "Check List of Inspection for Final Inspection"

Process of Today's Practice;

1) You were the Inspector on the Today's practice
2) Conditions are according to aforesaid:
   1. Out-line of the Works,
   2. Progress of the Works,
   3. Outstanding matters and
   4. Interview to the engineer in charge of the Works
3) *Fill and complete* the prepared *"Check List for Inspection"* for Case I and make comments and Remarks, if any

Q/A and Note

Case II: Inspection of 1st Interim Payment for Emergency Works, Humboe-Letefoho, Ermera on A10"

1. Out-line of the Works

Project Name: Emergency Works Humboe-Letefoho Road, Jct.A04 Geleno-Jct A10 Letrfoho
Location: Humboe- Letefoho (Sta. 6;700 – 25+000 Km), Ermera District
Contract No.: SSS/161/MOPTC – 2017
Start(Contract) Date: 19 September 2017
Completion Date: 540 days
Contract Price: USD $4,057,210.97
Contractor: BETUMEI UNIPESSOAL,LDA (Head Office at Dili)
Supervision: Region 4 of DRBFC

Changed work items by Variation Order No.1

Main work items: ※Total Contract Price is not changed

No. Item	Item Description	Unit	Original Quantity	Unit Price (US$)	Revised Quantity
202.1	Excavation Common and Rock Excavation	Cu.m	19,882.50	3.80	43,106.50
204.1	Sub grade preparation	Sq.m	62,500.00	0.85	62,500.00
301	Aggregate Sub Base Course	Cu.m	23,900.00	39.19	32,594.70
303	Crushed Aggregate Base Course	Cu.m	12,000.00	67.84	1,576.26
601.1a	Reinforced concrete pipe culvert, 1000mm (dia)	L.m	42.00	283.44	154.00
606	Stone Masonry	Cu.m	17,378.00	76.53	19,825.68
610	Gabion Wall	Cu.m	3,400.00	68.95	1,150.00
New Items					
202.2	Rock Excavation	Cu.m	—	11.46	12,152.50
204.2	Removal Existing Asphalt	Sq.m	—	2.27	15,300.00
601.2a	Reinforced concrete pipe culvert, 1200mm (dia)	L.m	—	356.76	68.00
601.3a	Reinforced concrete pipe culvert, 600mm (dia)	L.m	—	179.22	26.00
104	Relocation of Public Utilities (Compensation for Plantation of Coffee)	Ls	—	34,160.00	1.00

2. Progress of the Works

1) The Works commenced on September, 2017
2) The Progress as of December 2017 was 36 %
3) The Claim for 1st Interim Payment was made, with the amount about 1 M$ (one million US$)
4) The Works have been suspended from Jan to June, 2017
5) The Contractor submitted "Variation Order No.1" on 1st June, 2018
6) The Works resumed (re-started) on 9th June, 2017

10

Gabion Box Retaining Wall. Existing steel corugated pipe (2m dia) are used for remedial work. Some of old steel pie is found deformed from round shape on 13 February, 2018
<Quoted from Ph9, memo No.17>

On-going construction area for Stone masonry Retaining Wall and Line Drainage on 13 February, 2018
<Quoted from Ph10, memo No.17>

11

STA2-3 km Sub-Grade leveling and preparation for Sub-Base course; gravel material from Geleno River. And inspection of leveling and compaction by Macadam Roller on 28 June, 2018
<Quoted from Ph3, memo No.19>

STA at about 13km near existing , Bridge, Stone Masonry Retaining Wall. Checking Quality of the works using Check List for Construction: "Stone Masonry Retaining Wall":
on 28 June, 2018
<Quoted from Ph5, memo No.19>

Stok-pile Area (STA7km): Aggregate Sub Base Course (item301) Material. Samples are now testing at Laboratory for its quality assurance on 12 September, 2018
<Quoted from Ph4&5, memo No.21>

STA 18km; proposed 2×ϕ1200mm Pipe Culvert (New item, 601.2a) was completed as a Variation.
on 12 September, 2018 (only working sketch of by the Contractor was provided)
<Quoted from Ph14, memo No.21>

3. Outstanding matters

1) The test result of proposed material for "Sub-Base Course" has not yet been submitted by the Contractor
2) Without approval of the material of Sub-Base Course, such works has started and the Contractor insists the works have been done at some parts.
3) The location/position/area of works, such as Sub-Base Course, Retaining Wall, are not shown on the Drawing
4) Detailed shop drawing for 2×1200mm Pipe Culvert at STA18km has not yet been submitted from the Contractor. It is one of new work item of Variation No.1

Practice: Simulation of the Inspection

- Use "Check List of Inspection for Interim Payment"

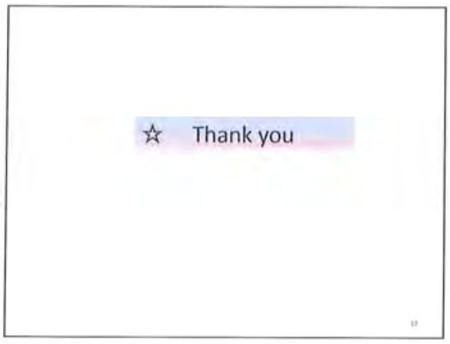
Process of Today's Practice;

1) You were the Inspector on the Today's practice
2) Conditions are according to aforesaid:
   1. Out-line of the Works,
   2. Progress of the Works,
   3. Outstanding matters and
   4. Interview to the engineer in charge of the Works
3) *Fill and complete* the prepared *"Check List for Inspection"* for Case II and make comments and Remarks, if any

15

Q/A and Note

References:
- Photos_No.4 of Ex-Japan Road by "Haraya"
- 1st Invoice for works accomplished on Emergency Works Humboe-Letefoho
- Table of QC points on Section 301, 302 & 303 aggregate course in SPC
- Copy of certificate of completion of No.4 section of Ex-Japan Rd (if any)


☆ Thank you

Attachment 13

Workshop for Explanation & Dissemination of Checklist for Construction Version_1 on 10 October 2018

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

Work Shop for Explanation and Dissemination of CHECK LIST for Construction_Version-1

Construction Dept. & Maintenance Dept. DRBFC

on 10:00- 11:00 10th October 2018
at Conference Room, DRBFC Dili

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works (MOP) and JICA Expert Team (JET)

Explanation of CHECK LIST for Construction_Version - 1

After making Version-0 in June, Check List have been used on the occasion of quality checking at the Emergency Works Humboe-Letefoho and Safety Patrol on Ex-Japan Road.
Adding the Check List of Inspection for Payment and other items, "CHECK LIST for Construction_ Version-1" is issued on October 2018.
Content of the List is as below,

CHECK LIST for Construction

Version -1_October 2018

Content of Check List	data file Number
Preface	00_Cover_Check List Ver.-1
I. Quality Control	
10_Earth Work	
Excavation	01_10 20 30_Earth work & structure
Embankment	ditto
Aggregate Surface Course (Crushed Aggregate Course on Existing Pavement)	ditto
Widening of Embankment	ditto
20_Small Structures	
Pipe Culvert	ditto
Stone Masonry Drainage	ditto
Stone Masonry Retaining Wall	ditto
Concrete Drainage	ditto
Gabion Mat	ditto
30_Box Culvert	ditto
40_Road Pavement works	
41_Base Course and Sub-base Course	01_40_CL_Road Pavement
42_Asphalt Pavement	
Design and specification	ditto
Check Points of Daily Quality Control on Site	ditto
Core Sampling Test	ditto
II. Safety Control	
10_Daily Safety Checking	02_Check List_Safety Control
20_Regular Safety Activities	ditto
30_Safety organization and management	ditto
40_Check List for Safety Patrol	ditto
III. Construction Management	
10_Tender document (Drafting, reference only)	03_CL_Tender & Inspection
20_Daily, Interim payment and Final Inspection	ditto
30_Drawing	ditto

Dissemination of CHECK LIST for Construction_Version-1

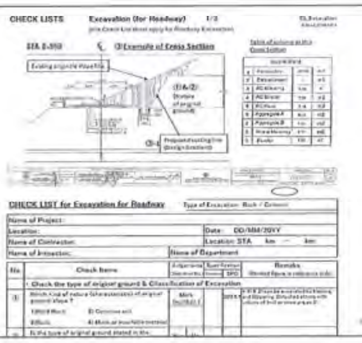
As many times as possible, practice/ training/ OJT of using "Check List for Construction" are to be carried out and its results will be feedback for brushing up "Check List" and up-dating Check List.

Proposed OJT site No.1 by DRBFC's Trainer:

Proposed site Name: Emergency Works Humboe-Letefoho Road, Jct.A04 Geleno-Jct A10 Letrfoho
Proposed Trainer: Eng. Sabino Da Costa Ventura
Proposed Attendance: Staff of Region 4 and Maintenance Department
Proposed work item: Excavation for slope for road widening, Sub-base Course and others

STA1-6 km: Rock Excavation (item202.2) Cutting rock slope for widening the Road width on June 2018

STA2-3 km: preparation for Sub-Base course on June and Stok-pile Area, Aggregate Sub Base Course (item301) Material checking on September 2018.



Proposed OJT site No.2 by DRBFC's Trainer:

Proposed site Name: STA17-19km, Pavement works by SunRise , on Ex-Japan Road
Proposed Trainer: Eng. Nazario de J. Fretas
Proposed Attendance: Eng. Martinho B. De Sousa and other staff of Construction Department
Proposed work item: - Aggregate Base Course
- Preparation work for Asphalt Pavement

STA14km: Crusher & Asphalt Plant of NTN @August, 2017 and September, 2018

STA17-18km of Ex-Japan Road; Aggregate Base Course works are carried out by Sunrise and management by NTN @ September, 2018

CHECK LISTS Base Course / Sub-base Course 1/2
(for Road Pavement)

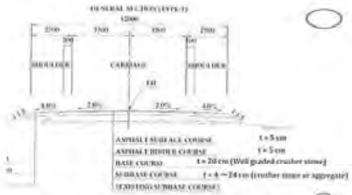


Figure 1. Example of Typical Section of Pavement (Rehabilitation Works)

CHECK LIST for Base/Sub-base Course Type of Course: (upper/lower)

Name of Project:	Thickness of Course: cm
Location:	Date: DD/MM/20YY
Name of Contractor:	Location: STA km ~ km

CHECK LIST for Base/Sub-base Course Type of Course: (upper/lower)

Name of Project:	Thickness of Course: cm
Location:	Date: DD/MM/20YY
Name of Contractor:	Location: STA km ~ km
Name of Inspector:	Name of Department:

No.	Check Items	Judgements (Selection No.)		Specification		Remarks (Printed figure is reference only)
				[illegible]	SPC	
	Construction Plan / Drawing					
①	Is Construction Plan prepared ?	Yes	No			
②	Is Drawing prepared on the site?	Yes	No			
②-2	Drawing is "Contract Drawing" or "Shop Drawing"	—	—			Contract Drawing / Shop Drawing
②-3	Thickness is indicated on the Drawing ?	Yes	No			
②-4	Ditto but "Type materials" of Base(sub-base) Course?	Yes	No			
< In case of Crushed Aggregate Base Course 303 / Aggregate Sub Base Course 301 >						
	Checking "Material"					
③	Are the material stored on the site properly?	Yes	No		[illegible]	
④	Are the material free from organic matter and other deleterious matters?	Yes	No		301.2 303.2	

CHECK LISTS Base Course / Sub-base Course 2/2

No	Check Items	Judgements (Selection No.)		Specification		Remarks (Printed figure is reference only)
				[illegible]	SPC	
⑤-1	Is the material satisfied with required "Grading" ?	Yes	No	—	301.2 303.2	[illegible]
⑤-2	Are the size of aggregate less than its maximum size?	Yes	No			[illegible]
⑥	Is the material satisfied with required "Properties" ?	Yes	No	[illegible]		[illegible]
⑦	Were the material tests results submitted for approval?	Yes	No			[illegible]
	Checking "Compaction" workmanship					
⑧	Are the spreading thickness proper ?	Yes	No		[illegible]	[illegible]
⑨	Are the compaction machine enough and properly ?	Yes	No			[illegible]
⑩	[illegible]	Yes	No			[illegible]
⑪-1	Are Field Density carried out as specified?	Yes	No		301.3 303.3	[illegible]
⑪-2	Have the Maximum Dry Density (MDD) already obtained ?	Yes	No	—		
⑪-3	Field Density (FD) tested by sand replacement method, are satisfied with the criteria of the Specification ?	Yes	No	—		[illegible]
⑪-4	Other than sand replacement method, write the kind type of test are conducted ?	—	—			
⑪-5	Is the result of "⑪-4" satisfactory or not ?	Yes	No			

Delivery:
"CHECK LIST for Construction" Version-1 October 2018

☆ Obrigado Barak !!

TO CR of JICA Timor-Leste OFFICE

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Version of the Sheet: Ver.7（Term: October 2018 – March 2019）

Name: Hisashi MUTO

Title: Team Leader/ Road Maintenance1

Submission Date: 31st March, 2019

< I. Summary (all achievements are as of 31st March, 2019) >

1. Progress

1-1 Progress of Inputs

1-1-1 Japanese side

< Short-term experts dispatched to Timor-Leste>

NO	Name	Title	Dispatched Period to Timor-Leste	Changes or delay
1	Hisashi MUTO	Team Leader/ Road Maintenance 1	(1st) 8th Mar – 10th Apr, 2016 (2nd) 14th Jun – 25th Jun, 2016 (3rd) 1st Sep – 18th Sep, 2016 (4th) 23rd Jan – 19th Feb,2017 (5th) 24th Mar – 2nd Apr, 2017 (6th) 18th Aug – 10th Sep, 2017 (7th) 24th Nov – 14th Dec, 2017 (8th) 2nd Feb – 4th Mar, 2018 (9th) 8th Jun – 1st Jul, 2018 (10th)19th Sep – 12th Oct, 2018 (11th)14th Nov – 8th Dec, 2018 (12th)10th Mar – 31st Mar, 2019	None
2	Makoto MATSUURA	Deputy Team Leader/ Road Maintenance 2	(1st) 8th Mar – 15th Apr, 2016 (2nd) 14th Jun – 13th Jul, 2016 (3rd) 20th Sep – 14th Oct ,2016 (4th) 1st Dec – 16th Dec, 2016 (5th) 23rd Jan – 19th Feb, 2017	None
3	Mitsuhide SAITO	Deputy Team Leader/ Road Maintenance 2	(1st) 24th Mar – 9th Apr, 2017 (2nd) 9th Jun – 25th Jun, 2017 (3rd) 16th Oct – 12th Nov,2017	Note: Mr. Mitsuhide Saito

			(4th) 16th Feb – 11th Mar,2018 (5th) 26th Apr – 16th May,2018 (6th) 7th Sep – 28th Sep,2018 (7th) 15th Feb – 17th Mar, 2019	replaced Mr. Matsuura in Deputy Team Leader post.
4	Johji KOIZUMI	Road Construction Supervision	(1st) 19th Jul – 17th Aug, 2016 (2nd) 24th Sep – 14th Oct,2016 (3rd)19th Jun – 5th Jul, 2017 (4th) 21st Aug – 4th Oct,2017 (5th) 14th Nov – 21st Dec,2017 (6th) 30th Jan – 4th Mar, 2018 (7th) 8th Jun – 1st Jul, 2018 (8th) 7th Sep – 13th Oct, 2018 (9th) 7th Feb – 23rd Mar, 2019	None
5	Sueo HIROSE	Quality Control/ Road Repair	(1st) 28th Mar – 17th Apr, 2016 (2nd)13th May – 11th Jun, 2016 (3rd) 14th Aug – 12th Sep, 2016 (4th) 7th Oct – 14th Oct, 2016 (5th) 23rd Jan – 22nd Feb,2017 (6th) 4th Aug – 3rd Sep, 2017 (7th) 16th Feb – 18th Mar, 2018 (8th) 1st Mar – 23rd Mar, 2019	None
6	Shutaro SAKANAKA	Disaster Restoration	(1st) 11th May – 31st May, 2016 (2nd) 28th Jun – 21st Jul, 2016 (3rd) 12th Sep – 6th Oct, 2016 (4th) 13th Feb – 8th Mar, 2017 (5th) 17th Apr – 7th May, 2017 (6th) 23rd Oct – 12th Nov, 2017 (7th) 16th Jan – 4th Feb, 2018 (8th) 2nd Mar – 18th Mar, 2018 (9th) 1st Jun – 17th Jun, 2018	None
7	Kazuharu KOISHIKAWA	Disaster Restoration2	(1st) 3rd Mar – 25th Mar, 2018 (2nd) 15th Jun – 8th Jul, 2018 (3rd) 7th Sep – 30th Sep, 2018	Note: Disaster Restoration 2 has been created as a new position;

				Mr. Koishikawa was assigned to this position in March 2018.
8	Yoshiyuki AKAGAWA	Road Design/ Project Coordinator	(1st) 17th Mar – 15th Sep, 2016 (2nd) 21st Jun – 13th Jul, 2016 (3rd) 12th Sep – 6th Oct, 2016 (4th) 13th Feb – 5th Mar, 2017	None
9	Nicholas BROOKER-JONES	Road Design/ Project Coordinator	(1st) 31st Jul – 30th Aug, 2017 (2nd) 16th Oct – 23rd Nov, 2017 (3rd) 2nd Feb – 4th Mar, 2018 (4th) 8th Jun – 1st Jul, 2018 (5th) 7th Sep – 30th Sep, 2018 (6th) 26th Feb – 21st Mar, 2019	Note: Mr. Brooker-Jones replaced Mr. Akagawa in Project Coordinator post.
10	Kenji MINEGISHI	Structure Design	(1st) 5th Apr – 24th Apr, 2016 (2nd) 5th Jul – 4th Aug, 2016 (3rd) 14th Nov – 13th Dec,2016 (4th) 12th May – 11th Jun, 2017 (5th) 1st Sep – 1st Oct,2017 (6th) 3rd Nov – 17th Dec, 2017 (7th) 6th Apr – 13th May, 2018 (8th) 24th Aug – 30th Sep, 2018	None
11	Takashi SAITO	Database	(1st) 19th Jul – 24th Aug, 2016 (2nd) 3rd Oct – 14th Oct, 2016 (3rd) 13th Mar – 12th Apr, 2017 (4th) 16th Jun – 2nd Jul, 2017 (5th) 18th Aug – 1st Oct, 2017 (6th) 16th Feb – 4th Mar 2018 (7th) 5th May – 19th May, 2018 (8th) 28th Aug – 11th Oct, 2018 (9th) 19th Feb – 21st Mar, 2019	None
12	Masahiko HAYASHI	Landslide	(1st) 16th Jun – 28th June, 2017	Note: Activity

			(2^{nd}) 27^{th} Oct – 9^{th} Dec, 2017 (3^{rd}) 18^{th} Mar – 18^{th} Apr, 2018	on Landslide analysis was approved by 2^{nd} JCC; Mr. Hayashi was assigned in June 2017.
13	Sohshi MIKAMI	Topographical Analysis	(1^{st}) 19^{th} Jun – 16^{th} Jul, 2017 (2^{nd}) 18^{th} Mar – 18^{th} Apr, 2018	Note: Activity on Landslide analysis was approved by 2^{nd} JCC; Mr. Mikami was assigned in June 2017.
14	Nao TSUJIMURA	Evaluation/Monitoring	Resident in Timor-Leste	None

< Equipment and materials >

NO	Items	Qty	Unit price	Unit	Total amount
1	Desktop computer	1	1,150	USD	1,150
2	Inclinometer assembly	1	1,585,800	JPY	1,585,800
3	Borehole casing	1	404,400	JPY	404,400
4	Dokenbo assembly	1	133,000	JPY	133,000

(Remark: Equipment and materials which have a service life of 2 years and are more than JPY 50,000 are listed.)

1-1-2 Timor-Leste side

- **Counterpart (C/P) personnel (from MPWTC and NDRBFC)**

NO	Name	Title of the Project	Engaged Period
1	Rui Hernani F. Guterres	Project Director	20th Feb, 2018, to date
2	Milton Ramanata C. Monteiro Joao Mario Gama de Sousa	Project Manager	20th Feb, 2018, to 28th Feb, 2019 1st Mar, 2019, to date
3	Simao G. Armindo Laranjinha	C/P staff	1st Mar, 2019, to date
4	Joao Pedro Amaral	C/P staff	8th Mar, 2016, to date
5	Joao Gregorio	C/P staff	8th Mar, 2016, to date

- **Equipment and materials for the project office**

NO	Items	Qty	Unit
1	Office space (including desks and chairs)	1	room

1-2 Progress of Activities

NO	Activity	Achievement level
1.2	To conduct periodic/routine inspection.	● Periodic/routine inspection has been done along A03, A04, A06, A08, A11, A12 and A16 (173 km). ● Road inspection using drive recorder has been conducted (1419 km).
1.3	To update the database based on the inspection result and repair/rehabilitation works of road and bridges.	● In 5th JCC, C/P requested repetition of training for operation of GIS database; after 5thJCC, JICA Expert Team repeated training of GIS operation. ● Data from urban & national road surveys were inputted into GIS database (173 km).
1.5	To implement emergency inspections and repair/rehabilitation works when necessity arises.	● During this monitoring period, C/P did not request support from CDRS regarding emergency inspections; JICA expert team proposed continuation of support for C/P carrying out emergency inspections; proposal was approval in 5th JCC.
1.6	To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget.	● Based on inspection results, NDRBFC is preparing 5-year and 2019 annual plans. ● NDRBFC has secured an annual budget for maintenance and rehabilitation works in 2019 (Infrastructure fund: 150,508,000 USD + Line of Ministry budget: 12,386,000 USD).
2.2.	To conduct the case studies for the planning, design check and construction supervision of the project.	● IPG and NDRBFC integration team conducted monitoring of the slope mass movement through data collection by inclinometer and underground water level indicator (Site: Aituto landslide). On-the-job training for payment inspection using checklists was conducted (site: A02 bypass road called Ex-Japan Road). ● On-the-job training for quality control of stone masonry retaining wall using checklists was conducted (site: Humboe-Letefoho).

<table>
<tr>
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<td></td>
<td>

Collaborative workshop on culvert planning/design check was carried out with ILO.
JICA expert team supported NDRBFC inter-departmental working group using the culvert design guideline; inter-departmental working group scrutinized a proposed design from a contractor, concluded that the design was excessive and suggested amendments (site: Sarlala, Ex-Japan Road).
JICA Expert Team examined knowledge improvement of trained NDBRFC staff. The test results for each subject were as follows:

<table>
<tr><th>Subject</th><th>Number of the people whose test scores have improved after training</th></tr>
<tr><td>Landslide investigation</td><td>17 people out of 17</td></tr>
<tr><td>Bridge substructure protection
(Scouring and protection block)</td><td>5 people out of 14</td></tr>
<tr><td>Culvert planning and design</td><td>6 people out of 11</td></tr>
<tr><td>Quality control,
Safety control and
Construction management</td><td>N/A
Pre-test was given in June; after pre-test, based on request of C/P, contents of checklists have been increased. In this monitoring period, JICA expert team revised contents of examination. The result of the re-examination will be reported in next reporting period.</td></tr>
<tr><td>Slope protection</td><td>3 people out of 7</td></tr>
</table>
</td>
</tr>
<tr>
<td>3.5</td>
<td>To reflect the lessons learned from case studies to the technical guideline</td>
<td>

JICA expert team supported C/P using the culvert design guideline; C/P scrutinized a proposed design from a contractor, concluded that the design was excessive and suggested amendments.
In order to standardize planning, design check and construction supervision of the project in all works in TL, C/P requested JICA expert team to launch those technical documents as official documents of MoP or NDRBFC; JICA expert team conducted workshops for dissemination of guidelines and checklists.
Municipal administrations and higher education institutes requested repeat seminar on using checklists; JICA expert team proposed continuation of support for C/P carrying out inspections using checklists; proposal was approval in 5th JCC.

</td>
</tr>
</table>

3.6	To disseminate the technical guideline for concerned parties	● JICA Expert Team organized workshops to disseminate the technical guidelines; NDRBFC inter-departmental working group conducted a workshop to present their culvert plan regarding 1) design flood of catchment and 2) design capacity of culvert; guidelines and checklists were disseminated to the representatives of municipal administrations and higher education institutes.

1-3 Achievement of Output

<table>
<tr><th colspan="2">Indicators of Outputs</th><th>Achievement level</th></tr>
<tr><td>1.1</td><td>More than 30% of requested budget for road maintenance are distributed.</td><td>December 2018, NDRBFC has proposed an annual budget plan for 2019 with a total amount of 450,221,000.90 USD; the details of each item are shown in the below table.
<table>
<tr><td>National roads</td><td>7,230,800 USD</td></tr>
<tr><td>Municipal roads</td><td>9,666,400 USD</td></tr>
<tr><td>Urban roads</td><td>1,560,000 USD</td></tr>
<tr><td>Rural roads</td><td>18,051,000 USD</td></tr>
<tr><td>Maintenance roads and bridges</td><td>13,632,000 USD</td></tr>
<tr><td>Bridge construction</td><td>2,395,000 USD</td></tr>
<tr><td>River protection</td><td>1,050,000 USD</td></tr>
<tr><td>Highway</td><td>4,788,000 USD</td></tr>
<tr><td>Environment and kilometer posts</td><td>60,000 USD</td></tr>
<tr><td>Emergency works</td><td>2,500,000 USD</td></tr>
<tr><td>Ongoing projects</td><td>384,190,700 USD</td></tr>
<tr><td>General administration</td><td>5,098,000 USD</td></tr>
</table>
February 2019, an annual budget for 2019 with a total amount of 162,894,000 USD was approved; the details of each item are shown in the below table.
<table>
<tr><td>Infrastructure fund for roads</td><td>127,532,000 USD</td></tr>
<tr><td>Infrastructure fund for bridges</td><td>9,979,000 USD</td></tr>
<tr><td>Infrastructure fund for maintenance and rehabilitation</td><td>12,997,000 USD</td></tr>
<tr><td>Line of Ministry budget</td><td>12,386,000USD</td></tr>
</table>
Above budget items need to be evaluated and break down per work.
Therefore, achievement level of this output is not ready to be measured.</td></tr>
<tr><td>1.2</td><td>Improved road database is utilized for preparation of the annual work plan of road maintenance.</td><td>65%
Proposed data collection method with drive recorder was adopted. However, volume of data was insufficient to measure its utilization. Moreover, improvement of the database is not ready to be measured.</td></tr>
</table>

2.1	At least 3 case studies for both construction and design are conducted. (Totally 6 case studies)	60% Case studies to improve the capacities of survey and design and safety control were conducted as planned. Implementation of case studies for construction management using checklists have been delayed due to delayed budget allocation. However, through OJT, JICA expert team compiled draft checklists twice. (The latest version 3 has been drafted.) Those case studies will be conducted in the project extension period.
2.2	More than 60% of trainees pass the achievement test for construction supervision and design.	Baseline survey results showed that the percentage of examinees exceeded the passing line by respective subject was a) design: 28%, & b) quality control: 8%. In order to grasp the knowledge improvement of trained NDBRFC staff, JICA Expert Team gave mock exams continuously. The trainees' scores from the mock exams have been increasing step by step. The final achievement test will be given after the completion of the case studies. Therefore, achievement level of this output is not ready to be measured.
3	Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	90% Draft guidelines for slope protection, bridge substructure protection, culvert design, and landslide investigation have been prepared. However, checks for whether prepared guidelines can be utilized by NDBRFC have been insufficient. In order to confirm their efficiency and applicability, JICA expert team carried out workshops for dissemination; guidelines and checklists were disseminated to the representatives of municipal administrations and higher education institutes. Dissemination of guidelines will be continued in the project extension period.

1-4 Achievement of the Project Purpose

Indicators of Project Purpose	Achievement level
Total length of maintained national roads were became 400km.	JICA expert team collected IRI data of all national roads; a collaborative working team of JICA experts from CADEFEST and CDRS projects have analyzing the data; a solid figure will be reported in the next monitoring period.

1-5 Changes of Risks and Actions for Mitigation

1-6 Progress of Actions undertaken by JICA

- JICA Timor-Leste shared important information and documents with JICA Expert Team.
- JICA Timor-Leste assisted visa acquisition process for JICA Expert Team.

1-7 Progress of Actions undertaken by Gov. of Timor-Leste

- DRBFC shared necessary information and documents with JICA Expert Team.
- DRBFC has prepared the drawings of road and bridge maintenance based on the road inspection.

1-8 Progress of Environmental and Social Considerations (if applicable)

- No activities for the progress of Environmental and Social Considerations are undertaken.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

- Not Applicable so far.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

- No other issues are confirmed so far.

2. Delay of Work Schedule and/or Problems (if any)

- Based on the PDM, the project activities have been implemented as planned.

3. Modification of the Project Implementation Plan

3-1 PO

- PO was modified after the 4th JCC. The latest version was ver.6.

3-2 Other modifications on detailed implementation plan

- General issue:
  As a result of the parliamentary election, a regime has change occurred. Due to political factors, the budget plan for 2018 was rejected. Under the influence of delayed budget allocation, implementation of activities 1.2, 1.3, 1.4, 1.6, 2.2, 2.3 and 3.5 has been delayed.

- Countermeasures have been taken by JICA Expert Team:
  1) In the coordination meeting between CDRS project and NDRBFC, CDRS Deputy Team Leader requested the Director of NDRBFC to prioritize allocation of the budget for the projects selected for case studies.
  2) CDRS team leader suggested to NDBRFC that the 2018 inspection work should be carried out by collaboration between relevant staff of Department of Project and Department of Maintenance in order to increase work efficiency with a limited budget.

- <u>Modifications of implementation plan and project period:</u>
  A 9-month extension of project term was approved at the 4th JCC. Those delayed activities mentioned above will be conducted during extension period.

4. Preparation of Gov. of Timor-Leste toward after completion of the Project

- The Gov. of Timor-Leste tries to secure the budget for road maintenance so that the capacity enhancement of NDRBFC for road maintenance which is the Project Purpose will be sustainable and contribute to the achievement of Overall Goal.

< II. Project Monitoring Sheet I & II >

- Project Monitoring Sheet I & II are attached as PM Form I and II.

Project Monitoring Sheet I (Revision of Project Design Matrix)

Version 3
Dated 31st August, 2017

Project Title: The Project for Capacity Development of Road Services in Timor-Leste (CDRS)
Implementing Agency: Ministry of Public Works, Transport and Communications
Target Group: Officials of Direstorate of Road, Bridge and Flood Control (DRBFC)
Period of Project: (Three (3) years)
Project Site: Whole Timor-Leste **Model Site:**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal The maintenance conditions of major roads are improved in TL.	OG1 More than 60% of major national roads is in good condition.	Periodic Road Inspection	Budget and staff will be secured at satisfactory levels. Traffic volume is not increased more than expected.	Indicator has been set up and approved in 2nd JCC on February 2017.	
Project Purpose Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	Total length of maintained national roads become 400km.	Periodic Road Inspection	Enough number of DRBFC staff in the HQs and regional offices is ensured as planned. Budget for road maintenance and management is ensured.	Indicator has been set up and approved in 2nd JCC on February 2017.	
Outputs Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan. Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country. Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	1-1 More than 30% of requested budget for road maintenance are distributed. 1-2 Improved road database is utilized for preparing the annual work plan of road maintenance. 2-1. At least 3 case studies for construction and 3 case studies for design are conducted (Totally 6 case studies). 2-2. More than 60 % of trainees pass the achievement test for construction supervision and design. 3. Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	Budget Report Monitoring Sheet Monitoring Sheet Achievement test Technical guideline prepared	Budget for road maintenance and management is ensured. The trained DRBFC personnel continue to work for the Project (They do not quit the Project) Unforeseen natural disasters will not occur which may destroy construction works under case studies.	Indicator has been set up and approved in 2nd JCC on February 2017. 2-1. 1 site for construction and 3 sites for design are selected.	

Activities	Inputs		Pre-Conditions
	The Japanese Side	The Timor-Leste Side	
1.1 To review existing management structure condition of maintenance and rehabilitation for major roads. 1.2 To conduct periodic/routine inspection. 1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges. 1.4 To formulate maintenance and repair/rehabilitation plans for next cycle. 1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises. 1.6 To undertake appropriate road maintenance/rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget. 1.7 To propose appropriate framework of road maintenance and rehabilitation for major roads. 2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies. 2.2 To conduct the case studies for the planning, design and construction supervision of the project. 2.3 To propose preferable structures for construction management for repair/rehabilitation and maintenance works through case studies. 3.1 To review existing technical documents for road maintenance and rehabilitation. 3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works. 3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies. 3.4 To prepare the technical guideline of investigation and design. 3.5 To reflect the lessons learned from case studies to the technical guideline. 3.6 To disseminate the technical guideline for concerned parties.	1. Dispatch of the Japanese experts Short-term experts: - Team leader / Road maintenance 1 - Deputy team leader / Road maintenance 2 - Road construction supervision - Quality control / Road repair - Disaster restoration - Road design / Project coordinator - Structure design - Database - Evaluation / Monitoring - Other areas if needed 2. Facillities and equipment In accordance with necessity of activities 3. Training in Japan In accordance with necessity of activities	1. Assignment of C/Ps - Project Director - Project Manager - DRBFC Staff 2. Assignment of Trainees In accordance of necessity 3. Facillities and Equipment - Project office Equipment and tools 4. Recurrent costs - Expenses for equipment maintenance - Spare parts - Transportation fees of C/Ps and trainees - Expenses for contract-out of works - Necessary expenditures for case studies - C/Ps' wages and allowances	DRBFC's budget necessary for the Project is allocated by TL government. <Issues and countermesures>

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 7
Dated 31st March, 2019

Project Title: The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste(CDRS)

Inputs	Plan / Actual	2016 I–IV, 2017 I–IV, 2018 I–IV, 2019 I–IV, 2020 I–IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert					
Team Leader/Road Maintenance 1 /Mr. Hisashi MUTO	Plan / Modify / Actual			-	-
Deputy Team Leader/Road Maintenance 2 /Mr. Makoto MATSUURA	Plan / Actual			March 2017, Mr. Matsuura resigned.	Mr. Mitsuhide Saito was dispatched as successor of Mr. Matsuura.
Deputy Team Leader/Road Maintenance 2 /Mr. Mitsuhide SAITO	Plan / Modify / Actual		Mr. Mitsuhide Saito replaced Mr. Matsuura as Deputy	-	-
Road Construction Supervision /Mr. Johji KOIZUMI	Plan / Modify / Actual			-	-
Quality Control/Road Repair /Mr. Sueo HIROSE	Plan / Modify / Actual			-	-
Disaster Restoration /Mr. Shutaro SAKANAKA	Plan / Actual			-	-
Disaster Restoration 2 /Mr. Kazuharu KOISHIKAWA	Plan / Modify / Actual			This position has been created to assist drafting guidelines.	Mr. Koishikawa was assigned for this position in March 2018.
Road Design/Project Coordinator /Mr. Yoshiyuki AKAGAWA	Plan / Actual			July 2017, Mr. Akagawa resigned.	Mr. Brooker-Jones was dispatched as successor of Mr. Akagawa.
Road Design/Project Coordinator /Mr. Nicholas BROOKER-JONES	Plan / Modify / Actual		Mr. Brooker-Jones replaced Mr. Akagawa as Project	-	-
Structure Design /Mr. Kenji MINEGISHI	Plan / Modify / Actual			-	-
Database /Mr. Takashi SAITO	Plan / Modify / Actual			-	-
Landslide /Mr. Masahiko HAYASHI	Plan / Actual		Activity on Landslide analysis was	-	-
Topographical Analysis /Mr. Sohshi MIKAMI	Plan / Actual		Activity on Landslide analysis was	-	-
Evaluation/Monitoring Ms. Nao TSUJIMURA	Plan / Modify / Actual			-	-
Equipment					
Desktop computer	Plan / Actual		Office use		
Inclinometer assembly	Plan / Actual		These equipment purchased to monitor landslide mass movement.		
Borehole casing	Plan / Actual				
Dokenbo assembly	Plan / Actual		Test equipment to grasp land penetration.		
	Plan / Actual				
Training in Japan					
	Plan / Actual				
In-country/Third country Training					
	Plan / Actual				

Activities / Sub-Activities	Plan / Actual	2016 I–IV, 2017 I–IV, 2018 I–IV, 2019 I–IV, 2020 I–IV	Responsible Organization (Japan / GOTL)	Achievements	Issue & Countermeasures
Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget					
1.1 To review existing management structure and condition of maintenance and rehabilitation for major roads	Plan / Actual	done	JICA expert team	Organizational and personnel exchanges were proposed at 3rd JCC.	
1.2 To conduct the periodic/routine inspection	Plan / Modify / Actual		GOTL: NDRBFC Dept. Maintenance and Dept. Project	1) Periodic / routine inspection has been done along A03, A04, A06, A08, A11, A12 and A16 (173km). 2) Road inspection using drive recorder has been conducted (1419km).	Issue: Due to political factors, budget for 2019 was approved in February. Activities of 1.2, 1.3, 1.4, 1.6 have been delayed. Countermeasures: 1) 2019 inspection work was carried out by JICA expert team. 2) Seminar on operation of GIS database was conducted. 3) Extension of project term was approved at 4th JCC; those delayed activities will be conducted during the extension period.
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	Plan / Modify / Actual		NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	1) Data from urban & national road surveys were inputted into GIS database (173km).	
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan / Modify / Actual		NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	Maintenance and rehabilitation work plan for 2019 was formulated based on inspection results.	
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	Plan / Modify / Actual		NDRBFC; JICA expert team assists this activity.	JICA expert team proposed continuation of support for C/P carrying out emergency inspections; proposal was approval in 5th JCC.	During this monitoring period, C/P did not request support from CDRS regarding emergency inspections.
1.6 To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget	Plan / Modify / Actual		NDRBFC Dept. Maintenance and Dept. Project; JICA expert team assists this activity.	NDRBFC has secured an annual budget for maintenance and rehabilitation works in 2019. (Infrastructure fund for maintenance: 12,997,000USD + Line of Ministry budget: 12,386,000USD)	
1.7 To propose appropriate framework of road maintenance/rehabilitation for major roads	Plan / Modify / Actual		JICA expert team		
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope protections					
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	Plan / Actual	done	JICA expert team	2 case study sites and action plan for each site were proposed in 3rd JCC and TL stakeholders approved the proposal. (totally 6 sites were identified.)	
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	Plan / Modify / Actual		Responsibility of TL government: secure budget for the projects which were selected for case studies.	OJT for payment inspection using checklists was conducted; OJT for quality control of stone masonry retaining wall using checklists was conducted.	
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	Plan / Modify / Actual		JICA expert team	Collaborative workshop on culvert planning/design check was carried out with ILO; JICA expert team supported C/P using the culvert design guideline; C/P scrutinized a proposed design from a contractor, concluded that the design was excessive and suggested amendments.	
Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.					
3.1 To review existing technical documents for road maintenance and rehabilitation	Plan / Actual	done	JICA expert team	JICA expert team reviewed existing technical documents, such as specifications and drawings from past projects.	
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works	Plan / Actual	done	JICA expert team	JICA expert team identified factors affecting structural failure / road damage using baseline survey results and road inspection results.	
3.3 To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies	Plan / Actual	done	JICA expert team	Classroom lectures for civil engineering design were implemented on schedule. Repeat lecture about operation of total station was provided.	
3.4 To prepare the technical guideline of investigation and design	Plan / Actual	done	JICA expert team	Draft guidelines for slope protection, bridge substructure protection and culvert design have been prepared.	
3.5 To reflect the lessons learned from case studies to the technical guideline	Plan / Modify / Actual		NDRBFC Dept. Project, chief of planning section and JICA expert team	JICA expert team supported C/P using the culvert design guideline; C/P scrutinized a proposed design from a contractor, concluded that the design was excessive and suggested amendments.	Issue: Checks for whether prepared guidelines (on slope protection, bridge substructure protection and culvert design) can be utilized by C/P have been insufficient. Countermeasure: In order to confirm their efficiency and applicability, guidelines will be introduced to projects other than case studies.
3.6 To disseminate the technical guideline for concerned parties	Plan / Modify / Actual		JICA expert team and C/P	A workshop for dissemination of guidelines and checklists was carried out; Guidelines and checklists were disseminated to the representatives of municipal administrations and higher education institutes.	
Duration / Phasing	Plan / Actual				

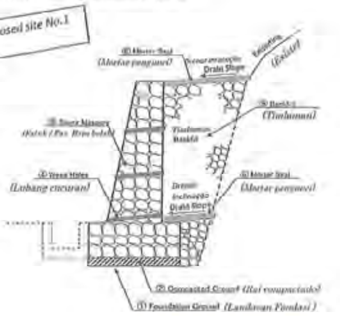
Monitoring Plan	Plan / Actual	2016 I–IV, 2017 I–IV, 2018 I–IV, 2019 I–IV, 2020 I–IV	Remarks	Issue	Solution
Monitoring					
Joint Coordination Committee	Plan / Modify / Actual		9-month extension of project period has been approved by 4th JCC. In the extension period, additional JCCs and monitoring activities will be conducted.	-	-
Set-up the Detailed Plan of Operation	Plan / Modify / Actual			-	-
Submission of Monitoring Sheet	Plan / Modify / Actual			Submission of monitoring sheet Ver.5 was delayed.	In order to improve project management, internal coordination meetings of CDRS expert team have been held.
Joint Monitoring	Plan / Modify / Actual			-	-
Post Monitoring	Plan / Actual				
	Plan / Actual				
Reports/Documents					
Technical Guideline	Plan / Modify / Actual		9-month extension of project period has been approved by 4th JCC.	Checks for whether prepared guidelines can be utilized by C/P have been insufficient.	During extension period, guidelines will be introduced to projects other than case studies.
Project Completion Report	Plan / Modify / Actual			Project completion will be postponed.	Submission of project completion report will be postponed to December 2019.
Public Relations					
Information to road users	Plan / Actual				
Event or opening ceremony for a OJT site	Plan / Actual				
Workshop	Plan / Actual			In 5th JCC, repetition of workshops for dissemination of guidelines and checklists was requested from representatives of municipal administrations.	During the extension period, workshops for dissemination of guidelines and checklists will be conducted.

Attachment 1

OJT using Checklist in Humboe-Letefoho on 21 February 2019

CHECK LISTS **Stone Masonry Retaining Wall** 1/2 CL_SM Retaining Wall
(LISTA VERIFIKASAUN) *(Moru Retensaun ho Fatuk)*

OJT_CL for proposed site No.1 & No.2

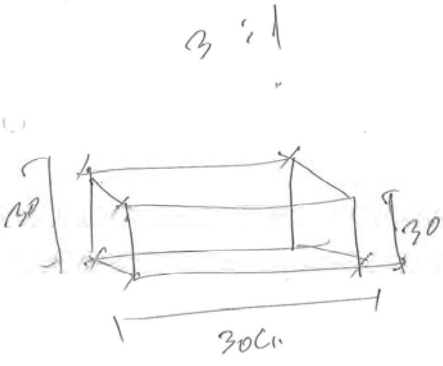


CHECK LISTS for Stone Masonry Retaining Wall
(LISTA VERIFIKASAUN ba Moru Retensaun ho Fatuk)

Name of Project *(Naran Projetu)*: EMERGENCY WORKS HOMBOE – LETEFOHO	
Location *(Fatin)*: A10	Date *(Data)*: 21 / 02 / 19 (DD/MM/YYYY)
Name of Contractor *(Naran Kontraktor)*: BEI HUEI UNIP. LDA.	Location *(Fatin)*: STA 0+00m – 01 km 300
Name of Inspector *(Naran Inspektor)*: AGUSTINHO DE COSTA	Name of Department *(Naran Departamentu)*: REG 4 MAINT.

SPC= Standard Specification of MPWTC-Nov2014 Edition

No.	Check Items *(Verifika Itens)*	Judgements (Selection No.)		Specification Standard	SPC	Remarks *(Observasaun)* (Printed figure is reference only)
⓪	Preparatory activity *(Aktividade preparatoriu)*					
	Did you confirm the drawings? *(Ita bo'ot komfirma ona dezenhu?)*	(Yes)	No			ORIGINAL DRAWING YES BUT SLOPE CUTTING CHANGE ON LOCATION
	Did you confirm the construction work plan? *(Ita bo'ot komfirma ona planu servisu construsaun tian?)*	(Yes)	No			
①	Foundation Ground *(Landasan Fondasi)*					
	Is strength of bearing ground sufficient? *(Resistensia bantalan tanah suficiente?)*	(Yes)	(No)			~~[illegible]~~ Kasar la suficiente · WST IS OK
	If No, was the replacement of soft ground appropriate? *(se Lae, troka rai mamar ne'e apropriadu ka?)*	Yes	No			Replacement, Thickness=40cm NA
②	Compacted Ground *(Rai compactado)*					
	Did you use the compactor for compaction? *(Ita bo'ot utiliza Compactor ba compactado?)*	Yes	No			NOT APPLICABLE BECOUSE CUTTING AREA



CHECK LISTS for Stone Masonry Retaining Wall 2/2 CL_SM Retaining Wall
(LISTA VERIFIKASAUN ba moru retensaun ho fatuk)

OJT_CL for proposed site No.1 & No.2

No.	Check Items *(Verifika Itens)*	Judgements (Selection No.)		Specification Standard	SPC	Remarks (Printed figure is reference only)
③	Stone Masonry *(Fatuk / Pasangan batu belah)*					
	Was Stone material appropriately? *(Material hanesan fatuk sira ne'e apropriadu ka?)*	(Yes)	No			150mm ≦ Stone thickness ≦ 250mm YES ACCORDING TO STANDARD SPECIFICATION
	Was cement mortar composed appropriately? *(Komposta cementi mortar ne apropriadu ona ka?)*	Yes	(No)			Cement 1 : Sand 4 · 30 SCOP 1 Cement NEED TO CONFIRM.
④	Weep Holes *(Lubang cucuran)*					
	Was diameter of weep hole appropriate? *(Lubang cucuran nia diametru apropriadu ona ka?)*	Yes	No			dia 100mm NOT YET INSTALLATION·
	Were Weep Holes laid out appropriately? *(Lubang cucuran koloka ho loloo ona ka?)*	Yes	No			Interval 2m NOT YET
⑤	Backfill *(Timbunan)*					
	Did you check the backfill material? *(Ita bo'ot verifika ona material timbunan ka?)*	Yes	No			Crushed stone NOT YET.
	Has the compaction been carried out properly? *(compactação halo ho loloo ka?)*	Yes	No			Vibrating Compactor 40~60kg *(Kompaktador Vibrador)*
	Did you confirm the soil density test results? *(Ita bo'ot komfirma ona rezultadu teste densidade rai ka?)*	Yes	No			N/A NOT APLILABLE *(La bele aplika)*
	Did you confirm the compacted thickness? *(Ita bo'ot komfirma ona compactação nia mahar ka?)*	Yes	No			N/A NOT APLICABLE *(La bele aplika)*
⑥	Mortar Seal *(Mortar pengunci)*					
	Did you check the thickness of mortar seal? *(Ita bo'ot verifika mortar sheal nia mahar ka?)*	Yes	No			100mm NA ·
	Was cement mortar composed appropriately? *(Semanti mortar ninia komposto apropriadu ona ka?)*	Yes	No			Cement 1 : Sand 2 NA ·

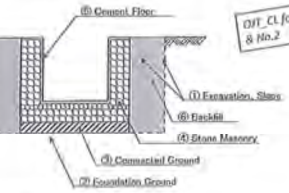
* Note, Remark and/or Comment <Optinal column for only OJT (1) & (2) >	
PERLIJA ESPVICH NEBO W/O ACTEPA NIA DIMENSAUN HALO FAVOR [illegible] HALO KOORDENASAUN HO SUP. OBRAS PUBLIK, NO PERLIJA HALO HOS INSTALASAUN BA TEM WEBE BELAIF HALO HANEOAN WEEP HOLE.	Inspector (Trainee): (Signature/date) 21/02/19 Inspected by (Name) AGUSTINHO DE D'COSTA (Department)
	Trainer: (Signature/date) Checked by (Name) Eng. Nazario Do Jesus Freitas/ Eng. Sabino Da Costa Ventura (Department)

* Record of recognition for the inspection

Rep. of Contractor (date/sign) *(Reprezentante kontraktor)*	Inspected by (date/signature) *(inspesionadu por)*	Checked by (date/signature) *(Verifika husi)*	Testifyed by (date/signature) *(Testemunha husi)*
name: Title & Contractor's name:	Inspector's name: Department of DRBFC:	name & title of Department:	name & title of DRBFC:

CHECK LISTS **Stone Masonry Drainage (Line Drain)** 1/2 CL_SM Drainage
(LISTA VERIFIKASAUN) *(Drenajem ho Fatuk (Pas. Batu belah))*

OJT_CL for proposed site No.1 & No.2



CHECK LISTS for Stone Masonry Drainage
(LISTA VERIFIKASAUN ba drenajem ho Fatuk)

Name of Project *(Naran Projetu)*: EMERGENCY WORK HUMBOE – LETEFOHO		
Location *(Fatin)*: A10	Date *(Data)*: 21 / 02 / 2019 (DD/MM/YYYY)	
Name of Contractor *(Naran Kontraktor)*: [illegible]	Location *(Fatin)*: STA 01 km00 – 01 km400	
Name of Inspector *(Naran Inspektor)*: AGUSTINHO DE D' DA COSTA	Name of Department *(Naran Departamentu)*	MAINTENANCE DEPARTMENT

SPC= Standard Specification of MPWTC-Nov2014 Edition

No.	Check Items *(Verifika Itens)*	Judgements (Selection No.)		Specification Standard	SPC	Remaks *(Observasaun)* (Printed figure is reference only)
⓪	Preparatory activity *(Aktividade)*					
	Did you confirm the drawings? *(Ita bo'ot komfirma ona dezenho?)*	(Yes)	No			changes on the site base of cutting after cutting got hit soil.
	Did you confirm the construction work plan? *(Ita bo'ot komfirma ona plano servisu konstrusaun)*	(Yes)	No			
①	Excavation, Slope *(Eskavasaun, Declive)*					
	Was excavation width appropriate? *(Eskavasaun nia largura apropriado ona ka?)*	(Yes)	No			YES / OK
	Was excavation slope appropriate? *(Inclinação ba eskavasaun nia apropriado ona)*	(Yes)	No			[illegible] la foo AMEASA BA BE PALMER WEBE ISTAL HEI
	Was removal of water appropriate? *(Remoção be apropriada ona ka?)*	(Yes)	No			
②	Foundation Ground *(Landasan Fondasi)*					NA
	Is strength of bearing ground sufficient? *(Resintencia bantalan tanah suficiente ka lae?)*	Yes	No			NA
	If No, was the replacement of soft ground appropriate? *(Se Lae, subtituisaun ba rai ne'ebe mamar apropriado ka lae?)*	Yes	No			Replacement, Thickness=40cm *(Substituisaun, mahar = 40)*
③	Compacted Ground *(Rai compactado)*					NA

CHECK LISTS for Stone Masonry Drainage 2/2

OJT_CL for proposed site No.1 & No.2

No.	Check Items (Verifika Itens)	Judgements (Julgamentu) (Selection No.)	Specification (Espesifikasaun) Standard	SPC	Remaks (Observasaun) (Printed figure is reference only)
	Did you use the compactor for compaction? (Ita bo'ot uza compactador ba halo compactasaun?)	Yes / No			N/A
④	Stone Masonry (Fatuk (Pasangan Batu belai))				[illegible]
	Was Stone material appropriately? (Material fatuk sira ne'e apropriadu ona ka?)	(Yes) / No			150mm ≦ Stone thickness ≦ 225mm
	Was cement mortar composed appropriately? (Semente mortar ninia apropriadu ona ka?)	Yes / (No)			Cement 1 : Sand 3 — HUSU BO COMPANHIA ... CONFIRM BO CAMA
⑤	Cement Floor (Piso semente)				N/A
	Wa...	Yes / No			Cement 1 : Sand 3
⑥					N/A
		s / No	—		Selected Material, From Borrow Pit No.1
		s / No			Vibrating Compactor 40～60kg
	Dic...	No	95%		Inspected density: 95%
	Did...	No	30cm		Inspected thickness: 30cm

Clarify the compacted that are regarding the site are not yet apple in the contractor shall requested to the work ... have been clear with the Eng. of PW ... coordinate with all the work on site ... due to the SPC and also all ... that have not yet work then implemented

* Note, Re... comment (Optional column for only OJT (1) & (2))

LOWS BO COMPACTOR WEBE HALE SEDAUK APLIKA HUSU BO COMPANHIA NOTA ATU HOTAO TENKI IHA FORDEGADAUNHO OBRAS PUBLIK PAR BECE HATA STANDAR OBRAS PUBLIK/DESEINO NO WOS BO ITEM SIRA SEDUK NEBE SEDAUK IMPLEMENTA.

Konaba Retaining wall everything is Ok

Inspector (Trainee): (Signature/date) 21/02/19

Inspected by (Name) AGUSTINHO (Department) MPW

Trainer: (Signature/date)

Checked by (Name) Eng. Sabino De Jesus Ventura

Eng. Sabino Da Costa Ventura

(Department)

* Record of recognition for the inspection

Rep. of Contractor (date/sign) (Representante husi Kontratista)	Inspected by (date/signature) (Inspesionadu husi)	Checked by (date/signature) (Verifika husi)	Testified by (date/signature) (Testemunha husi)
name: Title & Contractor's name:	Inspector's name: Department of DRBFC:	name & title of Department:	name & title of DRBFC:

CHECK LISTS Excavation (for Roadway) 1/4

OJT_CL for proposed site No.1

CL Excavation Edited 20180219

(this Check List sheet apply for Roadway Excavation)

(Lista verifikasaun ida ne'e aplika ba eskavasaun ba estrada)

STA. 0+060 ③Example of Cross Section

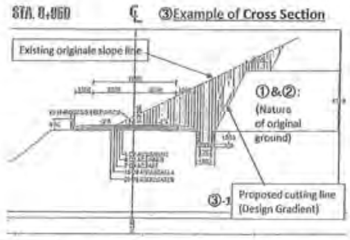


Table of volume at this Cross Section

(Tabela Volume Seksaun Transversal ida ne'e)

	WORK ITEM		
1	Excavation	[illegible]	m3
2	Embankment	-	m3
3	AC Wearing	3.00	m2
4	AC Binder	3.00	m2
5	AC Base	3.38	m2
6	Aggregate A	[illegible]	m2
7	Aggregate B	1.51	m2
8	Stone Masonry	1.51	m2
9	Plaster	1.10	m2

CHECK LIST for Excavation

(Lista verifikasaun ba eskavasaun)

Type of Excavation (Rock) / Comonn (Tipu Eskavasaun) (Fatuk / Comun)

Name of Project: EMPREENDIMENTO ... ROAD LETEFOHO (Proj)

Location: Jct A04 Gleno - Jct A10 Letefoho (Fatin)

Date: 21 / 02 / 2018 (dd/mm/yyyy) (Data)

Name of Contractor: BETUMEL UNIPESSOAL LDA (Kontraktor nia Naran)

Location: STA 0+... - ... m

Name of Inspector: FELICIANO DA COSTA (Inspektor nia naran)

Name of Department (Departementu nia naran)

SPC: Standard Specification of MPWTC-Nov2014 Edition

No.	Check Items (Verifika Itens)	Judgements (Julgamentu) (Selection No.)		Specification (Spesifikasaun) Standard	SPC	Remaks (Printed figure is reference only)
	• Check the type of original ground & Classification of Excavation (Verifika type rai original no Escakavasaun nia Klasifikasion)					
①	Which kind of nature (characteristic) of original ground/slope ? (Natureza (karakteristika) husi rai original/declive hanesan ida ne'ebe?) (1) Hard Rock (Fatuk tos) 2) Rock (Fatuk) 3) Common soil (Rai) 4) Muck or insuitable material (Foer ou material ne'ebe la ...)	Mark (number)			203.1.1	* 1) & 2) can be excavated by blasting and Rippering. Detached stones with volume of 1m3 or more are as 2)
②	Is the type of original ground stated in the Drawing or the Specification ? (Tipu rai original indika iha dezenu ou ...)	Yes	(No)			NO INDICATE IN DRAWING
	• Cross Section for Cutting Area of Road Excavation (• Seksaun transversal ba oteru area escavasaun estrada)					Yes

---

CHECK LISTS Excavation 2/4

(Lista Verifikasaun) (Eskavasaun)

OJT_CL for proposed site No.1

No.	Check Items	Judgements (Selection No.)		Specification Standard	SPC	Remaks (Printed figure is reference only)
③-1	Are the drawings of cross section for Roadway provided? (Dezenu ba seksaun transversal ba estrada fornese ka lae?)	(Yes)	No			AFTER VARIATION
③-2	Which interval length of cross section ? (Naran rook sai hanesan nanuk interval ba seksaun transversal?) 1) 25m 2) 50m 3) 100m 4) other length: ____ m	Mark (number)				CHECK NEW DRAWING
③-3	Are the proposed gradient of cutting line/ slope shown on the "Cross Section"(③-1) ? (Proposto gradiente linha oteru/declive hanesan hatudu iha "Seksaun Transversal"(③-1)?)	(Yes)	No			BO CONTINUE BE CAN BE SETTING
③-4	Are original ground line also shown on the "Cross Section" ? (Rai original moos hatudu hotu iha "Seksaun ...)	(Yes)	No			
③-5	Are the results of calculation of the area (m2), Excavated value, descrived on such Drawing ? (Rezultadu husi kalkulasaun ba area)	(Yes)	No			
	• Workmanship for Excavation on the site (Obra de mão ba eskavasaun iha ...)					
④-1	Are the stakes of setting out and/or leading frames provided on the site?	Yes	(No)		203.2.1	CONTINUADOR LAN DOE SETTING 'SP SUMAE-
④-2	Are the line, grades and dimension of slope/ excava- ted area followed to the Drawing or the instructions by the Engineer ? (Liana, klase no dimensaun declive/ area eskavasaun ...)	Yes	(No)		203.1	
⑤	Which kinds of machine or method of excavation are carried out ? (Tipu Makina no metodu saida mak realiza ba) (1) Excavator (2) Buldozzer 3) Bulldozer with ripper 4) Balsting method	Mark (number)				* In case of Blasting, works apply SPC section 203.2.5 "Presplitting"
⑥	Have the Contractor instructed to the operator regading work procedure of Excavation ? (Kontraktor fo intrusaun bo operador)	(Yes)	No			
⑦	Are conservation of Topsoil and Utilization of excavated material carried out satisfactory ? (Conservasaun husi rai superficial no utiliza material eskavasaun sira ne'e satisfatoriamente ka?)	(Yes)	No		203.2.2 203.2.3	

CHECK LISTS Excavation 3/4

(Lista Verifikasaun) (Eskavasaun)

OJT_CL for proposed site No.1

No.	Check Items	Judgements (Selection No.)		Specification Standard	SPC	Remaks (Printed figure is reference only)
	• Safety Measurement (Medição de segurança)					
⑧	Are the access route and working platform for the machine properly provided and Safely ? (asesu ba route no plataforma servisu ba makina fornese ho diak no ho seguru ka?)	Yes	(No)			TENKI FAU ROAD SAFETY MODI EMA ABSCESS DALAN BE ALEGURA IHA TEDERAN CONSTRUSAUN
⑨	Does the Contractor provided the watchmen who observe the works and make instructions to the operator ?	(Yes)	No			
⑩	When the road is reduced and limitted the width, are the warinig signboard and flagmen to the public traffic, provided ?	(Yes)	No			

* Note, Remark and/or Comment

Nota, observação e / ou comentário

SERVISU EXCAVATION ATU LAO DIAK HUSU BO COMPANHIA ATU MONTA STAKA TUIR DESEINO / BELE HALO OU MONTA MOS SAFETY ROAD ATU WUNE SERVISU CONSTRUSAUN - NEBE LAO IHA DALABELE LUPEDE TRANSPORTASI PUBLIK

Inspector: (Signature/date) Inspektor: (Assinatura/data) 21/02/19

AGUSTINHO

Inspected by Inspecionado por (Name) Naran (Department) Departamentu

Trainer: (Signature/date) Treinador: (Assinatura/data)

Checked by Verifika husi (Name) Sabino Da Costa Venture

(Naran) Sabino Da Costa Venture

(Department) Region 4 of Maintenance

(Departementu) Manutensaun Reb. 4

Rep. of the Contractor (date/signature) (Representante husi Kontratista)	Inspected by (date/signature) (Inspesionadu husi)	Checked by (date/signature) (Verifika husi)	Testifyed by (date/signature) (Testemunha husi)
name: Title & Contractor's name:	Inspector's name: Department of DRBFC:	name & title of Department:	name & title of DRBFC:

Attachment 2

OJT_ Demonstration for usage of Checklist for payment inspection on 7 Mach 2019

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

OJT (3)_Demonstration for usage of Check List for Payment Inspection

Case Study team for supervising, using Check List for Construction, DRBFC

on 10:00- 11:30 7 th March 2019
at Conference Room, DRBFC Dili

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works (MOP) and JICA Expert Team

Normal Flow of Inspection for Payment

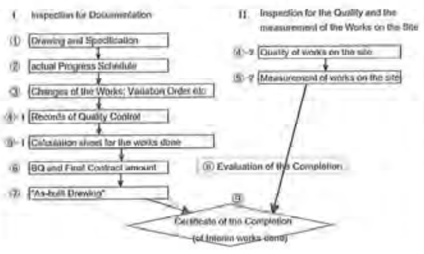


Figure: Flow of normal procedure for the Inspection

Demonstration for usage of Check List for Payment Inspection
in one example Pavement Works for on Ex-Japan Road

1. Out-line of the Ex-Japan Road

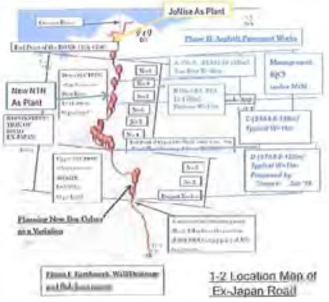
1-1 Overall Progress of Rehabilitation for Ex-Japan Road
Ex-Japan Road have been implemented in three phases;
Phase I: Earth works, structural works and Sub-base Course. Phase I consists of 9 contracts.
Phase II: Aggregate Base Course & 6cm Asphalt Concrete (AC) surface Binder Course. It consists of 4 contracts.
Phase III: 60m and 40m span bridge is supposed to be constructed at STA16km & 9km respectively

Phase I : Earth work, Stone Masonry structures & Sub-Base Course works items

Phase II : Base Course & Asphalt Concrete Surface Course works items

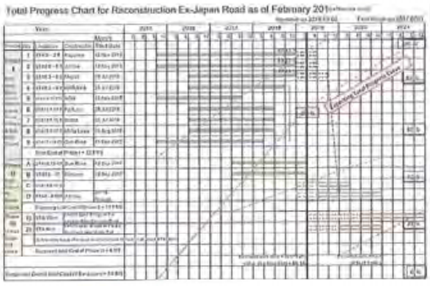
Ph1: Stone Masonry Retaining Wall has been carried out at about STA8+300m, Section No,3 Contract Phase I photo taken on 11 Feb,. 2019

Ph2:Asphalt concrete surfacing works have been completed at about STA16km, Contract B Phase II (Part 2) photo taken on 11 Feb,. 2019

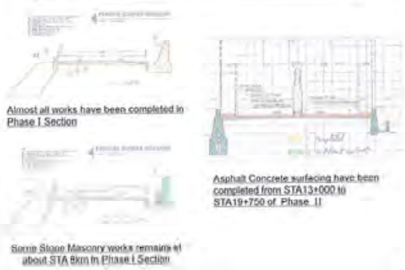


1-2 Location Map of Ex-Japan Road

Total Progress Chart for Reconstruction Ex-Japan Road as of February 2019



Typical Cross Section of Phase I & II



1-3. Out-line of one example Asphalt Paving Works

Project Name:	Asphalt Pavement Works, Phase 2 for Reconstruction of Road Ex. Japan
Location:	Dili-Beducu-Sarlala –Aileu STA17+000 – STA19+750
Contract No.:	SSS/121/MOPTC – 2017
Start / End Date:	12 Sept 2017(12 Nov 2015) / 31 Oct. 2018
Contract Price:	USD $2,489,023.43
Contractor:	Sun Rise Golden Construction Pty Lda
Supervision:	Construction Dept. of DRBFC
main works:	Foot way, Aggregate Base Course, Asphalt Binder Course t=6cm

Ph3 : Spreading and Compaction are carrying out for Sub-base course at about STA17km@2018.02.06

Ph4: Foot way construction at about STA 17-19km using Pre-cast concrete kurb and blocls as New Pavement project.@2018.06.11

Ph-5: Ditto but joint Inspection by site Safety Committee, including Contractor in charge of and using Check List for "Safety Patrol"@2018.09.19

Ph6: Base Course works are corried out, with Gradider at STA17km~17.5km by Sunrise and management by NTN @2018.09.11

Ph7: On Lower part (STA17.00-19.75), the width of As Paving is 12m (4line). @2019.02.11

Ph8: ditto but compacting by vibration Roller and watering is also conducted by big water tank lorry @2018.09.11ase Course works are carried out, with Gradider at STA17km~17.5km by Sunrise and management by NTN @2018.09.11

Ph9:On upper part (STA13.00-16.5), the width of As Paving is 110m (2line). On Lower part (STA17.00-19.75), the width of As Paving is 12m (4line). @2019.02.11

Bill of Quantities of the Works

[illegible]

- Main work Item:
  Crushed Aggregate Base Course: 5,962 m3
  6 cm Asphalt Concrete – Binder Course(AC-BC): 32,724 m2
  Sidewalk: 5,936 m2

2. Demonstration by filling marks/comments on to the Check List for Payment Inspection

2-1 Application for the Check List

This demonstration shows one example for Inspection for Payment using the Check List of the Inspection, according to following conditions/ assumption

Conditions: i) Inspector supposed to be J Koizumi, CDRS expert
ii) Inspection is made for the works done so far as Asphalt Concrete paving works
iii) Fill the marks & comments by red/brown color in the applicable Check List

OJT 3_Demonstration of CL for Payment Inspection

CHECK LIST for Final (Interim / Daily) Inspection (CM 03-20) 1/3

Type of Contract: Tender/Proposal, Design Build/…

Name of Project: Asphalt Pavement Works for Reconstruction of Road … (STA17+000 – STA19+750)

Location: [illegible] Date: 07 / 03 / 2019

Name of Contractor: [illegible]

Name of Inspector: Jobji Koizumi Name of Department: [illegible]

No	Check Items	Judgements Yes	Judgements No	Specification	SPC	Remarks
I	Inspection for Documentation					
①	Is Contract Drawing and Specification provided?	Yes	No			[illegible]
②	Is the actual Progress Schedule provided?	Yes	No			[illegible]
③	Is Variation Order(s), Claim(s) and other documents related the execution of the Works	Yes	No			[illegible]

OJT 3_Demonstration of CL for Payment Inspection

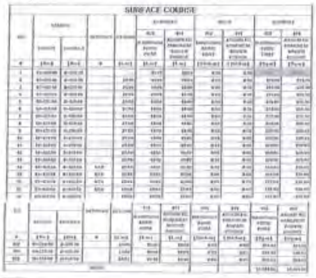
CHECK LIST for Final (Interim / Daily) Inspection 2/3 (CM 03-20)

No.	Check Items	Judgements Yes	Judgements No	Specification	SPC	Remarks
④-1	Is QC(Quality Control) records provided?	Yes	No			If QC records, such as … can be shown or provided in the Monthly Report or other report, this Check Item is "Yes"
	* Refer to CHECK LIST for Design Mix & specification (AsP-1)					
	· Test for material					
(1)	· Test Results of Sieve Tests for each type of aggregate					
(2)	Tests for characteristic of asphalt					
	· Record of Penetration value of asphalt					
	· Test result of Specific Gravity of asphalt					
	· Mix Design					
(3)	· Test Results of Sieve tests for proposed combined aggregate					
	· Records for proposed the Combination Gradation					
(4)	Records or Proposal for the Combination Ratio of each type of aggregate material					[illegible]
(5)	Report or Proposal for "Asphalt Content of Asphalt Concrete"					
	* Refer to CHECK LIST for Core Sampling Test (AsP-3)					
	· Marshall Test					
(1)	Test Result of Marshall Tests of Asphalt Concrete at Plant on production day					
	· Evaluation of Core Samples					
(2)	Records of Thickness of the sample of Asphalt Concrete on the site					
(3)	Test Results of Degree of Compaction (Dc) of AC by core sampling					
		Yes	No			If no or not enough such QC records provided, the Contractor shall be … to submit Test Results or Records as required.
⑤-1	Is the calculation sheet for the works done provided?	Yes	No			If provided it as shown the … P.17, …
⑥	Is the BQ and Final Contract amount provided?	Yes	No			… of Check Item ⑤-1 and … P.12 …
⑦	Is the "As-built Drawing" provided?	Yes	No			… This Inspection is for Interim Payment

2 Checklist for Inspection

One example form of table; Data for work done quantities of the work item

SURFACE COURSE



OJT 3_Demonstration of CL for Payment Inspection

CHECK LIST for Final (Interim / Daily) Inspection 3/3 (CM_03-20)

No.	Check Items	Judgements		Specification		Remarks
II	Inspection for the Quality and the measurement of the Works on the Site					
④-2	Is the Quality of the works on site satisfactory? (Is the site condition as same as QC records?)	Yes	No			Provided that the defected area of paving will be repaired until the Engineer's satisfaction
⑤-2	Is the site condition as same as the calculation sheet for the works done?	Yes	No			Provided that essential measurement like left are conducted and the site condition is satisfactory by the Engineer
	- Measure the width of the surfacing					
	- Measure the longitudinal length of the road					
III.	① Evaluation of the Inspection	Yes	No			
⑧	If "YES", PLS wrote next procedure Or If "No" PLS wrote outstanding issue.					
	1) In case "No", the Contractor shall be instructed to submit Test Results or QC records so that the works done should be testified to have necessary Quality and requirement by the Contract					
	2)					
IV.	Note, Remark and/or Comment					
	1) Monthly report or Final report is essential documents when Interim/Final Inspection will be made					

References & Questionnaire

1) Please fill or marks on to the delivered "OJT3_Check List of Inspection for Payment" by yourself like a demonstration, referring to the Check List for Asphalt Pavement
2) Please write any comments and opinion regarding to "Check List for Construction" , process of Inspection for work done on to the last column of sample Check List titled: " IV. Note, Remark and/or Comment "

References:
#1: Check List of Inspection for Payment (Questionnaire, OJT 3)
#2: Check List for Asphalt Pavement (OJT 3)

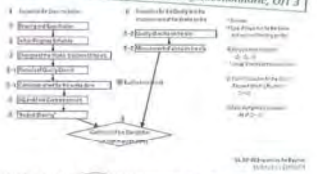
☆ Obrigado Barak !!

Ph2-18: A portion of AC Binder Course (at about STA18km+200) is stripped off for repair. Some bleeding are found near the area. @2019.02.27

Ditto but the repair works have been made @2019.03.05

Flow of normal procedure for Inspection

Ref.#1: CL for Payment Inspection_Questionnaire, OJT 3



CHECK LIST for Final (Interim / Daily) Inspection

Attachment 3

Collaborative workshop on culvert planning/Design check on 14 March 2019

REPUBLICA DEMOCRATICA DE TIMOR-LESTE
MINISTÉRIO DAS OBRAS PÚBLICAS
DIRECÇÃO GERAL DAS OBRAS PÚBLICAS
DIRECÇÃO NACIONAL DE ESTRADAS, PONTES E CONTROLO DE CHEIAS

ONE-DAY TRAINING WORKSHOP ON CULVERT DESIGN / PLANNING

Time	Topic / Activity	Speaker / Actor
09:30 – 10:00	Registration	RHD-SP
10:00 – 10:30	Opening • Greeting from CDRS • Introduction Remarks by RHD-SP • Opening Remarks by DRBFC	• Mr Hiroshi Muto, Team Leader • Mr Augustus Asare, Chief Technical Advisor • Mr João U. Gama de Sousa, Director
10:30 – 11:00	Discussion: Think-tank Exchange Quiz: Opinion Poll	All participants (moderator: Nicholas, CDRS) All participants
11:00 – 11:15	Refreshment break	—
11:15 – 12:15	Presentation: Guideline for Culvert Design	Mr Celestino F. Rosarios, Dept. of Highways, DRBFC
12:15 – 13:00	Lunch break	—
13:00 – 14:00	Presentation: Case Study of Bebola Culvert	Mr Manuel Soares, Dept. of Projects & Administration, DRBFC
14:00 - 14:45	Open Forum for Discussion	All participants (moderator: Nicholas, CDRS)
14:45 - 15:15	Rap-up and Quiz: Lessons Leard	All participants
15:15 - 15:30	Workshop Evaluation and Closing	RHD-SP & DRBFC

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Project Outline

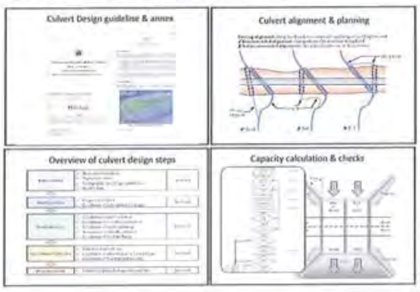
Ingerosec Corporation
Earth System Science Co., Ltd.

Project Target and Outputs

Item	Description
Project Title	The Project for the Capacity Development of Road Services (CDRS)
Project Duration	March 2016～March 2019 (3 years)
Project Site	Whole National Roads in Timor-Leste
Implementing Agency	Ministry of Public Works, Transport and Communications (MPWTC)
Target Group	Directorate of Road, Bridge and Flood Control (DRBFC)
Overall Goal	The maintenance conditions of major roads are improved in TL.
Project Purpose	Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.
Outputs	1. Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and budget plan 2.Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country 3. Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.

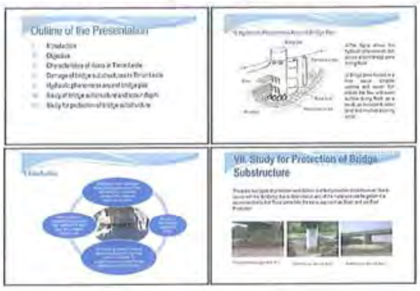
Activities to improve the capacity for surveying and design of drainage

Provision of Guideline for "Drainage — Culvert Design"



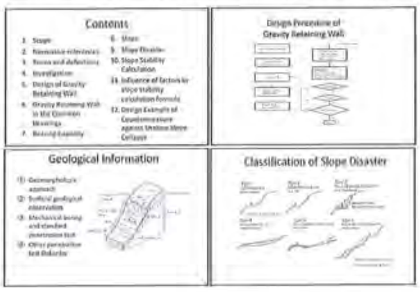
Activities to improve the capacity for surveying and design of protection against bridge scour

Provision of Guideline for "Bridge Substructure Protection"



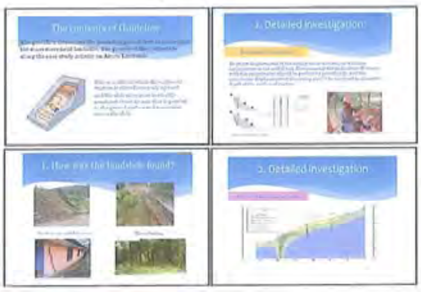
Activities to improve the capacity for surveying and design of slope protection

Provision of Guideline for "Slope Protection – Retaining Wall and Slope Collapse"



Activities to improve the capacity for surveying and design of slope protection

Provision of Guideline for "Slope Protection — Landslide Investigation"



Activities to improve the capacity of construction management for maintenance and rehabilitation

Provision of Checklists for
- "Construction — Quality Control"
- "Construction — Progress Control"
- "Construction — Safety Control"


7

Activities to improve the capacity of construction management for maintenance and rehabilitation

On-the-job training (OJT) for supervision using checklists on
- *Emergency Works* site on A10, Humboe-Letefoho, Ermera
- *Ex-Japan Road* site, Dili


8

REPUBLICA DEMOCRATICA DE TIMOR-LESTE
MINISTÉRIO DAS OBRAS PÚBLICAS
DIRECÇÃO GERAL DAS OBRAS PÚBLICAS
DIRECÇÃO NACIONAL DE ESTRADAS, PONTES E CONTROLO DE CHEIAS

TRAINING ABOUT GUIDELINE FOR CULVERT PLANNING & DESIGN

BY:
CELESTINO E. XIMENES
(Department of Highways)

2

Generalidade proposito ba culvert

- Objectivo husi design drainajem atu garante capacidade drainajem nebe apropriado ba facilidade drainajem nian, nebe signifika katak culvert nian spesifikasi suficiente atu akumula kemungkinan volume be'e husi limpasan no kusto konstrusaun nebe razoavel compara ho ninia benefisiu no aktividade economia. (*"The purpose of drainage design is to ensure reasonable capacity of drainage facilities, which means specifying culverts with sufficient drainage capacity to accommodate probable volumes of stormwater and at reasonable construction costs compared to their benefit to economic activities."*)
- Iha kontekstu hakur estrada, objectivo husi box culvert atu garante protesaun ba estrada nia estrutura no ba sira nebe usa estrada. (*"Within the context of road crossings, the purpose of box culverts is to ensure the protection of road structures and road users."*)

— Introduction, pagina vii

3

Atividade fundamental no dezenvolvementu

Kondisaun atual
- Manual dezeñu ponte ne'ebe eziste
- Controllu capacidade culvert ne'ebe mak raramente implementa
- Inundasaun no limpasan akontese durante udan bo'ot
- Estrutura estrada sai estragado


Solusaun
- Acquisição ba koñesementu liu husi treinamentu prática planeamentu & dezeñu
- Esperensia dezeñu liu husi realiza estudu caso ba culvert iha Estrada A05 besik sesurai no Estrada Ex-Japan besik sarlala
- Dezenvolve matadalan tecnica ba planeamento no dezeñu culvert iha Timor-Leste

4

Mata Dalan Estrada — Drenajem — Dezeñu Culvert

- CDRS fornese esbosu matadalan iha Juñu 2018
- Rekolla komentário
- DNEPCC finaliza matadalan iha Setembru 2018
- CDRS tradús matadalan ba Tetun iha Novembru 2018 (la ofisial – hanesan referensia deit)

5

Metodo

- Controlo ba dezeñu culvert:
(Check of culvert design)

$$Q > Q_P$$

- Metodo estimasaun limpasan:
(Method of runoff estimation)

$$Q_P = \frac{1}{3.6} \times C \times i \times A$$

- Kalkulasaun dezeñu kapasidade:
(Design of culvert capacity)

$$Q = V \times A = \frac{A^{5/3} \times S_0^{1/2}}{P^{2/3} \times n}$$



— Section 8.4, Design capacity of culverts, pajina 26
— Equation 9, Rational Method, pajina 21
— Equation 11, Manning discharge, pajina 26

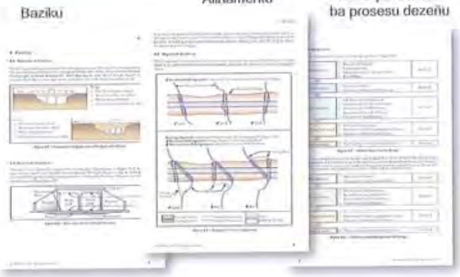
6

Konteudu mata dalan


7

Planeamentu

- Baziku
- Aplikasaun no Aliñamentu
- Vizaun jerál kona ba prosesu dezeñu



8

Planeamentu: limitasaun nebe recomenda ba structura culvert

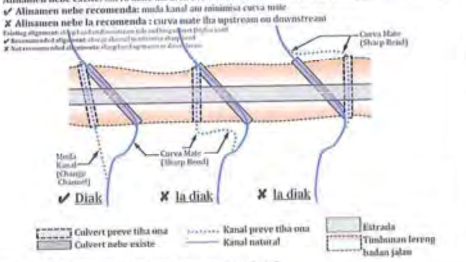
Property	Minimum	Maximum
Altura do caia (interno), D Tinggi gorong-gorong	0.75 m (750 mm)	5.0 m (5000 mm)
Largura (interna), B Lebar	0.45 m (450 mm)	6.5 m (6500 mm)
Kedalaman material teka ne to the culvert nia placa	0.5 m (500 mm)	—
Perbandingan (D : B) (Perbandingan)	1 : 1	1 : 3
Gradiente / Kemiringan ba culvert	0.005 m/m (0.5%)	0.100 m/m (10%)

— Table 4.1, Recommended limits for a concrete box culvert, pajina 4

9

Planeamentu: proposta apropriado liu ba muda culvert nian alinamen

Alinamen nebe existe: Curva mate iha area downstream no culvert nebe narak liu (custo nebe as teles)
✔ **Alinamen nebe recomenda:** muda kanal atu minimiza curva mate
✘ **Alinamen nebe la recomenda :** curva mate iha upstream ou downstream



— Figure 4.4, Examples of culvert alignment, pajina 5

10

Prosesu dezeñu

Koleksaun dadus (Data collection)	Informasaun kondisaun basiku iha Terenu (Foto); Dadus Topografiku; Dadus mapa / dadus geospatial; Dadus udan ben	Section 5
Analisa dadus udan ben (Rainfall analysis)	Analisa Frekuensia; Kalkulasaun udan ben diaria ba design	Section 6
Kalkulasaun ba inundasaun (Flood calculation)	Kalkulasaun ba catchment area; Kalkulasaun ba tempu konsentrasaun; Kalkulasaun ba udan ben nian intensidade; avaliasaun cofisien Limpasan; Kalkulasaun debit banjir	Section 7
Saluran terbuka hydraulic (Open-channel hydraulics)	Selekcaun ba Culvert nia dimensaun; Kalkulasaun capacidade culvert ba debit air; Kalkulasaun ba tipe arus no velocidade be nian	Section 8
Servisu Protesaun (Protection works)	Seleksaun ba medida protesaun no dimensaun	Section 9

— Figure 4.5, Outline of process for design, pajina 6

11

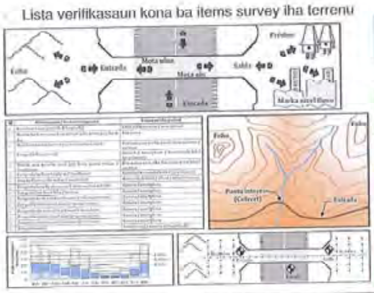
Koleksaun dadus no Análize udan ben

- Lista verifikasaun iha terrenu
- Análiza frekuensia

12

Koleksaun dadus

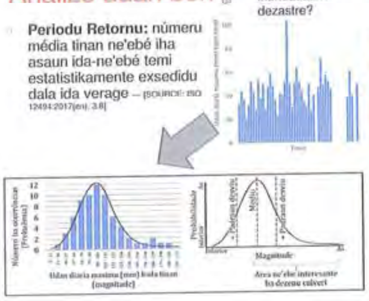
- Lista verifikasaun kona ba items survey iha terrenu



13

Analize udan ben

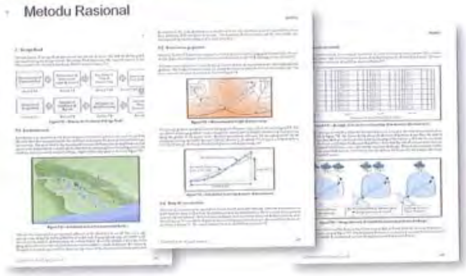
- **Periodu Retornu:** númeru média tinan ne'ebé iha asaun ida-ne'ebé temi estatistikamente exsedidu dala ida verage — [SOURCE: ISO 12494:2017(en), 3.8]



14

Dezeñu inundasaun

- Metodu Rasional

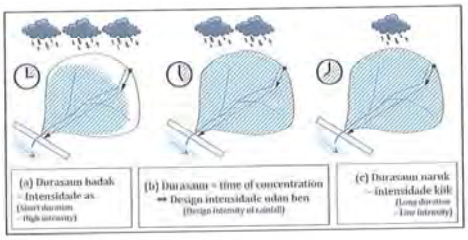


Dezeñu inundasaun

- Metodu Rasional ba kalkulasaun pico descarga, $Q_P = \frac{1}{3.6} CiA$
  - Mononobe Formula ba kalkulasaun intensidade udan ben, $i = \frac{R_{24}}{24}\left(\frac{24}{t_c}\right)^{0.6}$

Koleksaun dadus → Analiza udan ben → Dezeñu inundasaun → Hidrolika kanal-nakloke → Servisu protesaun

Dezeñu intensidade depende ba tempu konsentrasaun ba catchment

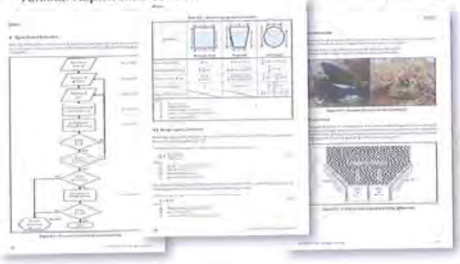


— Figure 7.8, Design intensity of rainfall for maximum probable discharge, pajina 19

Hidrolika kanal-nakloke no Servisu protesaun

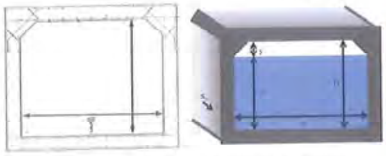
Verifika: Kapasidade dezeñu

Servisu protesaun



Dezeñu kona ba kapasidade Culvert

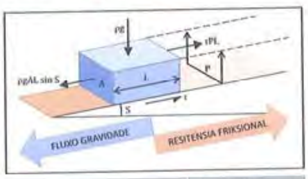
- Dezeñu kapasidade descarga ba culvert mak kalkulasaun ho Manning formula, $Q = \frac{A^{5/3} \times S_0^{1/2}}{P^{2/3} \times n}$



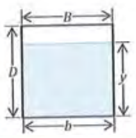
- Verifika: kapasidade dezeñu tenki bo'ot liu dezeñu inundasaun, $Q > Q_P$ ∴ suficiente ✔

Koleksaun dadus → Analiza udan ben → Dezeñu inundasaun → Hidrolika kanal-nakloke → Servisu protesaun

Manning koefisien ba roughness



Material ba culvert	Numeru Manning, n
Konkretu	
beton ne'ebe halo iha terrenu	0.015
beton ne'ebe produto fabrika nian	0.013



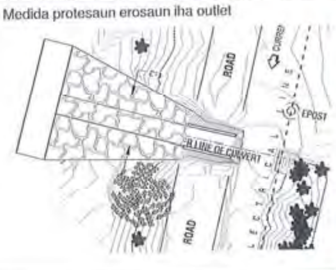
Area fluxo nian, $A = b \times y$

Keliling basah, $P = b + 2 \times y$

— Table 8.1, Recommended values of Manning number, pajina 23
— Table 8.5, Geometric properties for channels, pajina 26

Servisu protesaun

- Verifika kondisaun fluxo no nesesidade protesaun
- Medida protesaun erosaun iha outlet



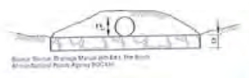
Koleksaun dadus → Analiza udan ben → Dezeñu inundasaun → Hidrolika kanal-nakloke → Servisu protesaun

Medida ba protesaun erosaun

Evaluasaun ba necesidade:

- Velocidade normal: 0.6 m/s ≤ V < 3.5 m/s
- Velocidade as: 3.5 m/s < V
  ➡ Protesaun nebe rekomenda

- Arus subcritical (Froude number < 1)
- Arus supercritical (Froude number > 1)
  ➡ Protesaun nebe rekomenda



— Section 8.4, Design capacity of culverts, pajina 27
— Section 8.5, Type of flow, pajina 28

REPUBLICA DEMOCRATICA DE TIMOR-LESTE
MINISTÉRIO DAS OBRAS PUBLICAS
DIRECÇÃO GERAL DAS OBRAS PUBLICAS
DIRECÇÃO NACIONAL DE ESTRADAS, PONTES E CONTROLO DE CHEIAS

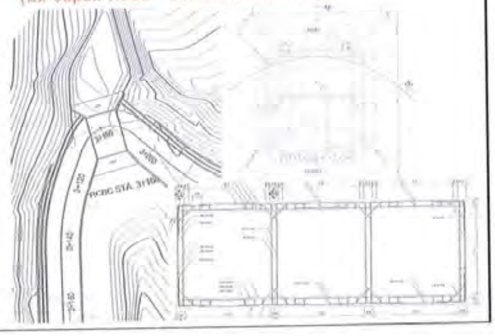
TRAINING ABOUT CULVERT DESIGN CHECK

EX-JAPAN ROAD PROJECT
SARLALA BOX CULVERT STA 3+100

BY:
MANUEL SOARES
(Department of Projects & Administration)

Lokasi nebe planu atu halo Box Culvert (Ex-Japan Road - Sarlala Sta 3+100)

Box Culvert design proposed by the contractor (Ex-Japan Road - Sarlala Sta 3+100)



Investigasaun baziku iha terrenu

Analize udan ben

	Project:	EX-JAPAN ROAD PROJECT SARLALA BOX CULVERT (CH. 3+100 KM)		Checker:	CEX
				Date:	30-Aug-18
	Title:	RAINFALL ANALYSIS		Engineer:	ITE
				Date:	28-Aug-18

- Distribuisaun Gumbel ba kalkulasaun dezenu udan ben.

$R_{24} = \mu + \sigma \times K$

Determinasaun ba klasifikasaun estrada

Estrada Rural	Estrada fora husi vila no cidade
Estrada Nasional	• [illegible] • [illegible] • [illegible]
Estrada Rejional	• [illegible] • [illegible]
Estrada Lokal	• [illegible]
Estrada Urbana	Estrada lokal iha vila no cidade [illegible]
Estrada Arterial Urbana	• [illegible]
Estrada Kolektor Urbana	• [illegible]
Estrada Lokal Urbana	• [illegible]

Preparasaun ba dadus udan ben

1) Annual maximum daily rainfall data

Table 1.1 – Annual maximum daily rainfall in Dili

Date	Annual maximum daily rainfall (mm/day)
[illegible]	110.0
[illegible]	88.0
[illegible]	65.0
[illegible]	80.0
[illegible]	58.0
[illegible]	77.0
[illegible]	100.0
[illegible]	130.8
[illegible]	91.2
[illegible]	73.0
[illegible]	98.0
[illegible]	73.0
[illegible]	67.6
[illegible]	155.6
[illegible]	73.0
[illegible]	90.0
[illegible]	87.8
[illegible]	84.8
[illegible]	146.8
[illegible]	170.0
[illegible]	58.2
[illegible]	126.7
[illegible]	113.1
[illegible]	89.3
[illegible]	88.4
[illegible]	88.6
[illegible]	58.8
[illegible]	173.6
[illegible]	58.9
[illegible]	110.1
[illegible]	83.7
[illegible]	98.7
[illegible]	93.7
[illegible]	54.8

Source: National Directorate for Water Resource Management
Source: Comoro Bridge Project

Kalkulasaun ba dezenu udan ben

2) Maximum probable daily rainfall

Gumbel distribution for maximum probable daily rainfall.

$R_{24} = \mu + \sigma \times K$
$= 91.6588 + 30.4364 \times 1.3046$
$R_{24} =$ 131.4 mm/day in Dili

Average (mean), $\mu = (110 + 88 + \ldots + 54.8) / 34$
$\mu =$ 91.6588 mm/day
Standard deviation, $\sigma = \sqrt{((110 - 91.7)^2 + (88 - 91.7)^2 + \ldots + (54.8 - 91.7)^2) / 33}$
$\sigma =$ 30.4364 mm/day

Frequency factor, $K = -\sqrt{6}/\pi \times (\gamma + \ln \ln T / (T - 1))$
$= -(\sqrt{6} / 3.1416 \times (0.5772 + \ln \ln 10 / (10 - 1)))$
$K =$ 1.3046
Pi constant, $\pi =$ 3.1416
Euler-Mascheroni constant, $\gamma =$ 0.5772
Return period, $T =$ 10 years

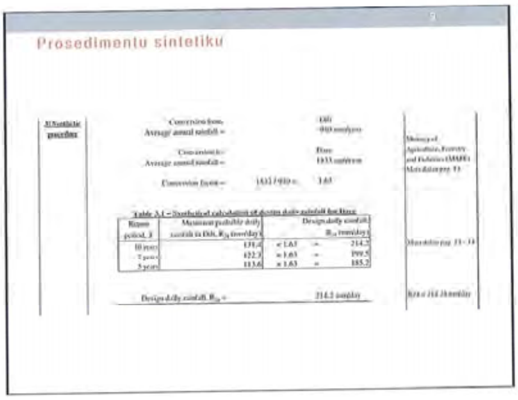
Table 2.1 – Recommended return periods of rainfall for culverts

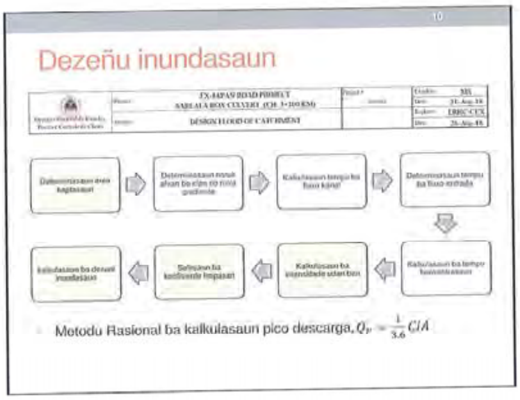
Road class	Level of drainage capacity	Return period of rainfall, T
National Roads / Urban Arterial Roads	High	10 years
Regional Roads / Urban Collector Roads	Medium	7 years
Local Roads / Urban Local Roads	Low	5 years

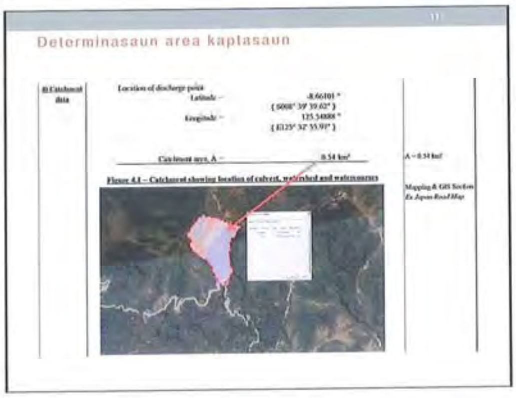
Table 2.2 – Calculation of maximum probable daily rainfall for Dili

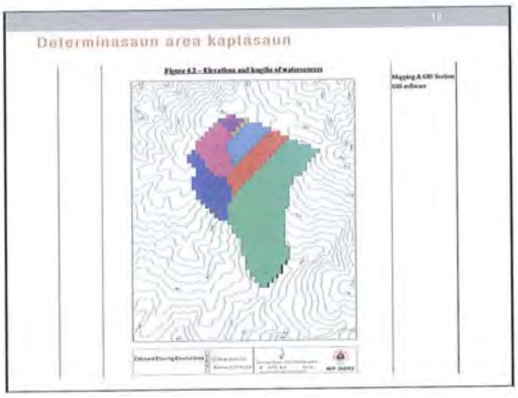
Return period, T	Frequency factor, K	Maximum probable daily rainfall, R_{24} (mm/day)
10 years	1.3046	131.4
7 years	1.0079	122.7
5 years	0.7195	113.6

Gumbel distribution
Meta data pg. 12 - 13
International Journal on Computer Science and Engineering, 2011 ISSN: [illegible]
Meta data pg. 11 Manual for Highway Earthworks, 2003; Code for the Design of Drainage of Highway Surfaces, 1994
Meta data pg. 13 - 14


9
Prosedimentu sintetiku


10
Dezeñu inundasaun
Metodu Rasional ba kalkulasaun pico descarga, Q_P = 1/3.6 CIA


11
Determinasaun area kaptasaun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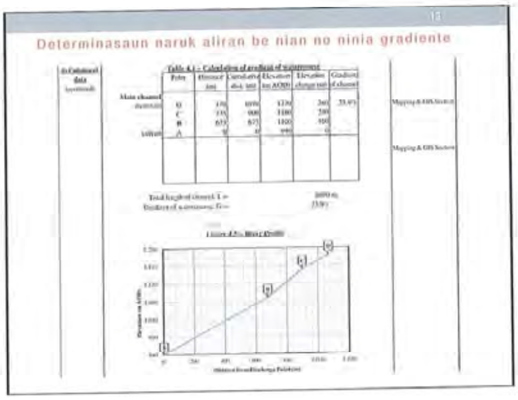
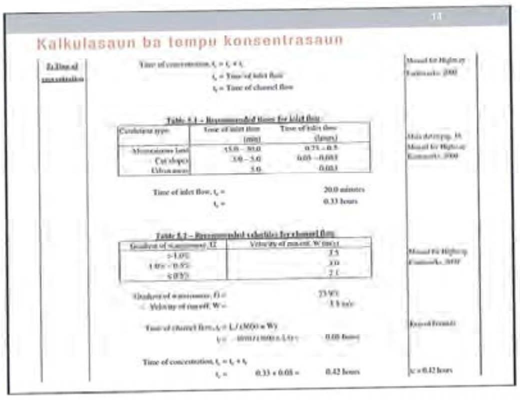
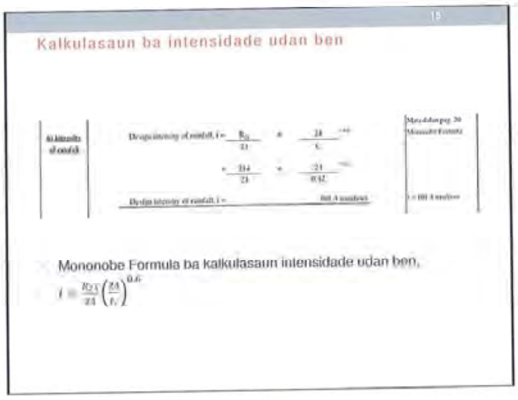
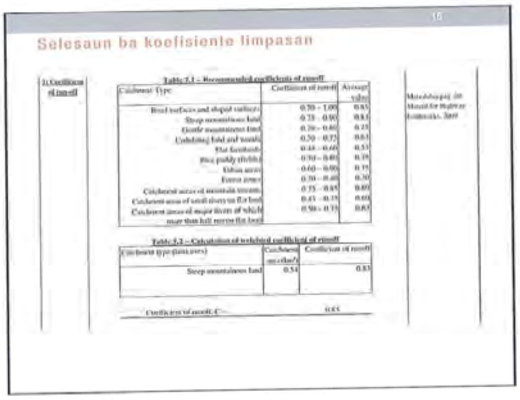
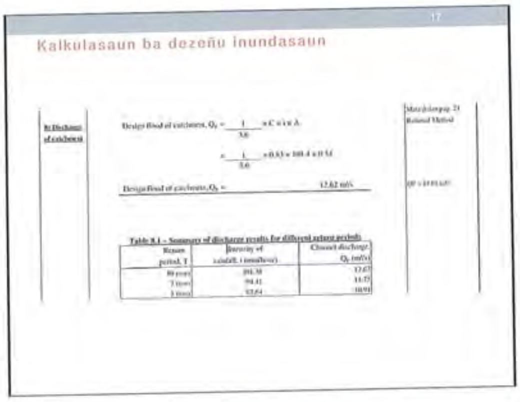
Determinasaun area kaptasaun

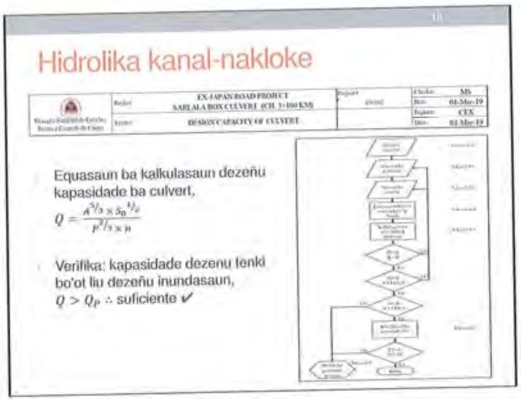

13
Determinasaun naruk aliran be nian no ninia gradiente

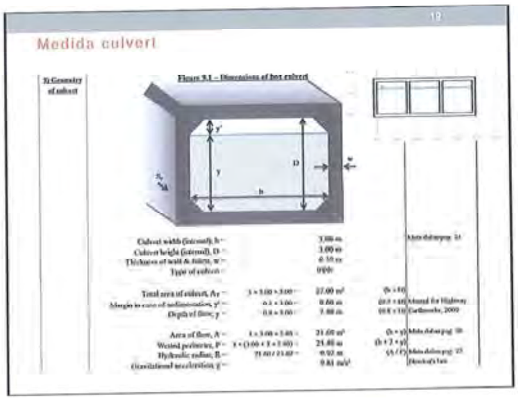

14
Kalkulasaun ba tempu konsentrasaun

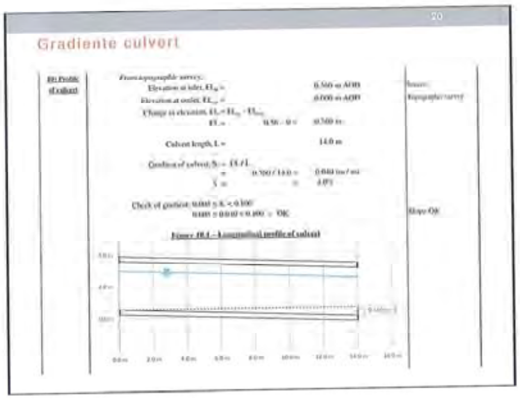

15
Kalkulasaun ba intensidade udan ben
Mononobe Formula ba kalkulasaun intensidade udan ben,

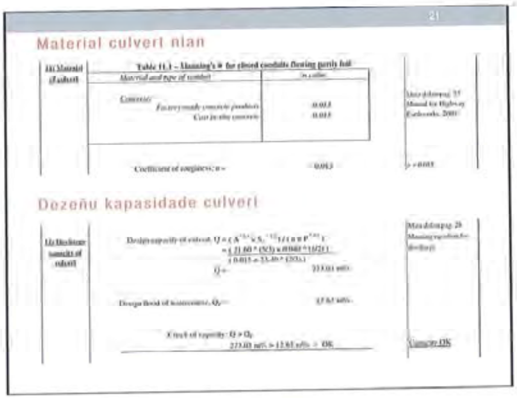

16
Selesaun ba koefisiente limpasan

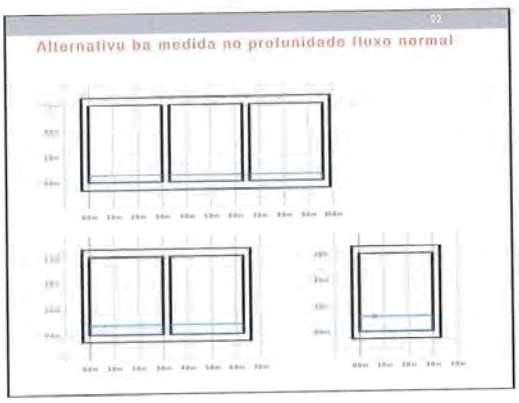

17
Kalkulasaun ba dezeñu inundasaun

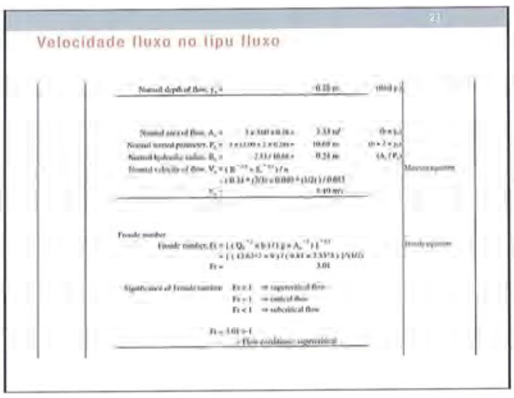

18
Hidrolika kanal-nakloke
Equasaun ba kalkulasaun dezeñu kapasidade ba culvert,
Verifika: kapasidade dezenu tenki bo'ot liu dezeñu inundasaun,
suficiente ✓

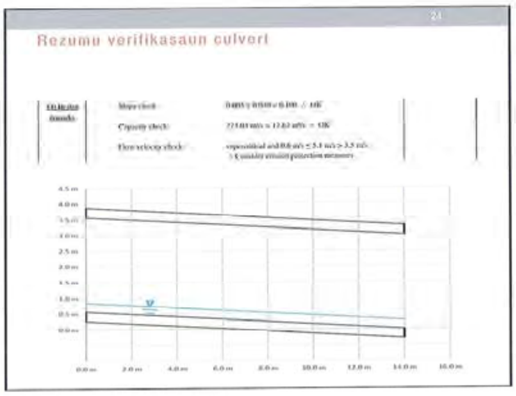

19
Medida culvert

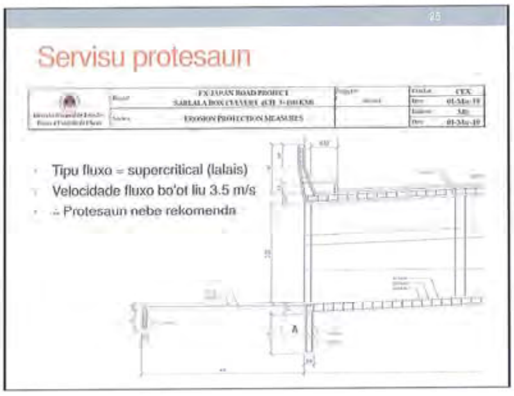

20
Gradiente culvert

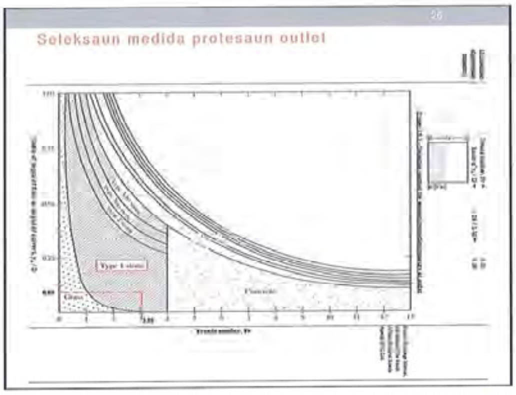

21
Material culvert nian
Dezeñu kapasidade culvert


22
Alternativu ba medida no profunidade fluxo normal

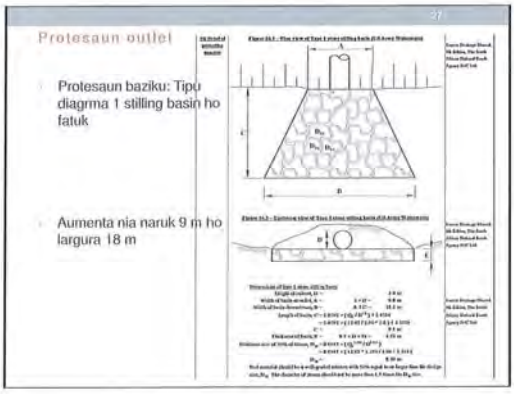

23
Velocidade fluxo no tipu fluxo


24
Rezumu verifikasaun culvert





Culvert Workshop: Case Study
14/03/2019



Attachment 4

CDRS workshop for Guideline and Checklist on 15 March 2019

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

Database for road maintenance and rehabilitation activity

Session1: Activities regarding GIS database cost estimation

Session2: IRI data activity

15th March, 2019

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC) and JICA Expert Team (JET)

Session1: Activities regarding GIS database and cost estimation

Procedure of Database activity

Step 1:
The position and point of road infrastructure facilities are input in GIS database
Method 1: The data are collected by Drive recorder and IRI application (for Good and Bad road)
Method 2: The data are collected through as built drawing for under construction road

Step2:
The inspection are conducted for collecting damaged condition

Step3:
The damaged condition data are input to GIS and estimated the budget

➢ *Step 1-a (Room and Field activity)*
The inspection are conducted for collecting basic data used by Drive recorder and IRI application, and As built drawing

Drive Recorder and IRI smartphone application

Setting in Vehicle

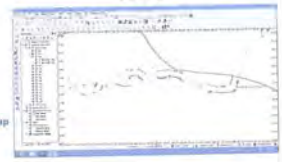
Data collection by As built drawing

➢ *Step 1-b: (Room activity)*
The basic data input to GIS Map according to the result of "Step 1"

Method1: Movie and IRI data

Input to the GIS Map

GIS Map



Method2: As built drawing

The Basic data
- Road surface condition (Movie and IRI)
- Point of the Cross culvert (Movie and as built drawing)
- Arrangement of the Retaining wall, Line drain and Guard rail(Movie and as built drawing)

➢ *Step 2: (Field activity)*
The inspection are conducted for collecting damaged condition in field

Preparation of Map for field inspection

GIS database (after "Step 2")

Export to the hard copy map

Go to the site to collect condition

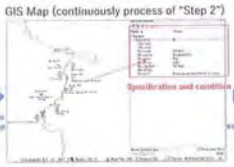
Field inspection for checking the damaged condition

➢ *Step 3: (room activity)*
The data input to GIS Map for damaged condition and estimated the budget

Result of the field inspection

Input to GIS Map

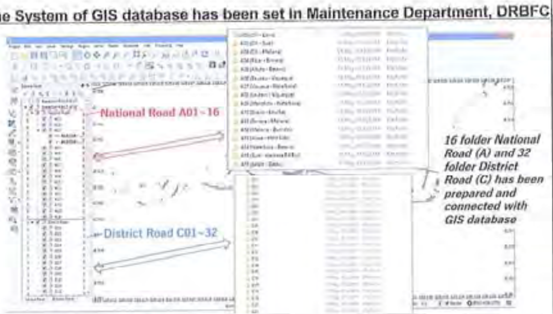
GIS Map (continuously process of "Step 2")



Cost estimation

File maker
Cost estimation system

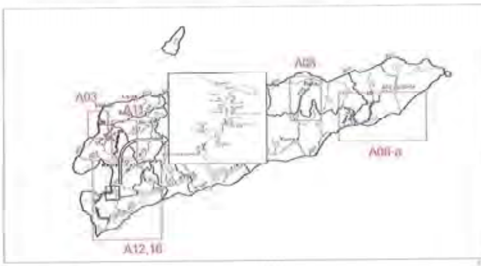
The System of GIS database has been set in Maintenance Department, DRBFC



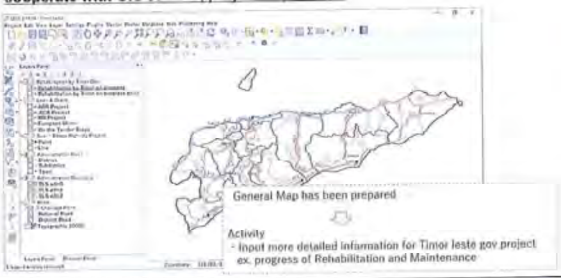
16 folder National Road (A) and 32 folder District Road (C) has been prepared and connected with GIS database

---

The Progress of GIS database for Maintenance



The GIS database for road rehabilitation progress will be prepare to cooperate with GIS section, project department



General Map has been prepared

Activity
- Input more detailed information for Timor leste gov project ex. progress of Rehabilitation and Maintenance

Session2: Introduction of IRI activity

GIS Mapping

A screen shot of android application which we developed

☆ Obrigado Barak !!

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

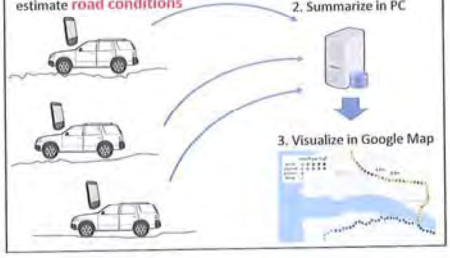
Introduction of IRI Mapping system using smartphone sensors in vehicles

15th March, 2019

Direstorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC) and JICA Expert Team (JET)

Objective of This Study

1. Collect data by **smartphone** and estimate **road conditions**



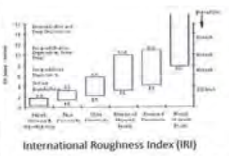
Background

Subjects of Road Condition Monitoring

Classification of
- paved
- Unpaved (gravel)
- Unpaved (earth)

Subjects of Road Condition Monitoring

Estimation of Roughness Level



Estimation of Roughness is useful method to estimate pavement condition and for national plan of road construction

IRI Data acquisition and GIS Mapping in Timor Leste

International Roughness Index (IRI)

IRI Data acquisition and GIS Mapping in Timor Leste

- The smartphone system is developed by Gifu University
  Graduate School of Natural Science and Technology, Department of Intelligence Science and Engineering, Information Science, Fukai-Lab,
- The system developer is Mr. Frederico Soares Cabral
  Faculty of Engineering, National Univ. of Timor-Leste, TIMOR-LESTE

Collaborated with CDRS Project

A screen shot of android application which we developed

Data Acquisition System

- An android application is installed in android smartphone.
- The android is fixed on the dashboard of vehicle with curing tape tightly.
- The application takes data in 100 Hz.

[Items stored by the application]

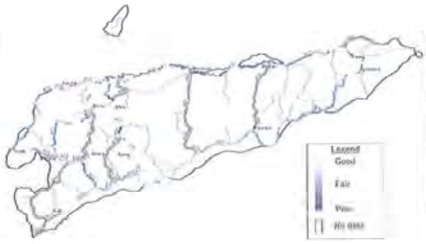
- Time stamp
- Acceleration of (x, y, z) axes
- Gyroscope of (x, y, z) axes
- GPS (Longitude, Latitude, Altitude)
- Compass

Totally 11 dimensions time series

A screen shot of android application which we developed

Setting in Vehicle

GIS Mapping

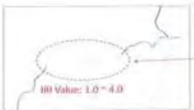


GIS Mapping

Sample of Classification in Paved Road

IRI Value: 0.0 ~ 3.0

New Paved Road

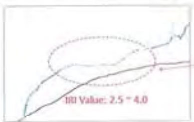


IRI Value: 1.0 ~ 4.0

Existing Paved Road

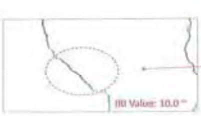
GIS Mapping

Sample of Classification in Unpaved Road



IRI Value: 2.5 ~ 4.0

Maintenanced Gravel Road



IRI Value: 10.0 ~

Earth Road

Design Guideline For Bridge Substructure Protection In Timor-Leste

15th March 2018

Presenter : Antonio De Araujo
(Department of Maintenance)
and Julius L. Kehy
(Department of Project)
NDRBFC

Outline of the Presentation

I. Introduction
II. Objective
III. Characteristics of rivers in Timor-Leste
IV. Damage of bridge substructures in Timor-Leste
V. Hydraulic phenomena around bridge pier
VI. Study of bridge substructure and scour depth
VII. Study for protection of bridge substructure
VIII. What we have to apply more and what should be resolved for future.

I. Introduction

II. Objective of the design guideline

Objective:

- To improve the design of countermeasure for bridge protection substructure from flood scour
- To reduce flood scour damage to bridge substructure in Timor-Leste

III. Characteristics of majority of Rivers in Timor-Leste

- Sources of many rivers in Timor-Leste are located in the mountainous area, at an altitude of **1000m to 2000m**
- The average annual rainfall in the northern region of Timor-Leste is approximately **1000mm to 2000mm** and in the southern region it is **1500 mm to 2000 mm**
- The length of their rivers **is short** and **share many natural characteristics with rivers in Japan**

IV. Condition of Bridges Substructure in Timor Leste

- The following figures show the scouring damage of Sahen Bridges right bank abutment and pier.

Figure 1. Sahen bridge abutment 2017

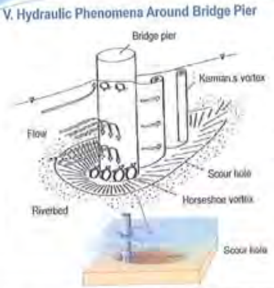
Figure 2. Sahen bridge pier 2017

- Figures 3 and 4 show the scouring damage of Mola Bridges Pier & abutment. Due to scouring damage, the caving of the footing can be seen

Figure 3. Mola bridge abutment

Figure 4. Mola bridge pier 2017

V. Hydraulic Phenomena Around Bridge Pier



- The figure shows the hydraulic phenomenon that occurs around bridge piers during flood.
- Bridge piers located in a river cause complex vortices and waves that disturb the flow and water surface during flood; as a result, an increase in water level and riverbed scouring occur

Hydraulic Phenomenal around bridge pier (Japan Example)

The figure show the state of scour on bridge pier after a flood in Japan.The flood caused a scour hole to form around the bridge pier

The figure show the actual phenomenon around a bridge pier during floods.the occurrences of complex flow around the bridges pier apparent.

VI. Study of Bridge Substructure Scour Depth

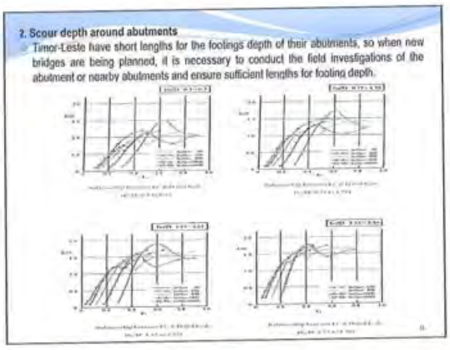
1. **Scour depth around bridge pier**

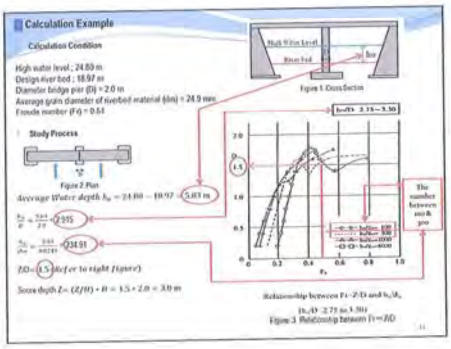
$$\frac{Z}{D}=f\cdot\left(\frac{h0}{D}\cdot\frac{h0}{dm}\cdot Fr\right)$$

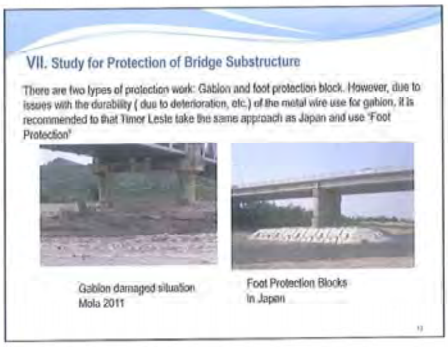
Fr : Froude number

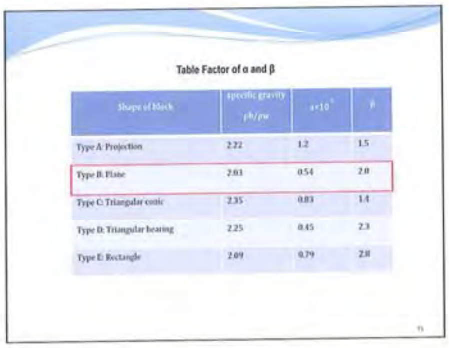
Step1
Calculate the dimensionless scour depth Z/D using the target locations average water depth h0, the diameter of bridge pier D, average grain diameter of riverbed material dm, and Froude number Fr

Step 2
The resulting Z/D should be corrected for changes in flow direction due to flooding or nearby bridge piers. After these corrections, the depth of scour hole around a bridge pier can be calculated

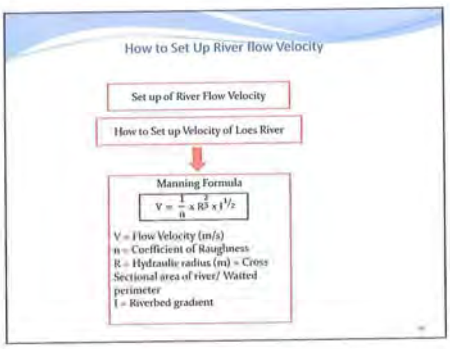


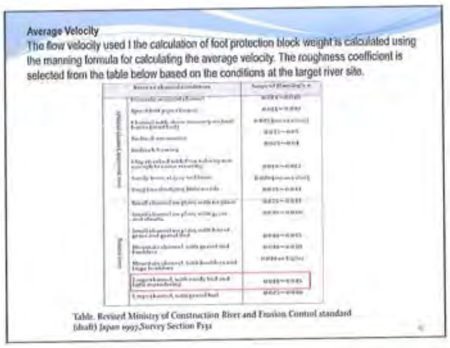


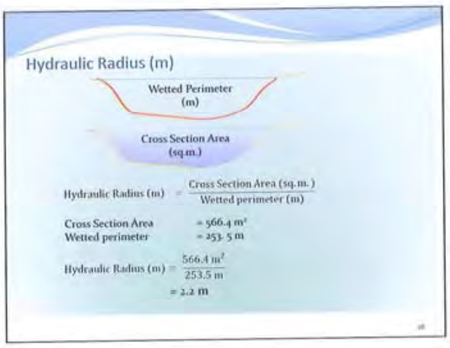




Shape of block	specific gravity ρb/ρw	α×10	β
Type A: Projection	2.22	1.2	1.5
Type B: Flate	2.03	0.54	2.0
Type C: Triangular conic	2.35	0.83	1.4
Type D: Triangular bearing	2.25	0.45	2.3
Type E: Rectangle	2.09	0.79	2.0







I: Riverbed Gradient

River bed slope=(97.3-88.95)m/1040m=0.80%

Result of Calculation

Cross section No.	No.8
n: Coefficient of roughness	0.03
S: Cross-sectional area of river (m2)	566.4
I: Rivered gradient	253.5
R: Hydraulic radius	0.008
Vm: Mean flow velocity (m/s)	5.1
Q: Discharge (m3/s)	2886.1

Calculation of weight of foot Protection blocks

The formula is used in Japan to calculate the necessary weight of foot protection blocks.

$$W \geq \alpha \left(\frac{\rho w}{\rho b - \rho w}\right)^3 \frac{\rho b}{g^2} \left(\frac{Vm}{\beta}\right)^6$$

Calculation Example for weight of foot Protection Block

- **Calculation Condition**

$W \geq \alpha \left(\frac{\rho w}{\rho b - \rho w}\right)^3 \frac{\rho b}{g^2} \left(\frac{Vm}{\beta}\right)^6$

Here

W		is the weight of foot protection block
Vm	5.1m/s	is the river velocity;
Shape	Type B	is the block type;
α	0.54	is the block factor;
β	2.0	is the block factor;
ρw	1000kg/m³	is the density of water
ρb	2030kg/m³	is the density of block
g	9.8m/s²	is the acceleration of gravity

- **Now W can be calculated as follows**

$$W = 0.54 \times \left(\frac{1000}{2030-1000}\right)^3 \times \frac{2030}{9.8^2} \times \left(\frac{5.1}{2}\right)^6$$

$W = 2872\ N$

$W = 293\ kg$

Dimension Shape of Block Plane

VII. What we have to apply more and what should be resolved for future.

What we can do at the moment is that
We prepared design and cost estimate of budget for project implementation. However, No formula and No standard as guideline to resolve bridge substructure protection, therefore, the cost estimate were not included bridge protection design.

Therefore detailed survey, detail design, detail estimate budget for bridge protection can be provided based on the guideline so we have to apply formula on each project. And the monitoring is significant for not only quality control but also feedback for design checking in maintenance department.

However it is still insufficient that requirement of engineering justification from decision maker. Hence, it maybe no budget for monitoring at the site and no arrangement for facility for engineers.
- Therefore we propose that decision maker should consider further engineering justification, and training opportunity in DRBFC.
- Regarding formwork of foot protection like Comoro No. 3 Bridge, it is needed to obtain formwork with its royalty, so DRBFC should keep one set of the form work at least.

24

Introduction of Road Guidelines
Slope Protection
Retaining Wall and Slope Collapse

Workshop of CDRS
15th March. 2019
Project Dep. Sabino de J. Lobato

Contents

Annex

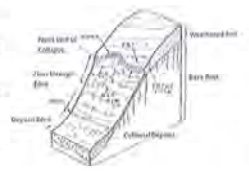
Annex A How to Use the Total Station
Annex B How to Use the Dokenbo
Annex C Excel Worksheets for Stability Calculation of Gravity Retaining Wall
Annex D Excel Worksheets for Slope Stability Calculation
Annex E Design Example of Catch Wall

Investigation of Ground Shape

- Design must stand on actual surveyed cross section at least.
- Total Station makes cross section survey easy.

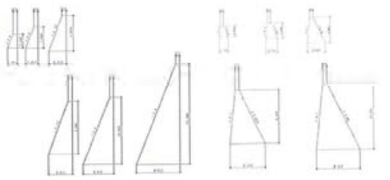
How to Obtain Geological Information

① Geomorphologic approach
② Surficial geological observation
③ Mechanical boring and standard penetration test
④ Other penetration test Dokenbo

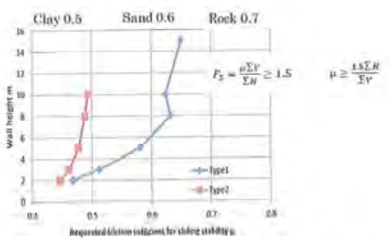


Dokenbo

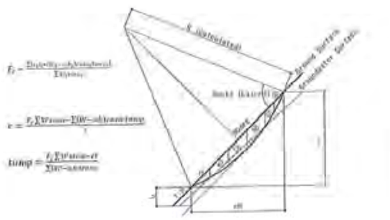
Gravity Retaining Wall in the Common Drawings



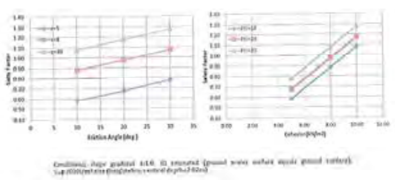
Sliding Condition



Slope Stability Calculation



Influence of Shear Strength to the Safety Factor



Thank You for Your Attention!

REPUBLICA DEMOCRATICA DE TIMOR-LESTE
MINISTÉRIO DAS OBRAS PÚBLICAS
DIRECÇÃO GERAL DAS OBRAS PÚBLICAS
DIRECÇÃO NACIONAL DE ESTRADAS, PONTES E CONTROLO DE CHEIAS

EXPLANATION ABOUT GUIDELINE FOR CULVERT PLANNING & DESIGN

BY:

CELESTINO E. XIMENES (Department of Highways)

Generalidade proposito ba culvert

(General purpose of a culvert)

- Objectivo husi design drainajem atu garante capacidade drainajem nebe apropriado ba facilidade drainajem nian, nebe signifika katak culvert nian spesifikasi suficiente atu akumula kemungkinan volume be'e husi limpasan no kusto konstrusaun nebe razoavel compara ho ninia benefisiu no aktividade economia. ("The purpose of drainage design is to ensure reasonable capacity of drainage facilities, which means specifying culverts with sufficient drainage capacity to accommodate probable volumes of stormwater and at reasonable construction costs compared to their benefit to economic activities.")
- Iha kontekstu hakur estrada, objectivo husi box culvert atu garante protesaun ba estrada nia estrutura no ba sira nebe usa estrada. ("Within the context of road crossings, the purpose of box culverts is to ensure the protection of road structures and road users.")

— Introduction, pajina vii

Atividade fundamental no dezenvolvementu

Kondisaun atual
- Manual dezeñu ponte ne'ebe eziste
- Controllu capacidade culvert ne'ebe mak raramente implementa
- Inundasaun no limpasan akontese durante udan bo'ot
- Estrutura estrada sai estragado

Solusaun
- Acquisição ba koñesementu liu husi treinamentu prática planeamentu & dezeñu
- Esperensia dezeñu liu husi realiza estudu caso ba culvert iha Estrada A05 besik sesurai no Estrada Ex-Japan besik sarlala
- Dezenvolve matadalan tecnica ba planoamento no dezeñu culvert iha Timor-Leste

Rationale and development activities

Present condition
- Bridge Design Manual exists
- Checks for culvert capacity are seldom implemented
- Flooding and overtopping occur during heavy rains
- Roads structures become damaged

Solution
- Acquisition of knowledge through practical training for planning & design
- Experience of design through conducting case studies of culverts on A05 near Sesurai & Ex-Japan Road near Sarlala
- Development of a technical guideline for culvert planning & design in Timor-Leste

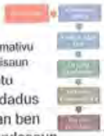
Mata Dalan Estrada — Drenajem — Dezeñu Culvert

- CDRS fornese esbosu matadalan iha Juñu 2018
- Rekolla komentáriu
- DNEPCC finaliza matadalan iha Setembru 2018
- CDRS tradús matadalan ba Tetun iha Novembru 2018 (la ofisial – hanesan referensia deit)

Road Guidelines — Drainage — Culvert Design

- CDRS provided draft guideline in June 2018
- Collection of feedback
- DNEPCC finalised guideline in September 2018
- CDRS translated guideline into Tetun in November 2018 (unofficial – for reference only)

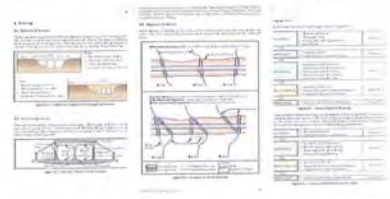
Konteudu mata dalan



Contents of guideline

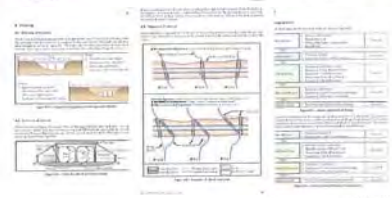
Planeamentu

- Baziku
- Aplikasaun no Aliñamentu
- Vizaun jerál kona ba prosesu dezeñu



Planning

- Basics
- Application and Alignment
- Design process overview



Planeamentu: limitasaun nebe recomenda ba structura culvert

Property	Minimum	Maximum
Altura do caixa (interno), D Tinggi gorong-gorong	0.75 m (750 mm)	5.0 m (5000 mm)
Largura (interna), B Lebar	0.45 m (450 mm)	6.5 m (6500 mm)
Kedalaman material leke ne to iha culvert nia placa	0.5 m (500 mm)	—
Perbandingan (D : B) (Perbandingan)	1 : 1	1 : 3
Gradiente / Kemiringan ba culvert	0.005 m/m (0.5%)	0.100 m/m (10%)

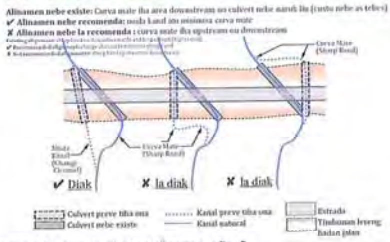
— Table 4.1, Recommended limits for a concrete box culvert, pajina 4

Planning: recommended limits for a concrete box culvert

Property	Minimum	Maximum
Height, D	0.75 m (750 mm)	5.0 m (5000 mm)
Width, B	0.45 m (450 mm)	6.5 m (6500 mm)
Cover depth (of material) above top plate	0.5 m (500 mm)	—
Proportion (height : width)	1 : 1	1 : 3
Gradient of culvert	0.005 m/m (0.5%)	0.100 m/m (10%)

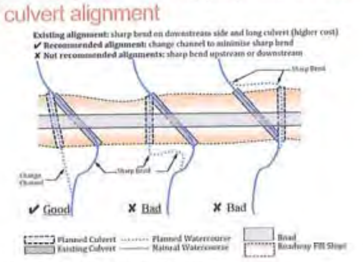
— Table 4.1, Recommended limits for a concrete box culvert, page 4

Planeamentu: proposta apropriado liu ba muda culvert nian alinamen



— Figure 4.4, Examples of culvert alignment, pajina 5

Planning: propose an appropriate change of culvert alignment



— Figure 4.4, Examples of culvert alignment, page 5

Prosesu dezeñu

Koleksaun dadus (Data collection)	Informasaun kondisaun bazika iha Terrenu (Fatin); Dadus Topografiku; Dadus mapa / dadus geospatial; Dadus udan ben	Section 5
Analiza dadus udan ben (Rainfall analysis)	Analiza Frekuensia; Kalkulasaun udan ben diaria ba design	Section 6
Kalkulasaun ba inundasaun (Flood calculation)	Kalkulasaun ba catchment area; Kalkulasaun ba tempu konsentrasaun; Kalkulasaun ba udan ben nian intensidade; avaliasaun coeficien Llupasaun; Kalkulasaun debit banjir	Section 7
Saluran terbuka hydraulic (Open-channel hydraulics)	Seleksaun ba Culvert nia dimensaun; Kalkulasaun capacidade culvert ba debit air; Kalkulasaun ba tipe arus no velocidade ba nian	Section 8
Servisu Protesaun (Protection works)	Seleksaun ba medida protesaun no dimensaun	Section 9

– Figure 4.5, Outline of process for design, pajina 6

Design process

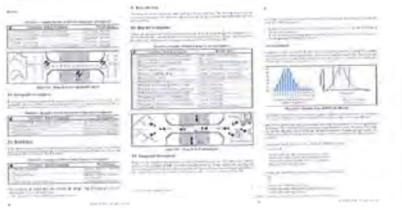
Data collection	Basic site information; Topographic data; Cartographic (map) / geospatial data; Rainfall data	Section 5
Rainfall analysis	Frequency analysis; Calculation of daily rainfall for design	Section 6
Flood calculation	Calculation of catchment area; Calculation of time of concentration; Calculation of rainfall intensity; Assessment of run-off coefficient; Calculation of flood discharge	Section 7
Open-channel hydraulics	Selection of culvert size; Calculation of culvert capacity for discharge; Calculation of flow type and velocity	Section 8
Protection works	Selection of protection measure and size	Section 9

– Figure 4.5, Outline of process for design, page 6

CDRS Workshop: Culvert Guideline 15/03/2019

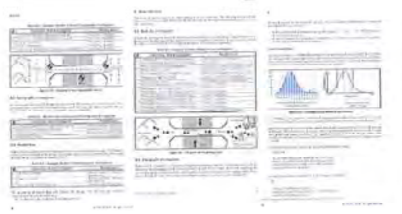
Koleksaun dadus no Análize udan ben

- Lista verifikasaun iha terrenu
- Análiza frekuensia



Data collection and Rainfall analysis

- Site checklist
- Frequency analysis



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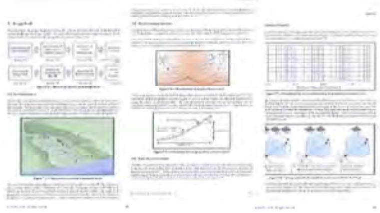
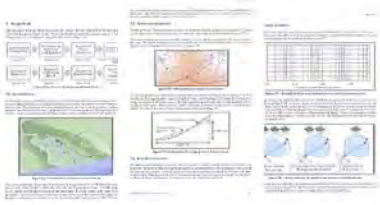
Dezeñu inundasaun

- Metodu Rasional



Design flood (calculation of runoff)

- Rational Method



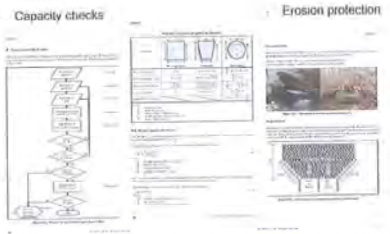
CDRS Workshop: Culvert Guideline 15/03/2019

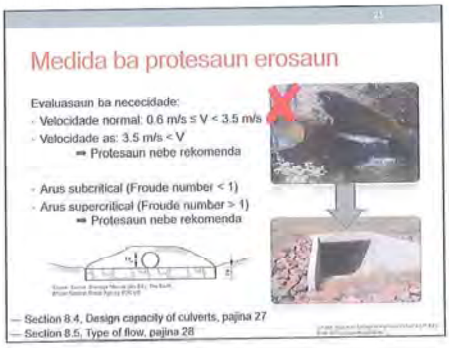
Hidrolika kanal-nakloke no Servisu protesaun

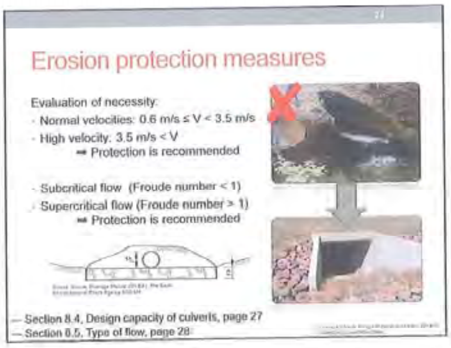
- Verifika: Kapasidade dezeñu
- Servisu protesaun

Open-channel hydraulics & Protection works

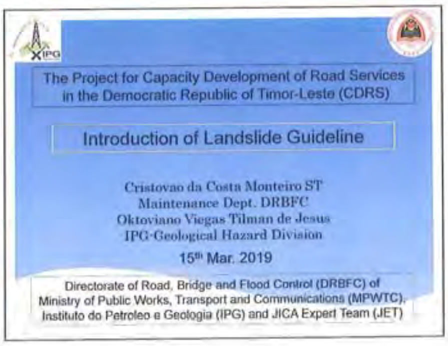
- Capacity checks
- Erosion protection

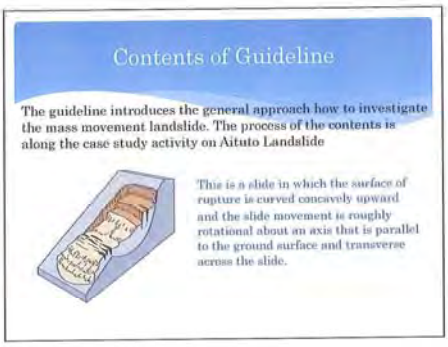


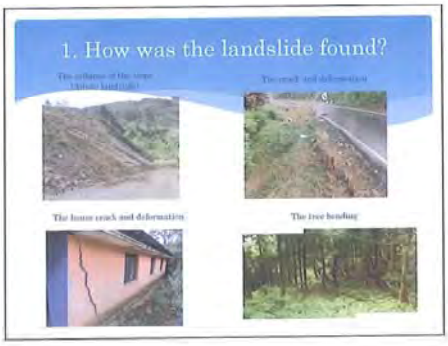

Medida ba protesaun erosaun
Evaluasaun ba nececidade:
· Velocidade normal: 0.6 m/s ≤ V < 3.5 m/s
· Velocidade as: 3.5 m/s < V
➡ Protesaun nebe rekomenda
· Arus subcritical (Froude number < 1)
· Arus supercritical (Froude number > 1)
➡ Protesaun nebe rekomenda
— Section 8.4, Design capacity of culverts, pajina 27
— Section 8.5, Type of flow, pajina 28

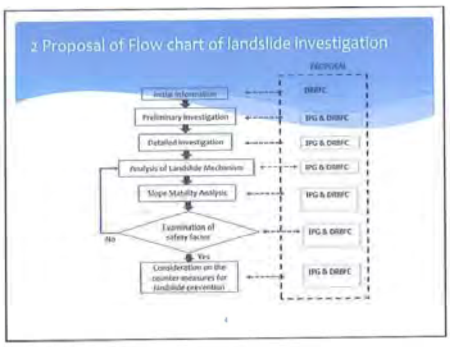

Erosion protection measures
Evaluation of necessity:
· Normal velocities: 0.6 m/s ≤ V < 3.5 m/s
· High velocity: 3.5 m/s < V
➡ Protection is recommended
· Subcritical flow (Froude number < 1)
· Supercritical flow (Froude number > 1)
➡ Protection is recommended
— Section 8.4, Design capacity of culverts, page 27
— Section 8.5, Type of flow, page 28


OBRIGADU


The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)
Introduction of Landslide Guideline
Cristovao da Costa Monteiro ST
Maintenance Dept. DRBFC
Oktoviano Viegas Tilman de Jesus
IPG-Geological Hazard Division
15th Mar. 2019
Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC), Instituto do Petroleo e Geologia (IPG) and JICA Expert Team (JET)

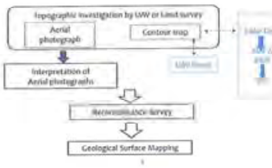

Contents of Guideline
The guideline introduces the general approach how to investigate the mass movement landslide. The process of the contents is along the case study activity on Aituto Landslide
This is a slide in which the surface of rupture is curved concavely upward and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide.


1. How was the landslide found?
The house crack and deformation
The tree bending


2 Proposal of Flow chart of landslide investigation
PROPOSAL
Initial Information
Preliminary Investigation
Detailed Investigation
Analysis of Landslide Mechanism
Slope Stability Analysis
Examination of safety factor
No
Yes
Consideration on the counter measures for landslide prevention
DRBFC
IPG & DRBFC

Proposal of Preliminary investigation

The overall topographic feature of the site slopes
- Understanding the topographic characteristic of the site slope
- Estimating the regional geologic structure of the site



1. Preliminary investigation

1 Topographic investigation

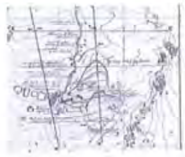
Purposes of the topographic investigation are to recognize
(1) The overall topographic feature of the site slopes
(2) Understanding the topographic characteristics of the site slope
(3) Estimating the regional geologic structure of the site

Creating a topographical map

1. Preliminary investigation

2 Field investigation

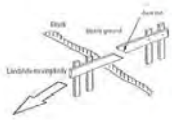
Purposes of the field investigation are to
(1) Understand the aerial extent and a general direction of movement of the landslide
(2) Assess the geology and geologic structure
(3) Estimate the cause of the sliding
(4) Predict future movement



2. Detailed investigation

Detailed investigation should be planned by selecting appropriate investigation methods and instruments.

Simple method to measure movement

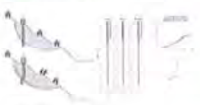


Drive stakes across a tension crack along the direction of movement. Then attach horizontal board to the stakes, and saw through the board. Any movement across the tension crack can be determined by measuring the space between the sawed portion of the board.

2. Detailed investigation

Inclinometer Measurement

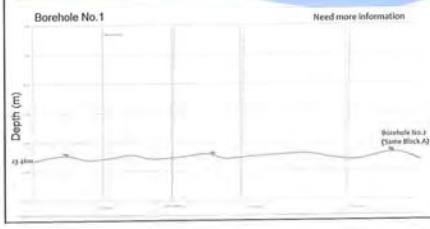
To detect displacement of the sliding mass, monitoring with the inclinometer is the useful tool. Measurement the inclination of casings with the inclinometer should be performed periodically, and the cumulative displacement of the casing should be analyzed to detect the depth of the surface of rupture.



Inclinometer Location

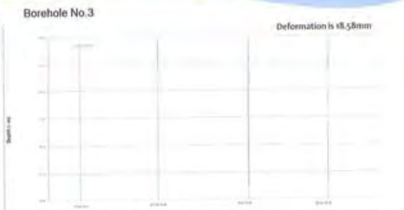
2. Detailed investigation

Inclinometer Measurement

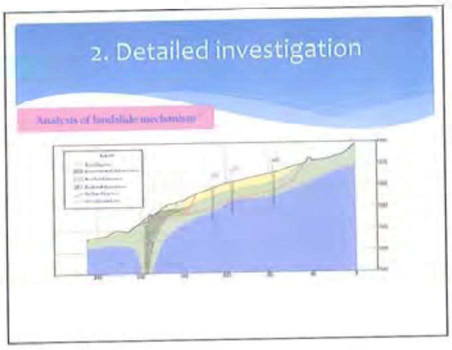


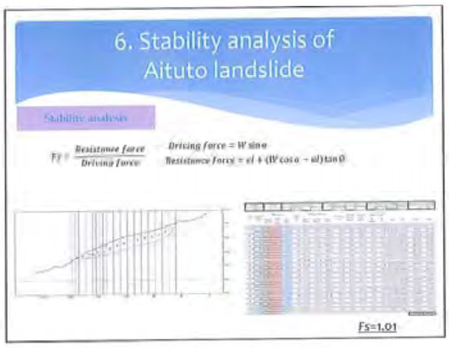
2. Detail Investigation

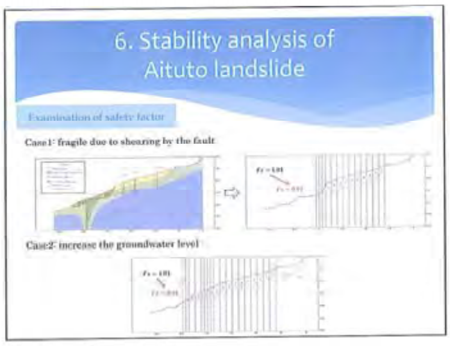
Inclinometer Measurement

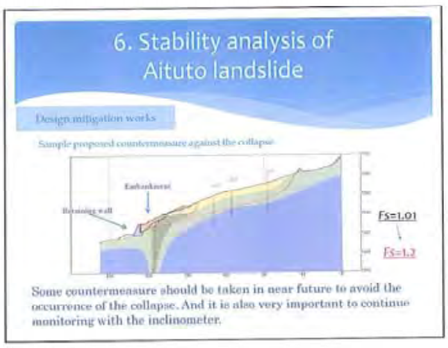



2. Detail Investigation
Inclinometer Measurement
Borehole No.4
No Deformation


2. Detailed investigation
Analysis of landslide mechanism


6. Stability analysis of
Aituto landslide
Stability analysis
Fs = Resistance force / Driving force
Driving force = W sin α
Resistance force = cl + (W cos α − ul) tan ϕ
Fs=1.01


6. Stability analysis of
Aituto landslide
Examination of safety factor
Case1: fragile due to shearing by the fault
Case2: increase the groundwater level


6. Stability analysis of
Aituto landslide
Design mitigation works
Sample proposed countermeasure against the collapse
Embankment
Retaining wall
Fs=1.01
Fs=1.2
Some countermeasure should be taken in near future to avoid the occurrence of the collapse. And it is also very important to continue monitoring with the inclinometer.


Obrigado barak
ba
atensaun!

Attachment 5

5^{th} Joint Coordinating Committee on the project for the Capacity Development of Road Services (CDRS) on 19 March 2019

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

		By	Time
1	Opening speech	MOP	9:30-9:40
2-1	Project activities up to date	JICA Expert Team	9:40-10:00
2-2	Database for road maintenance and rehabilitation activities	Maintenance Department NDRBFC	10:00-10:15
2-3	Checklist for construction	Construction Department NDRBFC	10:15-10:35
2-4	Technical guidelines	JICA Expert Team	10:35-10:40
2-5	Report on Workshop	JICA Expert Team	10:40-10:50
3	Evaluation of project and review of project activities plan	JICA Expert Team	10:50-11:10
4	Open discussion for the Project	All	11:10-11:40
5	Comments by JICA	JICA Representative	11:40-11:50
6	Conclusion and Closing remarks by MOP	MOP	11:50-12:00

The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

5th JCC
March 2019

Ingerosec Corporation
Earth System Science Co., Ltd.

Contents

1. **Project outline**
2. **Project activities up to date**
   1. **Case studies**
   2. **Database**
   3. **Checklists**
   4. **Guidelines**
   5. **Workshop**
3. **Evaluation of project and review of project activity plan**

1. Project Outline

Project Target and Outputs

Item	Description
Project Title	The Project for the Capacity Development of Road Services (CDRS)
Project Duration	March 2016~December 2019 (45 month)
Project Site	Whole National Roads in Timor-Leste
Implementing Agency	Ministry of Public Works, Transport and Communications (MPWTC)
Target Group	Directorate of Road, Bridge and Flood Control (DRBFC)
Overall Goal	The maintenance conditions of major roads are improved in TL.
Project Purpose	Capacity of DRBFC for maintenance of major roads in the whole country is enhanced
Outputs	1. Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and budget plan 2. Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country 3. Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection

Project Outputs and Indicators

<OUTPUT 1> Improve Road Maintenance Cycle

1-1. Over 30% of requested budget for road maintenance are distributed.
1-2. Improved road database is utilized for preparing the annual work plan of road maintenance.

<OUTPUT 2> Improve Capacity of DRBFC Construction Management for maintenance and rehabilitation

<Indicator in 2019>
2-1. At least 6 case studies for construction and for design are conducted.
2-2. Over 60 % of trainees pass the achievement test for construction supervision and design.

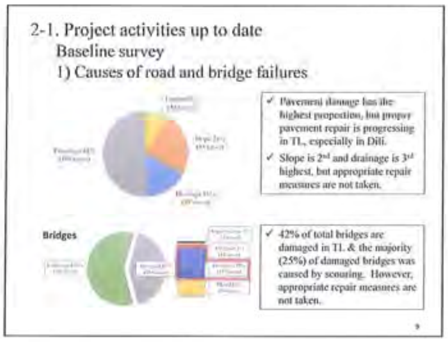
<OUTPUT 3> Technical guideline of investigation and design

<Indicator in 2019>
Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.

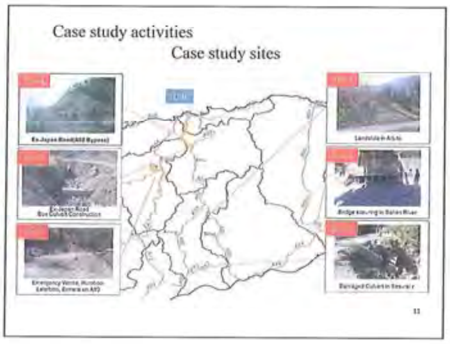
<Overall Goal>
The maintenance conditions of major roads are improved in TL.

<Indicator in 2022 (3 years after project completion)>
More than 60% of major national roads are in good condition.

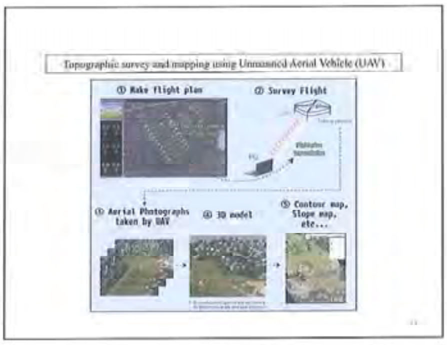
2. Project activities up to date


2-1. Project activities up to date
Baseline survey
1) Causes of road and bridge failures
✓ Pavement damage has the highest propotion, but proper pavement repair is progressing in TL, especially in Dili.
✓ Slope is 2nd and drainage is 3rd highest, but appropriate repair measures are not taken.
Bridges
✓ 42% of total bridges are damaged in TL & the majority (25%) of damaged bridges was caused by scouring. However, appropriate repair measures are not taken.
9

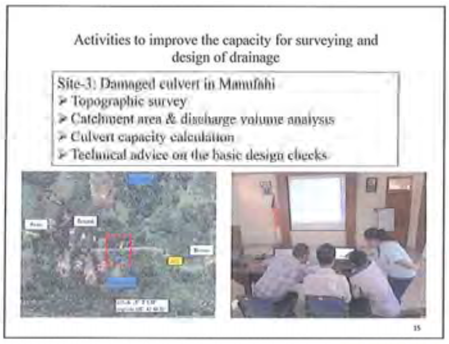

2) Cases of road and bridge failures
Pavement failure on A05 due to the lack of roadside ditch
Cut & embankment slope failure on A02 due to the heavy rain and lack of slope protection
Embankment slope failure on A07 due to the unsuitable foundation material and lack of compaction
Scouring of bridge substructure on A14 due to severe river flow and lack of protection
10


Case study activities
Case study sites
11


Activities to improve the capacity for surveying and design of slope protection
Site-1: Landslide in Aituto
➢ Geotechnical boring and topographic survey
➢ Monitoring of slope mass movement
➢ Analysis of field survey data
➢ Propose appropriate and applicable measures
12


Topographic survey and mapping using Unmanned Aerial Vehicle (UAV)
① Make flight plan
② Survey Flight
③ Aerial Photographs taken by UAV
④ 3D model
⑤ Contour map, Slope map, etc...


Activities to improve the capacity for surveying and design of protection against bridge scour
Site-2: Bridge scouring in Manatuto
➢ Topographic survey
➢ River flow analysis
➢ Propose appropriate or applicable measures
➢ Technical advice on basic design
14


Activities to improve the capacity for surveying and design of drainage
Site-3: Damaged culvert in Manufahi
➢ Topographic survey
➢ Catchment area & discharge volume analysis
➢ Culvert capacity calculation
➢ Technical advice on the basic design checks
15


Activities to improve the capacity of construction management for maintenance and rehabilitation
Site-4: Construction supervision on Ex-Japan Road
➢ Quality control
➢ Progress control
➢ Safety control
16

Activities to improve the capacity for design of drainage and the capacity of construction management

Site-5: Box culvert planning, design and construction supervision on Ex-Japan Road
- Check of box culvert size
- Construction supervision using "Checklist"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Activities to improve the capacity of construction management for maintenance and rehabilitation

Site-6: On-the-job training for construction supervision on Emergency Works site on A10, Humboe-Letefoho, Ermera
- Quality control using "Checklist"
- Safety control using "Checklist"


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2-2. Database of maintenance activities

Database for road maintenance and rehabilitation activities

Session1: Activities regarding GIS database and Cost estimation

Session2: IRI data activity

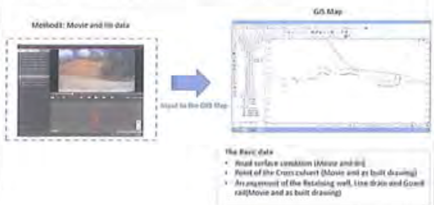
Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC) and JICA Expert Team (JET)

19

Session1: Activities regarding GIS database and cost estimation

- Step 1: (Preparation activity)

The basic data will be input to GIS Map from Drive Recorder



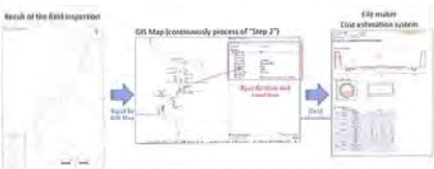
The Basic data
- Road surface condition (Movie and iri)
- Point of the Cross culvert (Movie and as built drawing)
- Arrangement of the Retaining wall, Line drain and Guard rail(Movie and as built drawing)

- Step 2: (Field activity)

The inspection are conducted for collecting damaged condition in field

- Step 3: (Data input activity)

The data input to GIS Map for damaged condition and estimated the budget



The Progress of GIS database for Maintenance

Basic data information used by drive recorder will be conducted for maintenance necessity road until June,2019

21

GIS database of road rehabilitation progress prepared by GIS section, project department

General Map has been prepared

Activity
- GIS database of Rehabilitation progress for Timor Leste Gov. project will be added until June, 2019

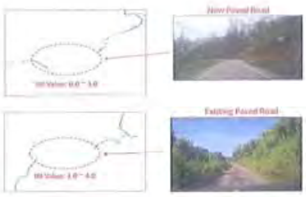
Introduction of IRI activity

GIS Mapping

A screen shot of android application which we developed

GIS Mapping

Sample of Classification in <u>Paved Road</u>



GIS Mapping

Sample of Classification in <u>Unpaved Road</u>

System proposal for IRI Data acquisition and GIS Mapping in the future

- The smartphone system is developed by Gifu University
- The system developer is Mr. Frederico Soares Cabral

<u>Proposal:</u>
This activity will be Collaborated with DRBFC

A screen shot of android application which we developed

2-3. Checklist of construction

Checklist for Construction

Eng. Nazario Da Jesus Freitas,
Construction Department, DRBFC

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works (MOP) and JICA Expert Team (JET)

<u>Content of presentation</u>
<u>for "Checklist for Construction (CL)"</u>

1. Objective of Checklist for Construction
2. Application of CL work item & user
3. Content of CL _ March 2019
4. Report of On-the-Job Training (OJT) using CL
5. Finalizing and Dissemination of CL

1. Objective of Checklist for Construction

One of objective of the CDRS Project is <u>the improvement of</u> capacity of DRBFC <u>construction management</u> for maintenance and rehabilitation Works.

<u>There is lack of the tool</u> like a "Checklist for Construction", effective references, <u>for daily supervising works on sites</u>.

So, "Checklist for Construction" has been drafted and issued for an effective small booklet, <u>as simple technical navigation and one of supporting</u> material, for construction supervising on the site.

2. Application of CL work item & user

CL consists of three fields ; I. Quality Control (QC), II. Safety and III. Construction Management

1) <u>*Checklists for QC*</u> is very simple and focusing <u>essential check point on the site</u>. So even junior staff of the Works can be use it and can instruct the Contractor properly and easily.
2) <u>*Checklist for Safety*</u> can be used by <u>**all personnel**</u> who are engaged and responsible <u>for construction works</u>.
3) <u>*Checklist for Construction Management*</u>, they are used when <u>"Procurement"</u> of the Works and <u>"Evaluation"</u> for the works accomplished are required to DRBFC officers according to the Contract

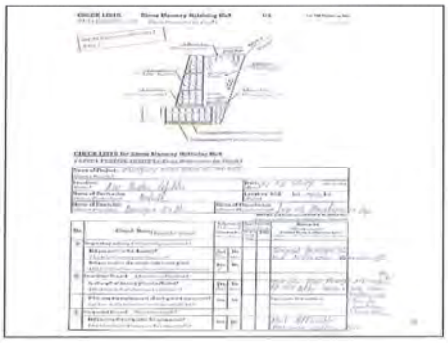
3. Content of CL _ Version-2

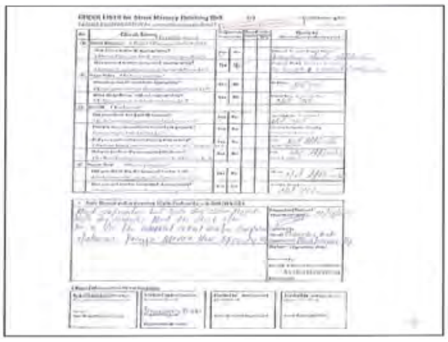
4. Report of On-the-Job Training (OJT) using CL

Ph1: STA0+300 A10 from Humboe JCT, Stone Masonry Retaining Wall is constructing.

Ph2: Ditto but using, CL(Checklist)_SM Retaining Wall sheets. Inspecting according to each "check item" of the sheet.

OJT (1), using "Checklist for Construction" by DRBFC's Trainer on Emergency Works, A10 Ermera





Using "Checklist for Safety Patrol" on the occasion of C/S Safety Patrol by DRBFC and the contractors

Ph-3: 2nd Safety Patrol by site Safety Committee, including Contractor in charge of the works, using Checklist for "Safety Patrol" : Inspection site: STA 7 – 8km of Ex-Japan Road, Stone Masonry Retaining Wall

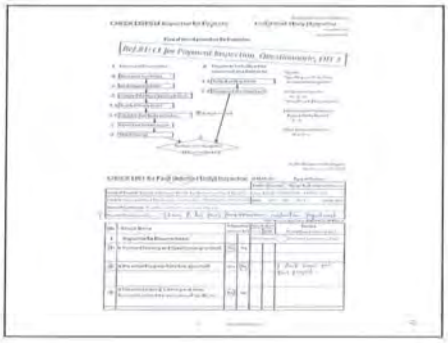
Ph-4: Ditto but inspection site ②: STA 6+270 , RC double Pipe Culvert, half of the road open to Public Traffic.

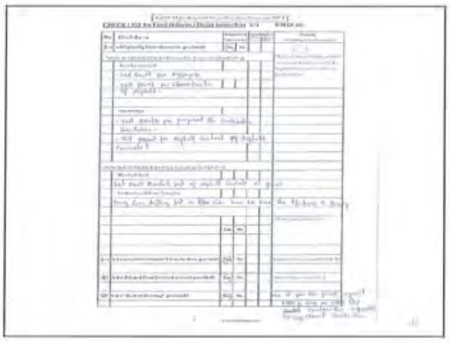
Member of pilot "Site Safety Committee"

Usage of "Checklist for inspection/evaluation for the works done(accomplished works in progress)" in work-shops

Ph5: Using Checklist of Inspection for the works done, evaluating how the works has accomplished in case of Emergency Works and one section of Ex-Japan Road in Works Shop on October 2018.

Ph6: All participants exercise to fill / write on to the blank Checklist sheet as same as the demonstration in OJT (3), Demonstration for usage of "Checklist of Inspection for the works done on 07 March 2019





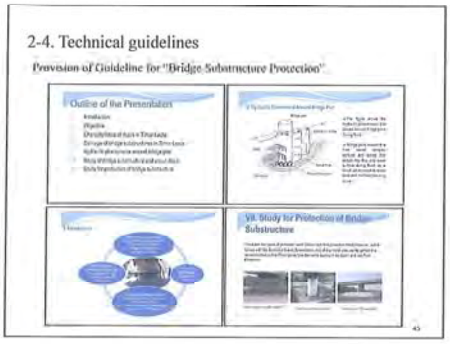
5. Finalizing and Dissemination of Checklist

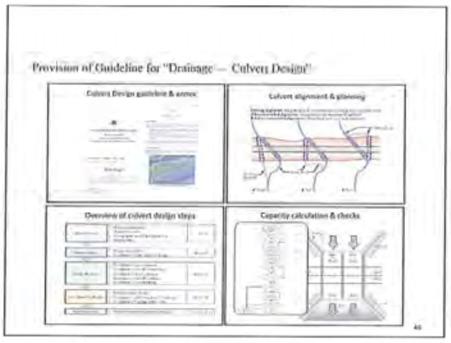
Finalizing of Checklist

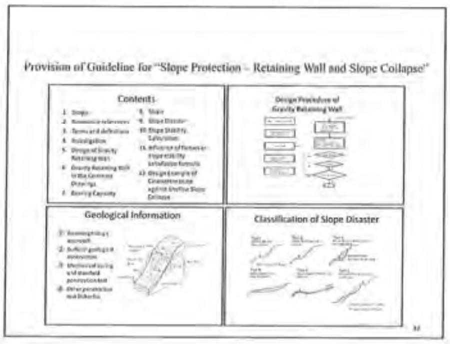
1) To make it more understandable List on the site supervision, description by Tetun words would be added
2) After feedback from practice / OJT of using "Checklist for Construction", it will be brushing up for updated Version of "Checklist"
3) Updated Checklist for Construction will be issued on September 2019

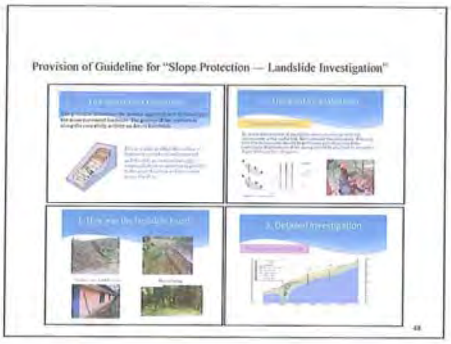
Dissemination of Checklist

1) In order to feedback for brushing up the "Checklist for Construction", as many practices / OJTs of using CL as possible are required.
2) Practical making use of "Checklist for Construction" are expected for improvement of supervising works on construction site
3) Not only DRBFC staff but also other personnel related to construction supervision may use this Checklist









2-5. Report on Workshop
Overview

- Purpose:
Dissemination of information about CDRS database, checklists and guidelines

- Activity:
One-day workshop of presentations and discussions in ETDA, Dili

- Reach:
Total participants = 58, including
  - 10 municipal directors
  - 3 municipal officers
  - 5 university / education staff (UNPAZ / DIT)
  - 5 donor program officers (ILO / R4D-SP / ERA-AF)
  - 2 public institute staff (IPG)
  - 8 interns / new graduates

2-5. Report on Workshop
Agenda

I. Database for road maintenance and rehabilitation
II. Introduction of IRI application
III. Checklist for Construction
IV. Guideline for *Bridge Substructure Protection*
V. Guideline for *Drainage - Culvert Design*
VI. Guideline for *Slope protection – Retaining wall and Slope Collapse*
VII. Guideline for *Slope protection – Landslide investigation*

2-5. Report on Workshop
Opening speech

by Nene Lobato
Chief of Department of Training and External Cooperation, DRBFC

2-5. Report on Workshop
Database for road maintenance and rehabilitation

Presentation by Department of Projects & Administration, DRBFC / CDRS Expert

Discussion with participants: UNPAZ (university)

2-5. Report on Workshop
Checklist for Construction

Presentation by Department of Maintenance & Conservation, DRBFC

Discussion with participants: municipal director

2-5. Report on Workshop
Guideline for Bridge Substructure Protection

Presentation by Department of Maintenance & Conservation / Project & Administration, DRBFC

Discussion with participants: DIT (higher education institute)

2-5. Report on Workshop
Guideline for Drainage - Culvert Design

Presentation by Department of Highways, DRBFC / CDRS Expert

Discussion with participants: municipal director

2-5. Report on Workshop
Guideline for Slope protection – Retaining wall and *Slope Collapse*

Presentation by Department of Projects & Administration, DRBFC

Discussion with participants: clarification of *Dokenbo*

2-5. Report on Workshop
Guideline for Slope protection – Landslide investigation

Presentation by Geological Hazard Division, Instituto do Petroleo e Geologia (IPG)

Discussion with participants municipal officer

3. Evaluation of project and review of project activities plan

3-1. Evaluation of project activity for Output 1

Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan

- Progress is gradual.

activities	plan/ actual	2016	2017	2018	2019
1.1 To review existing management structure and maintenance and rehabilitation condition on major roads	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

1.1 Management structure and maintenance conditions

- Completed: DRBFC agreed to use GIS database.

1.2 Periodic / routine inspections

activities	plan/ actual	2016	2017	2018	2019
1.2 To conduct the periodic/routine inspection	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- Site inspection of
  A03,A04,A06,A08,A11,A12,A16 173 km
- Site inspection using drive recorder of
  A01,A02,A03,A04,A05,A06,A07,A08,A09,A11, A12,A13,A14 1419 km
- Not enough to practical training on site
  → July 2019

1.3 Database updates

activities	plan/ actual	2016	2017	2018	2019
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- DRBFC has completed update of 173 km of national roads in the database.
- DRBFC plans to input the inspection results for 1171 km.
- DRBFC will continue to input the inspection results and update the database.
- CDRS will facilitate cooperation between the Department of Project & Administration and the Department of Maintenance & Conservation.

1.4 Maintenance plans

activities	plan/ actual	2016	2017	2018	2019
1.4 To formulate maitenance and repair/rehabilitation plan for next cycle	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- DRBFC completed process of result inspection to request budget with CDRS assistance.
- DRBFC construction on site and update of database are gradually progressing.
- It is necessary for DRBFC to plan for the next cycle

1.5 Emergency inspections

activities	plan/ actual	2016	2017	2018	2019
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS supported DRBFC works on A03, Loes river (scouring, large sandbag) and Jakarta II emergency work.
- In 2019, CDRS plans to support emergency work when the necessity arises.

1.6 Annual work and budget plans

activities	plan/ actual	2016	2017	2018	2019
1.6 To undertake appropriate road maintenance/ rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- DRBFC prepared drafts of 5-year and annual plans.
- CDRS is reviewing the plans regarding appropriateness and priority. CDRS will then advise DRBFC about updating these plans.

1.7 Framework for maintenance

activities	plan/ actual	2016	2017	2018	2019
1.7 To propose framework of road maintenance /rehabilitation for major roads	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS proposed integration of work between the Department of Project & Administration and the Department of Maintenance & Conservation in order to strengthen their capacity for maintenance
- CDRS will confirm that DRBFC will establish a sustainable framework.

3-2. Evaluation of project activity for Output 2

Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope protections.

- Progress is gradual.

activities	plan/ actual	2016	2017	2018	2019
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

2.1 Identification of case studies

- CDRS identified 6 case studies

2.2 Case studies for planning, design and supervision

activities	plan/ actual	2016	2017	2018	2019
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- Case studies for the planning and design check are on schedule. However, progress of construction supervision is gradual.
- CDRS will continue OJT and polish checklists for construction management.

2.3 Preferable structures for construction management

activities	plan/ actual	2016	2017	2018	2019
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- Necessary for CDRS to continue practical training on site and technical transfer to DRBFC.
- CDRS proposes to continue construction management using checklists.

3-3. Evaluation of project activity for Output 3

Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.

- Activities are on schedule.
- CDRS has been monitoring on site during the rainy season. CDRS will consider further additions to the slope protection guideline depending on issues faced after the rainy season.

3.1 Technical documents

activities	plan/ actual	2016	2017	2018	2019
3.1 To review existing technical document for maintenance and rehabilitation	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS collected and reviewed technical drawings.

3.2 Factors of failure

activities	plan/ actual	2016	2017	2018	2019
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS examined sites with damaged roads, bridges and slopes.

3.3 Knowledge of engineering

activities	plan/ actual	2016	2017	2018	2019
3.3 To aquire necessary knowleges of civil engineering for design	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS held lectures about each case study.

3.4 Technical guidelines

activities	plan/ actual	2016	2017	2018	2019
3.4 To prepare the technical guideline of investigation and design	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS prepared 4 technical guidelines.

3.5 Lessons learned

activities	plan/ actual	2016	2017	2018	2019
3.5 To reflect the lessons learned from case studies to the technical guideline	plan				
	actual				

: Plan : On schedule : Gradual progress : Delayed

- CDRS provided the guidelines on schedule.
- CDRS is monitoring on site during the rainy season. CDRS will consider further additions to the slope protection guideline depending on issues faced after the rainy season.

3.6 Dissemination of guidelines

activities	plan/ actual	2016	2017	2018	2019
3.6 To disseminate the technical guideline for concerned parties.	plan				
	actual				

: Plan : On schedule : Bradled progress : Delayed

- Dissemination of guidelines is on schedule.
- CDRS conducted a workshop on 15 March, 2019, to disseminate information about the database, checklists and guidelines to interested parties.

3-4. Other

Activity schedule for CDRS assistance

- As necessary, CDRS will consider further additions to the slope protection guideline depending on issues faced after the rainy season.
- CDRS will continue to update the database.
- CDRS will continue to utilize the checklists on site.
- CDRS will conduct a training workshop about the database and checklists in August 2019.
- CDRS will hold the 6th JCC meeting in September 2019.

Thank you for your attention
Obrigadu Barak !!

Minutes of the 5th Joint Coordinating Committee (JCC)
For
The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

The 5th Joint Coordinating Committee for the Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste (hereinafter referred to as "the Project") was held on 19th March, 2019, under the chairmanship of Mr. Joao M. Gama de Sousa, Director for DRBFC, Ministry of Public Works.

The chairman and members of the JCC have agreed to make these Minutes of Meeting and the overall work plan of the Project in 2019 based on the mutual understandings reached through the discussion, as attached hereto.

Dili, 21 March 2019

Mr. Hisashi MUTO
Team Leader
The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Mr. Rui Hermani Freitas Guterres,
Director General for Public Works,
Ministry of Public Works in the Democratic Republic of Timor-Leste

THE ATTACHED DOCUMENT

The 5th JCC for the Project was held on 19th March, 2019, at the conference room of the Director General for Public Works. The JCC consisted of the 6 agenda items shown in (I), and the subsequent decisions made are shown in (II).

(I) The JCC consisted of 6 agenda items:

1. Opening of JCC
2. Presentation of Project activities up to date
3. Evaluation of Project and review of project activities plan
4. Open discussion about the Project
5. Comments by JICA
6. Conclusion and closing remarks

(II) Decisions made:

a The JICA Team reported the works done and reason of delays in the implementation of activities for each outputs during last year. In order to disseminate the project output to the relating parties, the JICA Team proposed a further training activities proposed during the remaining project period for road inspection and database, Check List (CL) training to municipal public works, Guide Line (GL) work shop training to municipal and relating parties.

Timor-Leste side stakeholders agreed to the proposed activities of the project period; moreover, Timor-Leste side stakeholders requested the JICA Team to consider further cooperation to support.

b Member of Municipal Public works expressed the importance of the Design GL and CL for their works, but the training to them is not fully conducted. Therefor they request either JICA team or the Director of DRBFC consider the training to municipal engineers during the period exceeding the JICA's assignment period.

JICA Team replay the main target of this project is the capacity development of DRBFC staff for maintenance of National Road and the assignment of this project is fixed and difficult to expand the period without approval of JICA.

But at the same time The Team understands the necessity of dissemination of GL/CL to Regional Offices of DRBFC which were already dis-centered and sifted to each municipalities, therefor further training of GL/CL to municipalities will be conducted during remaining period. And during the training to DRBFC staff, Training of Trainer (TOT) was also conducted with using not only English version but also Tetun version being prepared. Therefor by using this version and the trainers, DRBFC can support to train to the municipal engineers.

DRBFC replayed to consider such support to the municipality and request JICA team to prepare Tetun/Indonesia version for final approval.

c Member of Municipal public works request JICA team to prepare and submit the report of this project including the activities done and outputs.

JICA Team answered the project completion report shall be prepared and submit before the final JCC on this September for the acceptance of the report which is including the project activities done and output results. And also the Team will send GL/CL date to all attendants of work shop during 15th March, 2019 and 5th JCC as well.

d Member of IPG expressed many thanks to the Project including TOT for the sustainability, Training of technical development and monitoring of Land Slide at Manatuto with close cooperation conducted with IPG and DRBFC.

e Member of DRBFC request the Team that the GL/CL is very useful therefor official approval by the minister is necessary.

JICA Team also request DRBFC to get approval by either the minister or the Director General for registration of official document.

The Director of DRBFC agreed the request and will conduct the proper action.

f JICA made some comments that JICA feel good progress and outputs of the project including close cooperation with IPG for GL, and also cooperation with UNTL not only for road inspection by IRI but also UNTL research activities and CL is useful for quality, progress and safety control of construction works on site. JICA also pointing that referring to some comments made, remaining some issues shall be identified by next final JCC and also if such issues required JICA's cooperation, please prepare official request by this end of August to JICA.

g DRBFC side requested the Team to continue the strengthening of Trainers for the training of GL/CL and also to continue the cooperation with R4D for the establishment of Data base of road network. DRBFC also requested to JICA further cooperation of the technical transfer project for Disaster Prevention of road network with simple bridge management and also request the master plan study of Dili road development and Feasibility Study of Priority Project.

JICA side confirmed such request need more discussion and preparation of official request to JICA.

Appendix: 1. Attendant List of 5th JCC

2. Work Plan in 2019

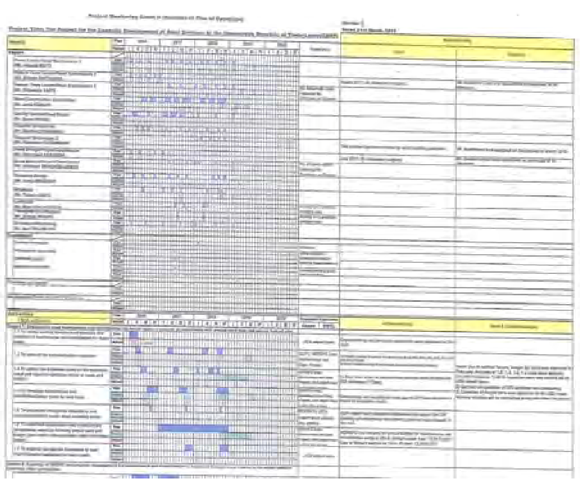
Appendix 1 Attendance list

Date: 19th March 2019

Subject: 5th JCC meeting on the Project for Capacity Development of Road Services (CDRS) in the Republic Democratic of Timor-Leste

Venue: Conference room of DG office in Mandarin

No.	Mr/Ms	Name	Affiliation/Duty	Department	E-mail	Mobile	Signature
1	Mr/Ms	Profirio Fernandes Xavier	In-house Consultant	JICA			
2	Mr/Ms	Devi Emanuel	Director	MOP Liquiça			
3	Mr/Ms	Gaspar V.P. Amaral	Director	MOP Aileu			
4	Mr/Ms	José M. da Costa	Director	MOP Ainaro			
5	Mr/Ms	Nazario de Jesus Freitas	Engineer	DNEPCC			
6	Mr/Ms	Sueo HIROSE	Q/C	JICA Expert Team			
7	Mr/Ms	Hisashi MUTO	Team Leader	CDRS-JICA			
8	Mr/Ms	Simão Laranjinha	Engineer	DNEPCC/Project Dep.			
9	Mr/Ms	Aleixo H. G. L. da Cruz	Director	MOP Dili			
10	Mr/Ms	Fernando F. F. C. Freitas	Chief of Department	DNEPCC/High way			
11	Mr/Ms	Nicholas Brooker-Jones	Road Design/Project COOD	CDRS-JICA			
12	Mr/Ms	Herculano Amaral	R4D	R4D			
13	Mr/Ms	Nagaishi Masafumi	CR	JICA			
14	Mr/Ms	Octaviano S. de Carvalho	PO	JICA			
15	Mr/Ms	Emilio dos Santos	PR	JICA			
16	Mr/Ms	João Gregorio de Carvalho	Chief of Department	DNEPCC/Project Dep.			
17	Mr/Ms	João Gama	Director	DNEPCC			
18	Mr/Ms	Nene Lobato	Chief of Department	DNEPCC/Training & COOP			
No.	Mr/Ms	Name	Affiliation/Duty	Department			Signature
19	Mr/Ms	Eugenio soares	Director	IPG-DRG			
20	Mr/Ms	Pedro Alexandre	Director	MOP Baucau			
21	Mr/Ms	Johji KOIZUMI	Road Construction SP	CDRS-JICA			
22	Mr/Ms	Takashi SAITO	GIS database	CDRS-JICA			
23	Mr/Ms	Bendito Belo	Representative Dir.	MOP Lautem			
24	Mr/Ms	Fonsatto A. da C. Reis	Interim Director	MOP Bobonaro			
25	Mr/Ms	Augustus Assre	Chief Tech Adviser	ILO-R4D			
26	Mr/Ms	Sertorio Pereira	Director	MOP Ermera			
27	Mr/Ms	Pedro Corte Real Noronha	Staff	DNEPCC-Maintenance Dept.			
28	Mr/Ms	Filomena C.C. de Almeida	Staff	DNEPCC-Maintenance Dept.			
29	Mr/Ms	Leticia S. A. Barreto	Engineer	CDRS-JICA			
30	Mr/Ms						
31	Mr/Ms						
32	Mr/Ms						
33	Mr/Ms						
34	Mr/Ms						
35	Mr/Ms						



Attachment 6

Seminar for GIS database operation & IRI activities introduction on 20 March 2019

The Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste (CDRS)

GIS database and IRI Seminar

20th March, 2019

Directorate of Road, Bridge and Flood Control (DRBFC) of Ministry of Public Works, Transport and Communications (MPWTC) and JICA Expert Team (JET)

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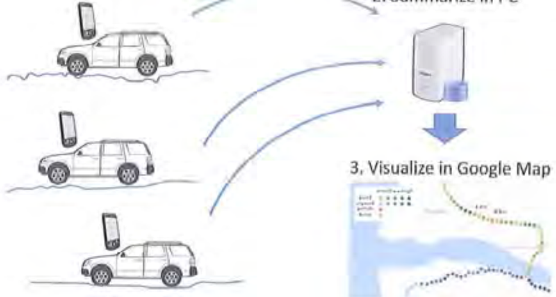
Objective of This Study

1. Collect data by **smartphone** and estimate **road conditions**

2. Summarize in PC

3. Visualize in Google Map

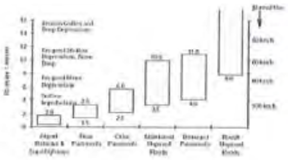


Subjects of Road Condition Monitoring

Classification of
- Paved
- Unpaved (gravel)
- Unpaved (earth)

Subjects of Road Condition Monitoring

Estimation of Roughness Level



International Roughness Index (IRI)

Estimation of Roughness is useful method to estimate pavement condition and for national plan of road construction.

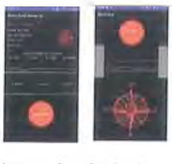
IRI Data acquisition and GIS Mapping in Timor Leste

International Roughness Index (IRI)

IRI Data acquisition and GIS Mapping in Timor Leste

- The smartphone system is developed by Gifu University
  Graduate School of Natural Science and Technology, Department of Intelligence Science and Engineering, Information Science, Fukai-Lab.
- The system developer is Mr. Frederico Soares Cabral
  Faculty of Engineering, National Univ. of Timor-Leste, TIMOR-LESTE

Collaborated with CDRS Project



A screen shot of android application which we developed

Data Acquisition System

- An android application is installed in android smartphone.
- The android is fixed on the dashboard of vehicle with curing tape tightly.
- The application takes data in 100 Hz.

[Items stored by the application]
- Time stamp
- Acceleration of (x, y, z) axes
- Gyroscope of (x, y, z) axes
- GPS (Longitude, Latitude, Altitude)
- Compass

Totally 11 dimensions time series

A screen shot of android application which we developed

Setting in Vehicle

System of IRI data analysis

[Items stored by the application]
- Time stamp
- Acceleration of (x, y, z) axes
- Gyroscope of (x, y, z) axes
- GPS (Longitude, Latitude, Altitude)
- Compass

Totally 11 dimensions time series

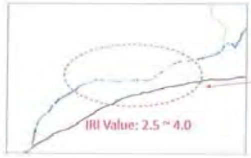
[IRI data analysis and Mapping]
- IRI data (csv or excel)
- GIS Mapping

The system developer (Mr. Frederico Soares Cabral)
Faculty of Engineering, National Univ. of Timor-Leste, TIMOR-LESTE (Gifu Univ)

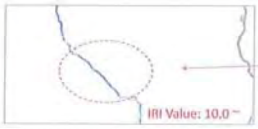
GIS Mapping

GIS Mapping

Sample of Classification in <u>Unpaved Road</u>



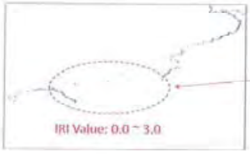
Maintenanced Gravel Road



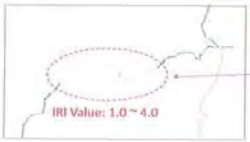
Earth Road

GIS Mapping

Sample of Classification in <u>Paved Road</u>



New Paved Road



Existing Paved Road

<u>The Progress of GIS database for Maintenance</u>

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<u>The GIS database for road rehabilitation progress will be prepare to cooperate with GIS section, project department</u>