Democratic Republic of Timor-Leste
Ministry of Public Works

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

December 2019

Japan International Cooperation Agency (JICA)

Ingerosec Corporation
Earth System Science Co., Ltd.

EI
JR
19-133

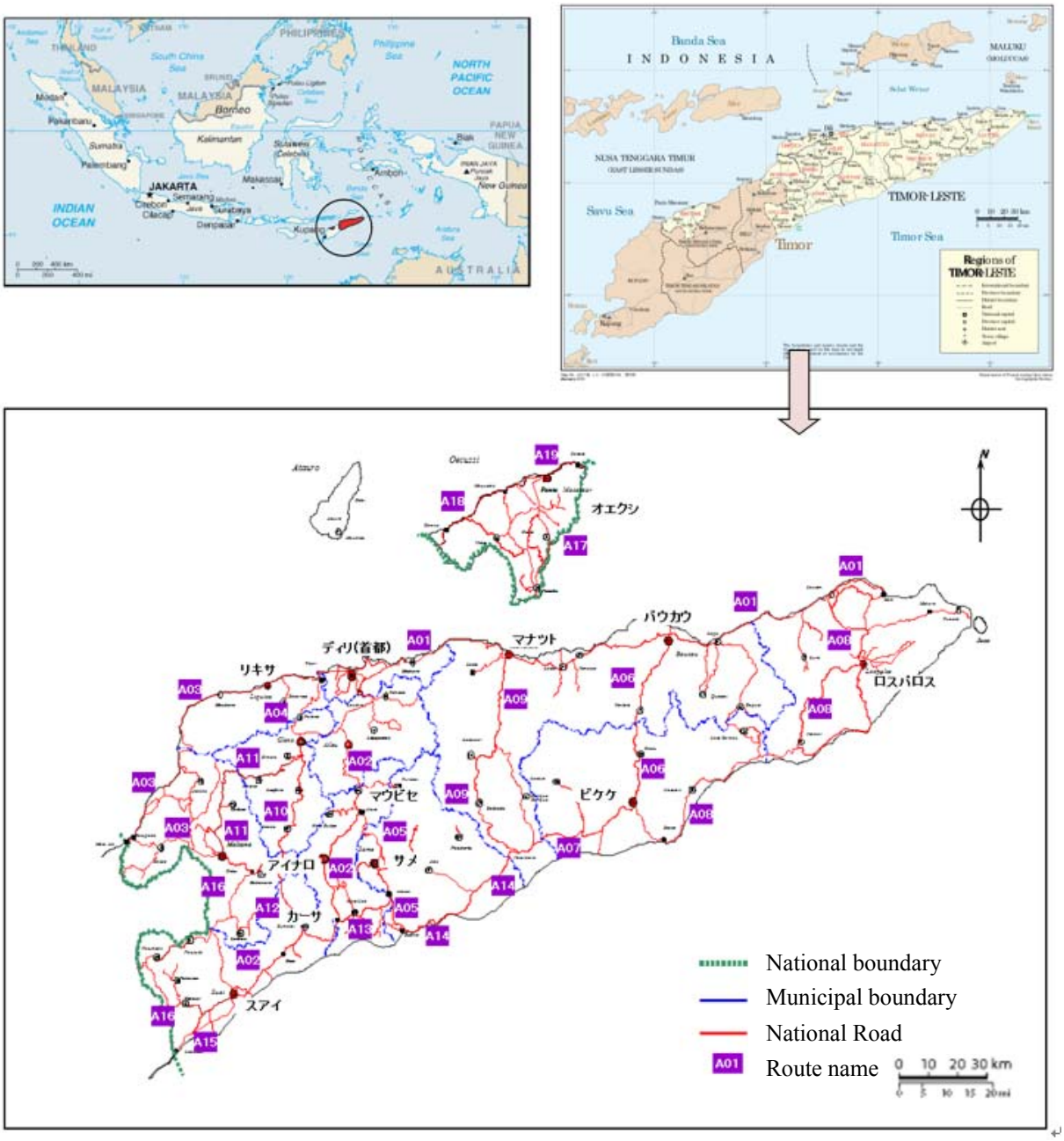
Project for Capacity Development of Road Services in the Democratic Republic of Timor-Leste

Contents

The Democratic Republic of Timor-Leste

Land area:	14,900 km²
Population:	1.183 million (as of 2015)
Capital city:	Dili
Ethnic groups:	Austronesian (Malayo-Polynesian) and Melanesian-Papuan with small minorities of Chinese and Portuguese (descendants)
Languages:	Tetun, Portuguese (official languages), Indonesian, English (practical languages)
Religions:	Christian (99.1%), Muslim (0.79%)

Source: Ministry of Foreign Affairs of Japan



Project location map

List of figures

List of tables

List of Abbreviations

Abbreviation	English name	Japanese name
AASHTO	American Association of State Highway and Transportation Officials	米国州道路交通運輸担当官協会
ADB	Asian Development Bank	アジア開発銀行
ADN	National Development Agency / *Azensia Dezemvolvimentu Nacional*	国家開発庁
AdP	Águas de Portugal group	ポルトガル水道局
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer	資源探査用将来型センサ
AusAID	Australian Agency for International Development (until 2013 / see DFAT after 2013)	（旧称）オーストラリア国家開発庁
C/P	counterpart	カウンターパート
CADEFEST	Capacity Development of the Faculty of Engineering, Science and Technology, the National University of Timor-Lorosa'e, Phase 2	東ティモール国立大学工学部能力向上プロジェクト・フェーズ 2
CDRM	The Project for the Capacity Building of Road Maintenance in the Democratic Republic of Timor-Leste (2005 – 2008)	道路維持管理能力向上プロジェクト
CDRS	The Project for the Capacity Development of Road Services in the Democratic Republic of Timor-Leste (2016 – 2019)	道路維持管理水準向上プロジェクト
CDRW	The Project for the Capacity Development of Road Works in the Democratic Republic of Timor-Leste (2010 – 2014)	道路施工技術能力向上プロジェクト
DAC	Development Assistance Committee	開発援助委員会
DEM	digital elevation model	数値標高モデル
DFAT	Australian Department of Foreign Affairs and Trade	オーストラリア外務省
DG	draft guideline	手引書案
DIT	Dili Institute of Technology	ディリ工科大学
DNEPCC	see DRBFC / *Direcção Nacional de Estradas, Pontes e Controlo de Cheias*	道路・橋梁・治水局
DRBFC	Directorate of Roads, Bridges and Flood Control	道路・橋梁・治水局
DSP	development strategic plan	開発戦略計画
FDG	final draft guideline	手引書最終案
GDEM	global digital elevation model	全球 3 次元地形データ
GEBCO	general bathymetric chart of the oceans	大洋水深総図
GIS	geographic information system	地理情報（処理）システム
ILO	International Labour Organisation	国際労働機関
IPG	Institution of Petroleum and Geology – Public Institute	国立石油地質研究所

Abbreviation	English name	Japanese name
IRI	International Roughness Index	国際ラフネス指標
JCC	joint coordinating committee	合同調整委員会
JICA	Japan International Cooperation Agency	国際協力機構
MDRI	Ministry of Development and Institutional Reform / *Ministério de Desenvolvimento e de Reforma Institucional* (until 2018)	（旧称）開発・制度改革庁
METI	Japan's Ministry of Economy, Trade and Industry	日本国経済産業省
MM	meeting minutes	議事録
MOP	Ministry of Public Works / *Ministério das Obras Públicas*	公共事業省
MOPTC	Ministry of Public Works, Transport and Communication / *Ministério das Obras Públicas, Transportes e Comunicações* (until 2018)	（旧称）建設・運輸・交通省
MTDP	medium term development plan	中期開発計画
MTTP	medium term transport plan	中期運輸計画
NASA	The US's National Aeronautics and Space Administration	アメリカ合衆国航空宇宙局
ODA	Official Development Assistance	政府開発援助
OJT	on-the-job training	実地訓練
PDM	project design matrix	プロジェクト・デザイン・マトリックス
QA	quality assurance	品質保証
QC	quality control	品質管理
QGIS	geographic information system (GIS) application	キュージーアイエス（地理情報システムのソフトウェア）
RAMS	roads asset management system	道路資産管理システム
R4D-SP	Roads for Development Support Programme	道路開発支援プログラム
R/D	record of discussion	政府間技術協力合意文書
SPD	Strategic Development Plan	戦略開発計画
TOT	training of trainers	講師育成研修
UAV	unmanned aerial vehicle	無人機
UNIPAZ	Universidade da Paz	平和大学
UNITAL	Universidade Oriental Timor Lorosa'e	東ティモール・オリエンタル大学
UNTL	National University of Timor Lorosa'e	東ティモール国立大学
WB	World Bank	世界銀行
WD	working draft (guideline)	手引書作業草案

Chapter 1 Outline of the Project

1.1 Background of the Project

In the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste"), road transport is the only means of transportation, except maritime traffic, and the national road network is the most important transportation and distribution infrastructure. The national road network has a total length of 1,426 km and comprises 19 routes that connect the 13 municipalities. However, this road network has road surface damage caused by deterioration over time, road collapse caused by heavy rain in the rainy season, and bridge scouring caused by flooding. In addition, due to the turmoil after independence in 2002, insufficient road maintenance has exacerbated the road condition. The obstructions to traffic due to landslides during the rainy season not only negatively affects economic activities, but also prevents residents from accessing education and health care services, especially in rural areas, thereby becoming an obstacle to maintaining and improving the lives of the people. It is the task of the Ministry of Public Works (MOP, renamed in 2018 from the Ministry of Public Works, Transport and Communication / MPWTC) to properly maintain and manage the road infrastructure which is the foundation of such social and economic activities.

Against this backdrop, JICA has so far provided the MOP with technical assistance to improve their capacity for road maintenance by strengthening the management cycle, from inspection of road conditions to budget requests. Through the case studies of the improvement and rehabilitation work that were carried out around the capital city, Dili, the capacity of the MOP for construction supervision has been improved. On the other hand, many national roads are still damaged every rainy season and the collection of road repair records in the database is still not sufficient, which makes it difficult to identify the causes of road damage and formulate a repair plans. Therefore, the capacity development of the MOP regarding road repair, improvement and rehabilitation works is still an urgent issue.

Under such circumstances, in February 2013, the Government of Timor-Leste requested support from Japan in the form of a technical cooperation project entitled "The Project for Capacity Development of Road Services", which aimed to further improve road maintenance capability of the MOP and the Directorate of Roads, Bridges and Flood Control (DRBFC).

1.2 Overview of the Project

1.2.1 Overview of the Activities

(1) Overall goal and Project Purpose

Overall Goal:

The maintenance conditions of major roads are improved in Timor-Leste.

Project Purpose:

Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.

(2) Expected 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.

(3) Activities to achieve expected Outputs

【Activities related to Output 1】

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.

【Activities related to Output 2】

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.

【Activities related to Output 3】

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.

1.2.2 Target Area

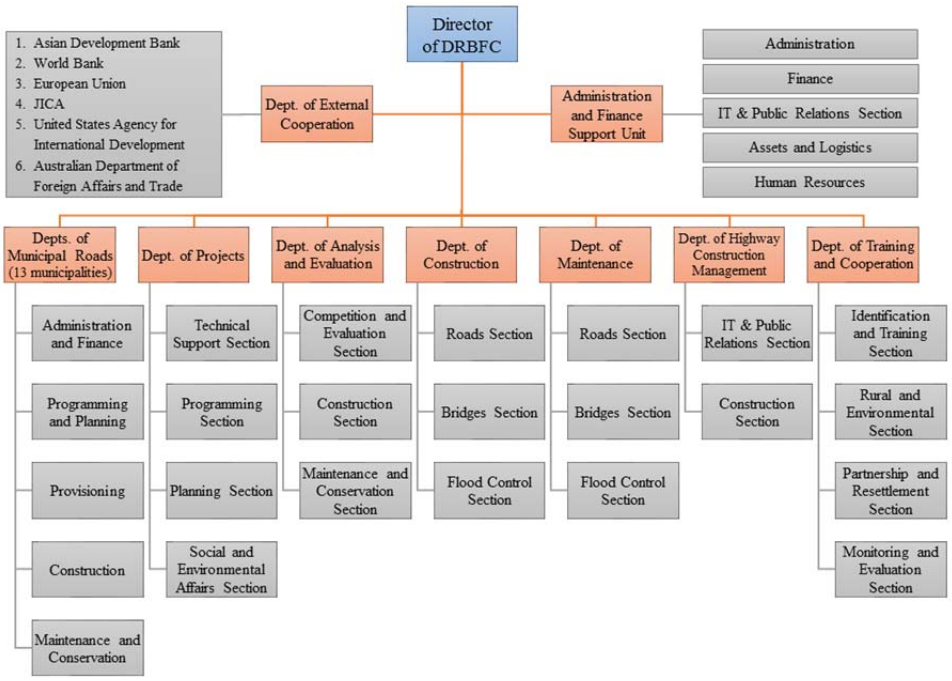
The target area of this project is the national roads in Timor-Leste (19 routes from A01 to A19). The technology transfer to the DRBFC will be carried out with the aim of improving the national roads in Timor-Leste to a 'better passable' state for several years. On the other hand, the maintenance of newly constructed and maintained roads by donor assistance is not covered by this project.

Source: JICA Expert Team

Figure 1.1 National road network in Timor-Leste

1.2.3 Counterpart

Figure 1.2 shows the organization of the counterpart organization, Directorate of Roads, Bridges and Flood Control (DRBFC).



Source: DRBFC

Figure 1.2 Organization chart of DRBFC

1.2.4 Project implementation period

An agreement to implement this project was concluded on 19 October, 2015 (see Record of Discussion: R/D in the Annex). The planned and actual implementation periods of this project were as follows.

Plan: February 2016 to March 2019 (37 months)

Actual: February 2016 to December 2019 (46 months)

1.2.5 Reporting

In this project, the deliverables listed in Table 1.1 were prepared and submitted.

Table 1.1 Deliverables in the project

	Deliverables	Status	Date of Submission
1	Work plan (Japanese)	Submitted	18 February, 2016
2	Work plan (English)	Submitted	4 March, 2016
3	Monitoring Sheet Version 1	Submitted	30 June, 2016
4	Monitoring Sheet Version 2	Submitted	12 October, 2016
5	Monitoring Sheet Version 3	Submitted	31 March, 2017
6	Monitoring Sheet Version 4	Submitted	30 September, 2017
7	Monitoring Sheet Version 5	Submitted	31 March, 2018
8	Monitoring Sheet Version 6	Submitted	31 October, 2018

	Deliverables	Status	Date of Submission
9	Monitoring Sheet Version 7	Submitted	31 March, 2019
10	Final Report (Draft)	Submitted	31 July, 2019
11	Monitoring Sheet Version 8	Submitted	30 September 2019
12	Final Report	Submission	13 December 2019

Source: JICA Expert Team

Chapter 2 Project Activities and Results

2.1 Project input

2.1.1 Input from Japan

(1) Dispatch of Experts

The input from Japan was the dispatch of experts.

The roles of specialists indicated in the R/D and terms of reference were: Team Leader / Road Maintenance, Road Construction Supervision, Quality Control, Road Design / Structure Design, Database / Project Coordinator, Road Repair, and Evaluation / Monitoring. The plan was for a total of 6 experts to fulfil 10 roles for a total of 85.5 man-months. In the revised personnel plan after the initial contract, the Deputy Team Leader / Road Maintenance 2 and Disaster Restoration roles were added as necessary, the Road Design and the Structure Design were separated into 2 roles, and the Road Design and the Project Coordinator were combined into 1 role. The revised plan was for a total of 9 experts to fulfil 13 roles for a total of 85.49 man-months.

At the beginning of this project, the indicator for Output 3 of PDM (Version 0) was the "Number of standard drawings prepared (Indicator 3-1)". However, this indicator was changed to preparing technical guidelines for countermeasures against road disasters, which are currently the most problematic, because the standard drawings had already been prepared and the understanding of design methods was insufficient. This change was approved by the 2nd Joint Coordinating Committee (JCC) meeting held on 16 February, 2017. Addition of personnel and provision of equipment were needed, because landslide observation and analysis and terrain analysis were necessary for disaster restoration work. A contract amendment including these changes was made on 31 May, 2017. With this first contract amendment to include Landslide and Topographical Analysis roles, the personnel plan was changed to a total of 11 expert to fulfil 15 roles for a total of 90.49 man-months.

The DRBFC construction that were selected as case studies for this project were delayed due to a substantial delay in the budget for 2017 and a delay in the budget preparation for 2018. For this reason, a second contract amendment to extend the project end date from March 2019 to December 2019 was approved at the 4th JCC meeting held on 26 September, 2018. Subsequently, the personnel plan was changed to 11 experts to fulfil 15 roles for a total of 92.83 man-months, including additional work after August 2019. A summary of input by the JICA Expert Team is shown in Table 2.1.

According to the terms of reference, training in Japan would only be conducted when it was deemed necessary within the project period. In this project, the training in Japan was not conducted, because members of the DRBFC had already participated in the road maintenance training conducted by the JICA International Center in Japan and, even if advanced techniques were taught, such techniques could not be implemented locally and so the expected effect of training in Japan would not be much.

Table 2.1 Input by the JICA Expert Team from Japan

Role	Name	Affiliation	Man-months (MM)		
			TL	Japan	Total
Team Leader / Road Maintenance 1	Hisashi Muto	Ingerosec Corporation	10.63	0.20	10.83
Deputy Team Leader / Road Maintenance 2	Makoto Matsuura	Ingerosec Corporation	4.80	0.20	
Deputy Team Leader / Road Maintenance 2	Mitsuhide Saito	Ingerosec Corporation	6.98	0.25	7.23
Road Construction Supervision	Johji Koizumi	Ingerosec Corporation	11.50	-	11.50
Quality Control / Road Repair	Sueo Hirose	Ingerosec Corporation	8.23	-	8.23
Disaster Restoration	Shutaro Sakanaka	Ingerosec Corporation	6.80	-	6.80
Disaster Restoration 2 (reinforcement)	Kazuharu Koishikawa	Ingerosec Corporation	3.20	-	3.20
Landslide (reinforcement)	Masahiko Hayashi	Earth System Science Co., Ltd.	3.00	-	3.00
Road Design / Project Coordinator (predecessor)	Yoshiyuki Akagawa	Ingerosec Corporation	3.30	0.10	3.40
Road Design / Project Coordinator (successor)	Nicholas Brooker-Jones	Ingerosec Corporation	6.57	0.10	6.67
Structure Design	Kenji Minegishi	Earth System Science Co., Ltd.	9.60	-	9.60
Database	Takashi Saito	Earth System Science Co., Ltd.	10.27	-	10.27
Topographical Analysis	Sohshi Mikami	Earth System Science Co., Ltd.	2.00	-	2.00
Evaluation / Monitoring (reinforcement)	Teresa Nao Tsujimura	Ingerosec Corporation	1.10	4.05	5.15
Source: JICA Expert Team		Total	87.93	4.90	92.83

(2) Equipment procurement

In this project, the following materials and equipment were procured to implement the project activities.

Table 2.2 shows a list of materials and equipment procured.

Table 2.2 Procured equipment list

No.	Equipment name	Standard / Part No.	Purpose of use	Quantity
1	In-hole inclinometer	Digital Q tilt-6000 (Probe Model-4480) (Handy Logger Model-4470)	Landslide measurement	1 set
2	Inclinometer embedded material (casing)	Painted casing (improved version of hard anodized casing)	Landslide measurement	1 set
3	Water level gauge	WL50M	Landslide measurement	1 set
4	Dokenbo soil penetrometer	Model-4940A (devised by Public Works Research Institute in Japan)	Selection of unstable slopes, stability calculations and design of countermeasures	1 set
5	Desktop computer	PC Optiplex 5040 i7	Project management	1 set

Source: JICA Expert Team

2.1.2 Input from Timor-Leste

(1) Counterpart (C/P) layout

1) Project Director

At the 1st JCC meeting held on 23 June, 2016, the Director General of Public Works was elected as the Project Director. During the project, the Director General was changed due to staff reassignment and his successor continued the work of Project Director. The Project Directors held six JCC meetings and provided guidance to the project manager and counterparts. In addition, he coordinated with other organizations as necessary, made efforts to prepare the Slope Protection and the Landslide Investigation guidelines, and held joint workshops with government agencies specialising in geology.

2) Project Manager

At the 1st JCC meeting held on 23 June, 2016, the Director of DRBFC was elected as the Project Manager. During the project, the Director was changed twice due to staff reassignment and his successors continued the work of Project Manager. The project manager collaborated with the JICA Expert Team to formulate policies for specific activities within the DRBFC, such as training for road inspections, maintenance, construction management, design guidelines and improvement of general civil engineering knowledge. He was involved in the assignment of each C/P staff for case studies and other activities.

3) DRBFC staff

At the 1st JCC meeting held on 23 June, 2016, the Chief of the Department of Projects, the Chief of the Department of Construction and the Chief of the Department of Maintenance were elected as representatives of the C/P and were responsible for the daily activities of each department during the project. Specifically, these representatives carried out activities with the JICA Expert Team such as road inspections, data entry, maintenance planning and budget planning, and quality control of works. In addition, each C/P representative was involved in selecting case study sites, planning activities, conducting construction management site training and preparing design policies. In the workshops for reporting project results, they mobilized external organizations such as international donor organizations including the World Bank and Asian Development Bank, private construction companies, educational institutes including the National University of Timor Lorosa'e, and the conducted extensive public relations activities.

(2) Trainee placement

This project did not conduct training in Japan. However, training was conducted in Timor-Leste to improve the basic knowledge of civil engineering in order to achieve each output. Amongst the counterparts, several staff with a good understanding of engineering were positioned as trainer candidates and training of trainers (TOT) was conducted. The candidate trainers were asked to prepare in advance and manage the workshops when conducting case studies for quality control and training related to the preparation of guidelines.

(3) Facilities and equipment

1) Project office

The DRBFC established the CDRS office within the Dili office of the DRBFC. The CDRS office is large enough for 10 members of the Japan Expert Team and 1 local staff to work.

2) Office equipment

The office was fully equipped with the required number of desks and chairs, and provided with electricity, lighting and air conditioning.

(4) Necessary cost

1) Office equipment maintenance costs

The DRBFC maintained the electricity supply, electric lights and air conditioners. Spare parts were also provided during repairs.

2) Costs required for case studies

Quality control of construction, confirmation of design conditions of construction facilities, checking of design dimensions against design conditions, examination and implementation of countermeasures against disasters were conducted as case studies. For the case studies, the most appropriate projects were selected from amongst the projects under construction, as the costs required for the construction had already been secured by the DRBFC. However, since the presidential election and national election were held in Timor-Leste in 2017, the budget allocation to each ministry was less than usual and, after the election, investment expenditures were frozen because the budget plan of the new government was not approved by the National Parliament due to disagreements that occurred when the ruling and opposing parties changed. Due to parliamentary disagreements, political turmoil continued until the following year and another national election was held in 2018. As a result, a new coalition government was established; however, due to unscheduled elections, the approval of the budget plan and budget disbursement were delayed.

In this project, case study sites were selected from public works being implemented by the Government of Timor-Leste, and activities aimed at improving the capabilities of counterparts relating to surveying, planning and construction management were carried out through on-site training. However, due to repeated political changes, the delays in budget approval and disbursement resulted in the project end date being postponed, as described in Section 2.1.1, and so it was necessary to increase the man-months of experts dispatched during the extension period.

3) Costs concerning counterparts

The salaries and allowances of counterparts were basically covered by the DRBFC. However, the DRBFC was unable ensure sufficient business travel expenses and accommodation allowances when working in rural areas, and there was a tendency for reimbursements of business trip expenses to be chronically delayed. In this project too, the DRBFC had many delays in reimbursing business trip expenses and there were cases where activities could not be carried out as planned, so the JICA Expert Team urged the DRBFC to secure budget for business trips. As a result, the DRBFC began securing on-site travel expenses for road inspections, construction management and design checks in the 2019 budget.

2.2 Project activities and results

2.2.1 Project activities

Expected outputs to achieve the Project Purpose are the following three outputs, as described in Section 1.2.1.

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."

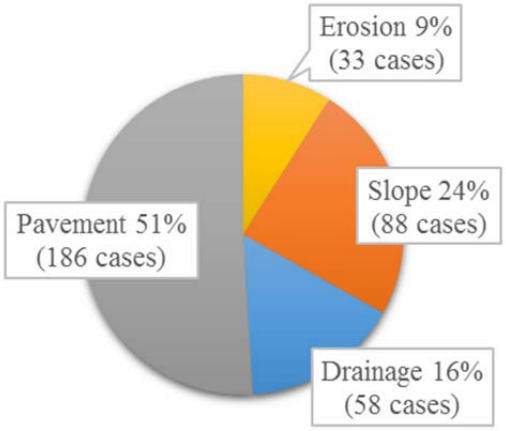
The details of activities conducted to achieve the expected outputs are described in Section 2.2.2, Section 2.2.3 and Section 2.2.4.

2.2.2 Activities 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."

(1) Analysis of current maintenance system and condition of national roads

In addition to reviewing the contents of the 9 road maintenance projects approved in the fiscal year 2016 budget, the JICA Expert Team also visited the target roads, examined improvement measures for inspection surveys, and confirmed database issues and improvements. Specifically, the JICA Expert Team confirmed the contents of the 9 road maintenance projects that were fully introduced in the 2016 budget. These infrastructure development projects are not for single-year projects, but for multi-year and expensive infrastructure projects that use infrastructure funds over several years. This project targeted periodic inspections and partial repairs on sections where the DRBFC had completed rehabilitation work for asphalt or gravel pavement. The current condition of road damage in Timor-Leste was analysed while confirming the actual situation. The road damage data analysed was collected from sources such as the road database that was prepared previously by Project for the Capacity Development of Road Works (CDRW), from the current road damage data compiled by the Department of Projects, and from information on road damage compiled by the Chief of the Department of Maintenance. The results are shown in Figure 2.1. The proportion of damages to the pavement was the largest at 51%, followed by slope failure at 24%, drainage damage at 16%, and road shoulder erosion at 9%.



Source: CDRW Road Database

Figure 2.1 Types of road damage in Timor-Leste

Pavement damage is mostly due to the weakness of the pavement structure, lack of cross grade due to vehicle traffic, stagnation of rainwater due to depressions, and expansion due to insufficient maintenance. In recent years, it is thought that the technology related to pavement repair is becoming established, because the progress of fundamental pavement reconstruction work by donors is progressing and the number of repairs to pavements has increased.

Daily inspections are difficult to implement due to the DRBFC's organizational structure and budget issues.

The organizational structure of the DRBFC is a centralized system and implementation of road maintenance and rehabilitation is limited to those instructed by the DRBFC headquarters. In addition, in the event of an emergency such as a disaster, the DRBFC is contacted by residents and local government organizations, and measures are limited to reactive countermeasures after the damaged has reached an extent where it interferes with traffic, because local governments have little knowledge of disaster prevention.

(2) Implementation of periodic/routine inspections

According to the budget restriction, the project focused on supporting periodic/routine inspections. The main contents of technical transfer activity were about how to record data on site and technical assistance about data processing. As well as the support for recording data, a practical maintenance cycle was established by utilizing a GIS database to efficiently store the data. Additionally, due to budget restrictions for site inspections, an efficient method was proposed to conduct data collection within the limited budget, input data into the GIS database and estimate the cost of repair works. The procedure of technical transfer activity was as follows.

1) 1st technical transfer activity for site inspections and data collection

National road A06 was the target of this 1st inspection activity for technical transfer. The main purpose of this activity was to carry out the inspection method proposed by the JICA Expert Team. It was implemented for the purpose of improving the road inspections implemented by the Department of Maintenance.

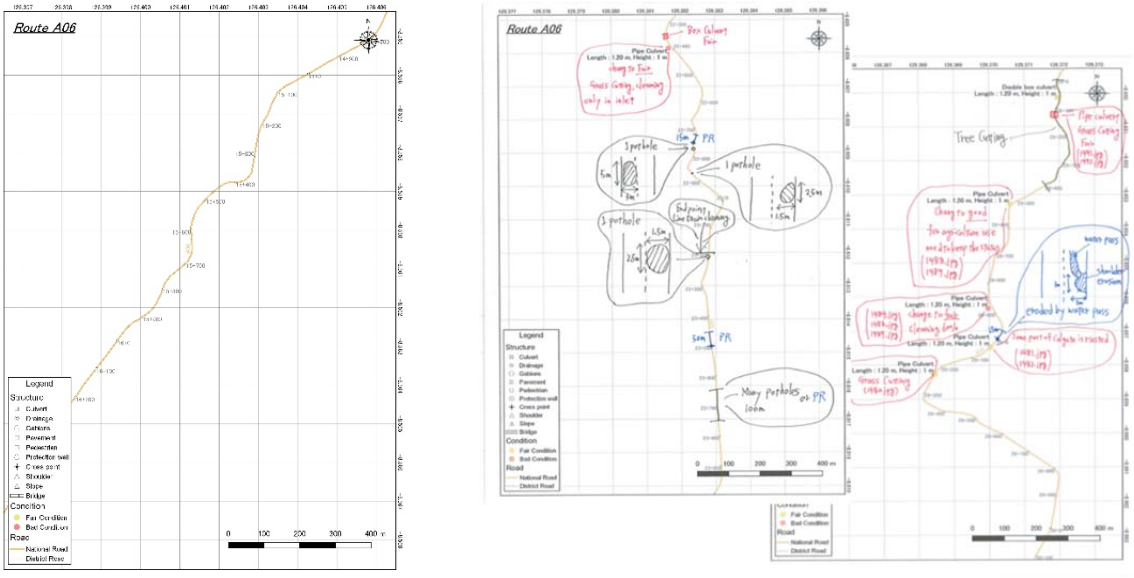
Dates and location of site inspections

Dates: 30 to 31 March, 2017

Location: National road A6

Proposal of inspection method and contents

The inspection method implemented by C/P involved the position of road facilities being measured using a car odometer without using map. The problem with the method using car odometers is that measurements are different depending on the car and this variation increases proportionally to the total road length. Therefore, that method was not suitable for periodic/routine inspection to identify the same location compared with previous inspections. In consideration of above situation, the JICA Expert Team proposed a trial method that utilized 1:5,000 maps with coordinates on which C/P could sketch the general information like shoulder collapse and pavement damage. The items for data collection were limited to potholes, drainage that needed cleaning or minor repairs, weeding and small-scale shoulder collapse, which are the necessary items for the road maintenance work that is implemented by the Department of Maintenance. Additionally, the JICA Expert Team held discussions with the DRBFC to clarify the criteria for distinguishing between roads that require maintenance and roads that require rehabilitation, and the need to integrate this information on a national management map.



Source: JICA Expert Team

Figure 2.2 Map before an inspection (left) and map annotated with inspection results (right)

Data processing after site inspections

After site inspections, the collected data was input into the GIS database. The data and map were utilized in the 2nd site inspection activity to estimate the maintenance budget for fiscal year 2018. The details of the GIS database are explained in Section (3), below.

2) 2nd technical transfer activity for site inspections and data collection

The 2nd site inspection was conducted in order to estimate the cost of conducting road inspections using the method proposed in the 1st technical transfer activity, and to estimate the budget required for road maintenance in fiscal year 2018. The target section was selected by the Department of Maintenance as a candidate section for a maintenance budget application for 2018. A cost estimation system that was developed using File Maker Pro software was utilized to estimate the maintenance budget for the target section. The details are explained in Section (3), below.

Dates and locations of site inspections

Dates: 11 to 13 September and 18 to 26 September, 2017

Locations: sections of A08, A11, A12 and A16 requiring maintenance

3) Establishment of road inspection method and development of GIS database

It was not possible to conduct site inspections for budget estimation for fiscal year 2019 because a budget for C/P business trip expenses could not be secured, due to the budget issues caused by the above-mentioned political changes in 2017 and 2018. Under the above conditions, the project activities were restricted to one-day site inspections from Dili and focused on technical transfer to enhance the C/P capacity for management cycle, database development and cost estimation.

Dates and locations of site inspections

Dates: 10 to 11 September, 2018

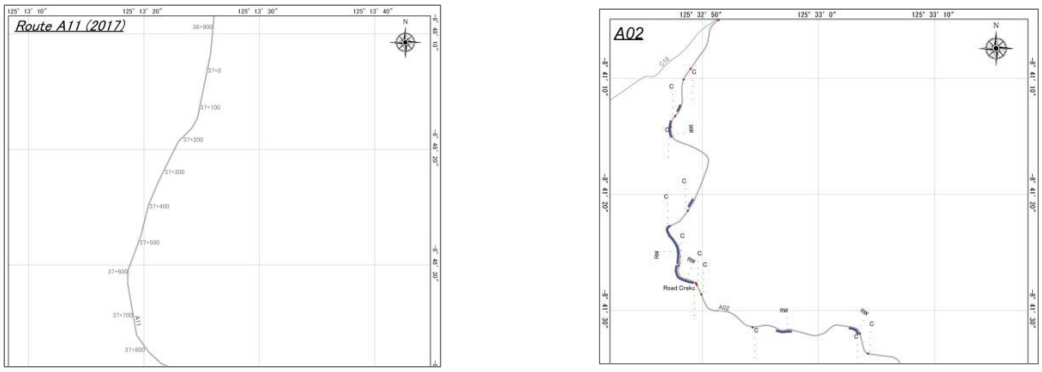
Locations: A03 (Loes bridge-Bobonaru) and A04 (Tibar-Gleno)

Contents of inspection

The site inspections were conducted as one-day trip to sections that had been proposed in the five-year maintenance plan (2019–2024) of the DRBFC. The C/P for technical transfer had been mainly the Department of Maintenance thus far; however, these site inspections were conducted jointly with C/P from the GIS section in the Department of Projects. The Department of Projects is responsible for managing construction and maintenance works under the control of the DRBFC on national, municipal and rural roads. By also involving the Department of Projects in inspections carried out by the Department of Maintenance, these inspection activities promoted sharing of the methods and data that the Department of Maintenance had gained. Additionally, these inspections aimed to clarify the demarcation between the maintenance work managed by the Department of Maintenance and the repair work planned by the Department of Projects.

Proposal of inspection method

It was necessary to conduct site inspections in the shortest possible time due to the budget restrictions for C/P business trips, so the JICA Expert team proposed an improved inspection method. The method in the 2nd site inspection was to collect and record data about road facility type, position and condition at the same time as conducting the inspection on site, which required more time on site. This method was improved by using a dashboard camera system and showing the location of road structures on the maps in advance. This method allowed the use of a portable GPS receiver to reduce the effort required to locate inspection items, decreased the time needed for inspections on site and improved the efficiency of site investigations. The details of the method are described below.



Source: JICA Expert Team

Figure 2.3 Comparison of investigation maps without (left) and with dashboard camera (right)

(3) GIS database updating

In this project, the two kinds of GIS database were developed: Timor-Leste Road Inspection GIS and Timor-Leste Management GIS. Additionally, the maintenance cost estimation system utilized by File Maker Pro software was also developed in this project. Hereafter, the contents of each database and technical transfer activities are described.

1) GIS database for maintenance and inspection（Timor-Leste Road Inspection GIS）

The Timor-Leste Road Inspection GIS is a database for storage of inspection results of maintenance activities. The main user is the Department of Maintenance. However, the use and development of the database are limited to basic editing and updating with minimum system operation, because it is the first time for the Department of Maintenance to operate the GIS database and the users are general engineers, not GIS technicians. The main role of this database is as follows.

・Management of road facility types and locations

・Management of road facility conditions

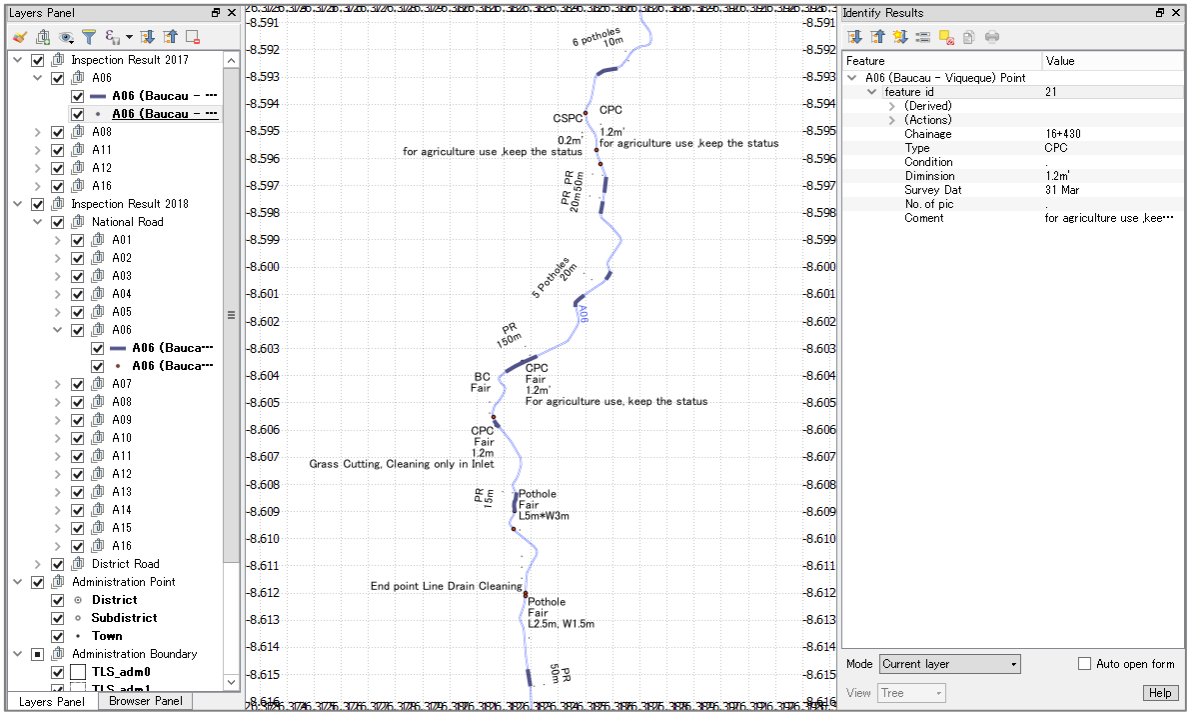
・Preparation of inspection maps

This database was constructed for the purpose of managing data collected during periodic inspections. Inspection results of road facility conditions for national roads A06, A08-a, A11, A12, and A16, which were implemented in 2017, and national roads A3 and A4, which were implemented in 2018, are stored in the database. The road facility types and locations, which were collected by dashboard camera, are also stored in the database. Thus, the database covers the whole national road network.

a) Structure of GIS database

Items

Data is stored either as point data or as line data. The items to be entered as point data include cross drainage, potholes and bridges. The items to be entered as line data are gutters, damaged road sections (excluding potholes) and retaining walls. A sample of point data and line data in the GIS database is shown in Figure 2.4.



Source: JICA Expert Team

Figure 2.4 Sample data in the Timor-Leste Road Inspection GIS database

Layer settings

In the GIS database, the inspection results and national roads are managed as layers. The target of this project was national roads; however, at the request of DRBFC, it is also possible to input inspection results for municipal roads, in anticipation of road maintenance of municipal roads in the future. Currently, base layers for all national and municipal road are stored in the database, and data of inspection results can be entered when the DRBFC conducts future inspections.

b) Method of data input

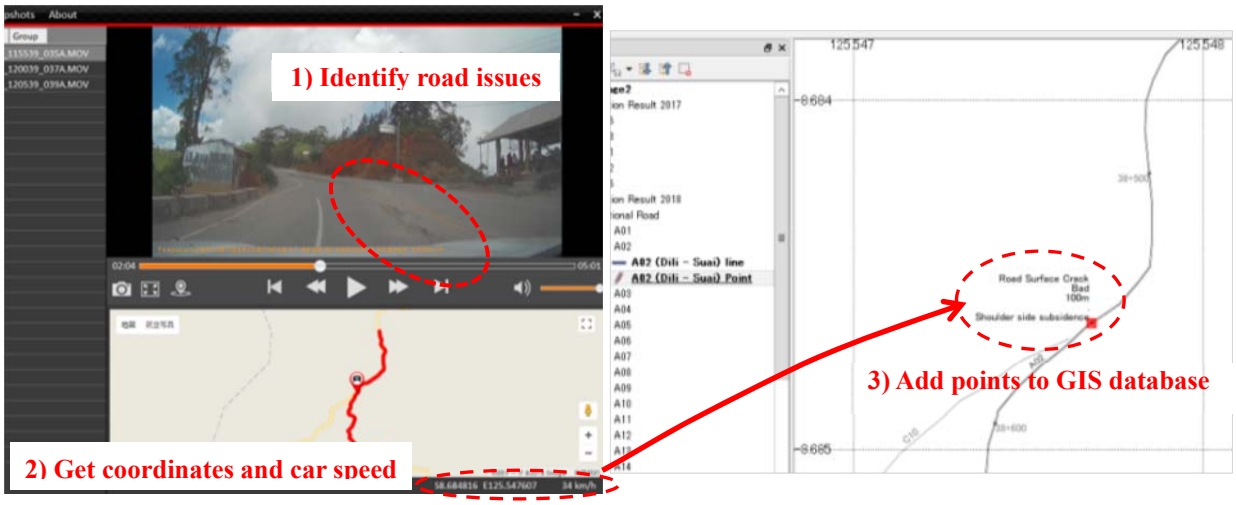
In preparation for site inspections, the GIS database has a function to export maps for use on site to record handwritten inspection results. After data collection on site, the data are inputted into the GIS database according to the map of handwritten inspection results.

Data input by dashboard camera

Under condition where it was difficult to secure a budget for business trips, a more efficient method to develop the GIS database using a dashboard camera was proposed. The detail procedure is as follows.

- Step1: videos are taken by dashboard camera when driving on site, then the movies are reviewed on a computer using specific video software.
- Step 2: the position of road facilities are inputted into the GIS database based on the coordinates displayed in the above video software.

An example of the data input procedure is shown in Figure 2.5.



Source: JICA Expert Team

Figure 2.5 Example of data input from the video of a dashboard camera to the GIS database

Based on the basic map information prepared with the dashboard camera procedure, the DRBFC can then efficiently conduct site inspections to get a detailed understanding of the road facility conditions.

c) Technical transfer activity and method of database management

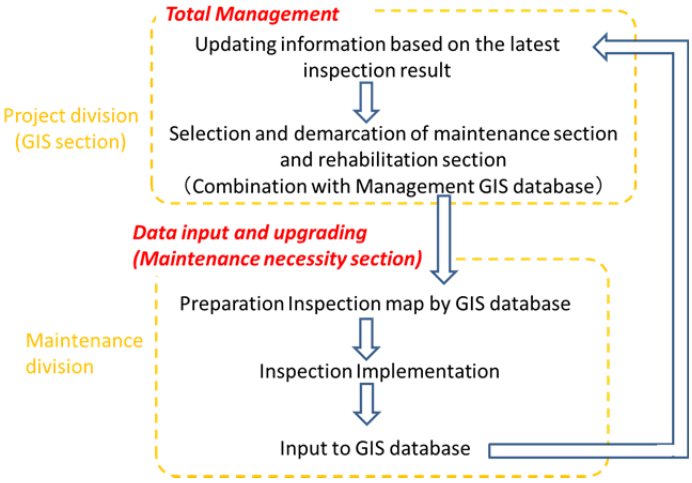
Technical transfer activity

Technical transfer activities were conducted to train C/P how to input data following the above data entry procedure. The technical transfer was conducted through on-the-job training with C/P working alongside the JICA Expert Team to input the GIS data, so that problems and issues could be resolved when necessary. One person was selected from the administration section of the Department of Maintenance to be the GIS database manager, who was the key person for technical transfer. Each member of the inspection team in the Department of Maintenance took responsibility for inputting the inspection data, so technical transfer was conducted for the inspection team in addition to the key person.

Database management method

The main user of this GIS database is the Department of Maintenance. However, the C/P in the Department

of Maintenance mainly input data of inspection results and they are not familiar with GIS database operations, so there may be issues if the Department of Maintenance were responsible for overall database management. In addition, the Department of Projects, which plans repairs and maintenance work for roads in Timor-Leste, also needs the latest inspection results from the Department of Maintenance and needs to input the inspection results of repair works. The JICA Expert Team proposed that the GIS section in the Department of Projects manages the database overall and that the Department of Maintenance follows the instructions of the GIS section and updates the database. A flowchart of the proposed database management process is shown in Figure 2.6.



Source: JICA Expert Team

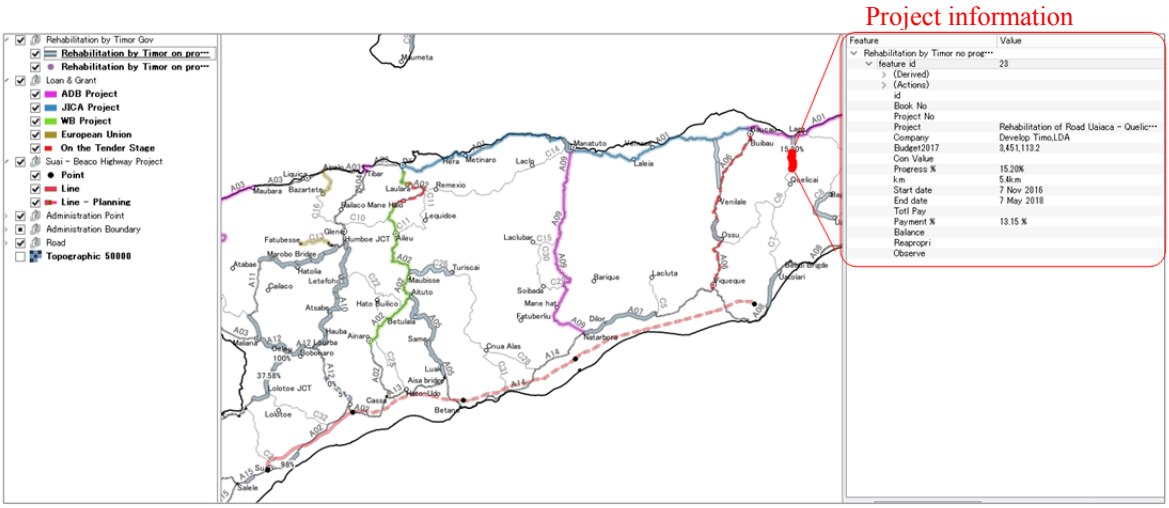
Figure 2.6 Flowchart of database management for the Timor-Leste Road Inspection GIS

2) GIS database for road network management (Timor-Leste Management GIS)

The Timor-Leste Management GIS is a database for road network management, which was developed as a separate system from the "Timor-Leste Road Inspection GIS". The purpose of this database is progress management of all rehabilitation projects implemented by Timor-Leste government and donor project. Additionally, road surface conditions can be evaluated using the International Roughness Index (IRI).

a) Structure and items of GIS database

The projects are categorized by colour. Information such as progress of construction and status of payments is stored for each project, and the database is updated as necessary. A sample of the project information stored in the database is shown in Figure 2.7.



Source: JICA Expert Team

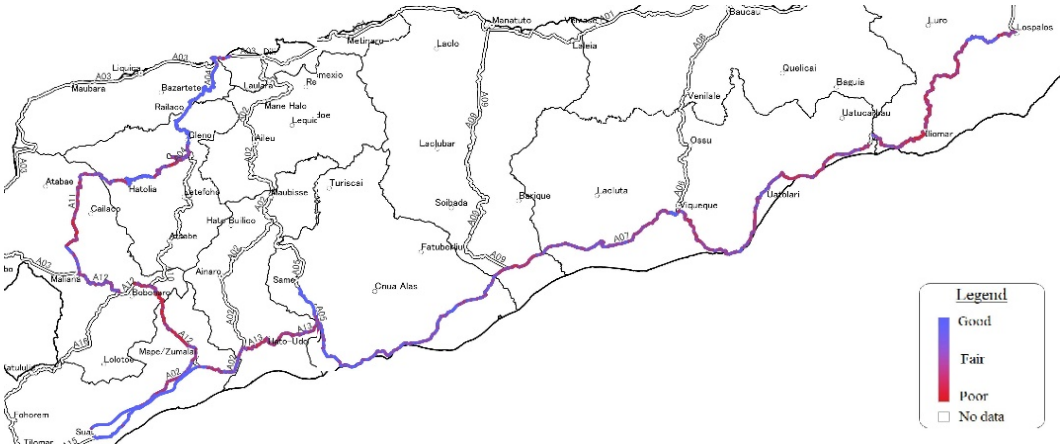
Figure 2.7 A sample of project information in the Timor-Leste Management GIS

b) Data acquisition method of road surface conditions as IRI

In this project, a survey of national roads was conducted to collect of IRI data. Using the IRI data, a map of the road surface type (paved or unpaved) and the road surface conditions (well maintained or requiring repair) was created. These IRI data were introduced to this GIS database for reference.

Method of data acquisition

The IRI data were collected by a simplified method using a smartphone application. The IRI values were analysed and calculated from GPS, acceleration, and gyro sensor within the smartphone. The scale of IRI values corresponding to road surface conditions were also confirmed visually by comparing video data from the dashboard camera with the recorded IRI values.



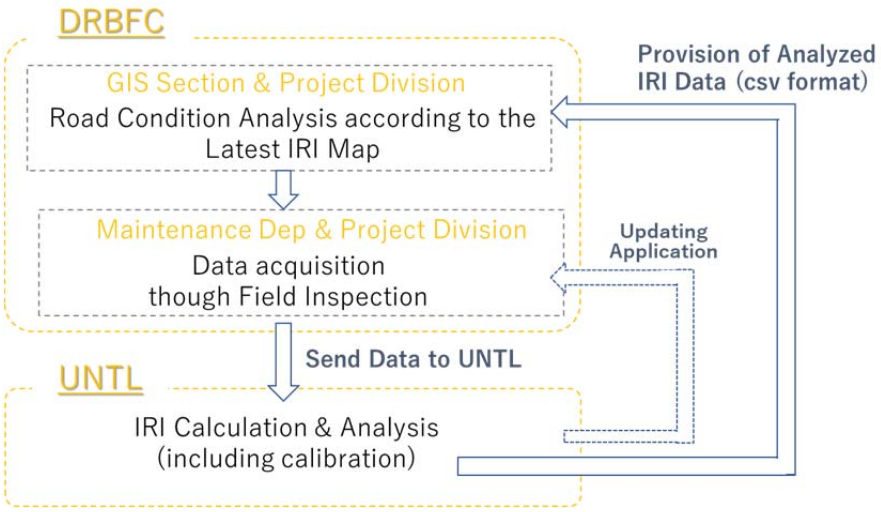
Source: JICA Expert Team

Figure 2.8 IRI Mapping

Collaboration with National University of Timor Lorosa'e (UNTL)

The IRI smartphone application has been developed by Gifu University in Japan, and the system developer belongs to the UNTL at present. Because it is currently in the trial stage, it will be necessary to

continuously upgrade to functions and interfaces of this application to achieve suitable accuracy for all users. The JICA Expert Team proposed for the DRBFC to collaborate with UNTL to conduct data collection and analysis in order to upgrade the precision of results and make the interface user-friendly for DRBFC. A flowchart of the process for data collection, analysis and system upgrades is shown in Figure 2.9.



Source: JICA Expert Team

Figure 2.9 Flowchart of development activities and demarcation between DRBFC and UNTL

(4) Technical support to formulate annual maintenance budget

The Department of Maintenance selects road sections every year for implementing maintenance work. Maintenance projects called 9 Packages project (2016 to 2018) and 7 Packages project (since 2017) are being implemented as proposed by the Department of Maintenance. However, appropriate maintenance costs were not estimated at the budget request stage, so there are significant differences between the planned and actual maintenance costs at the implementation stage. In this project, the JICA Expert Team established a cost estimation system to calculate the required maintenance for each road section, and conducted technology transfer so C/P can estimate the maintenance budget in subsequent years.

a) System Structure

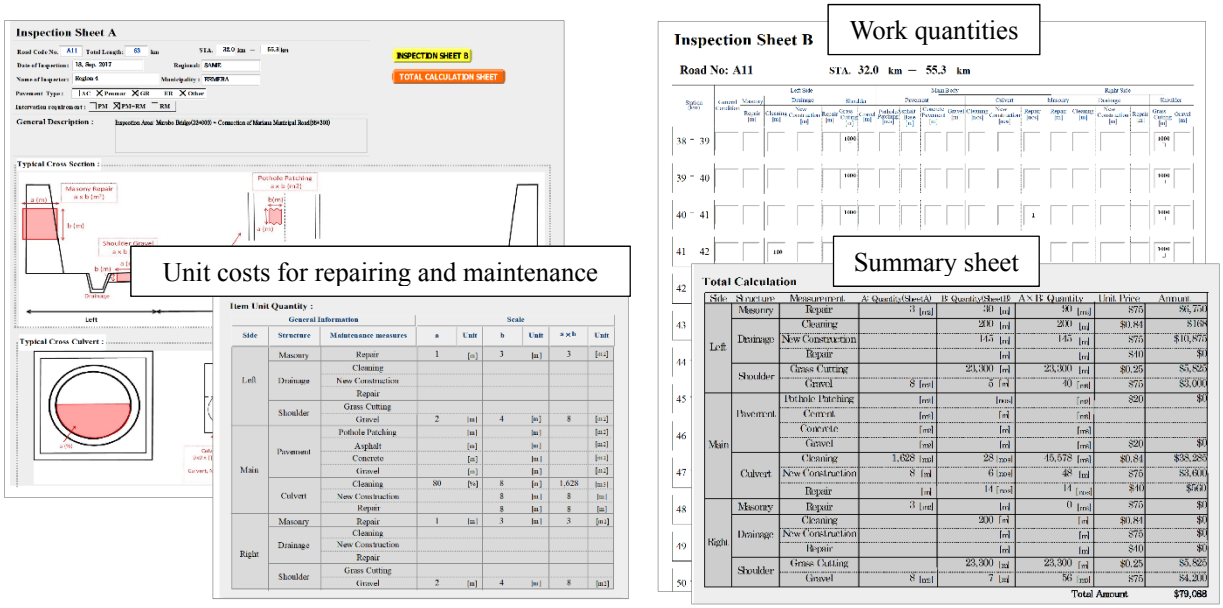
Estimation system using File Maker Pro Software

An estimation system for road repair costs was previously established by the Project for the Capacity Development of Road Works (CDRW, 2010-2014) using File Maker Pro software. Therefore, the JICA Expert Team adopted File Maker Pro software to leverage the CDRW information and further developed the budget estimation system.

Estimation Item and method

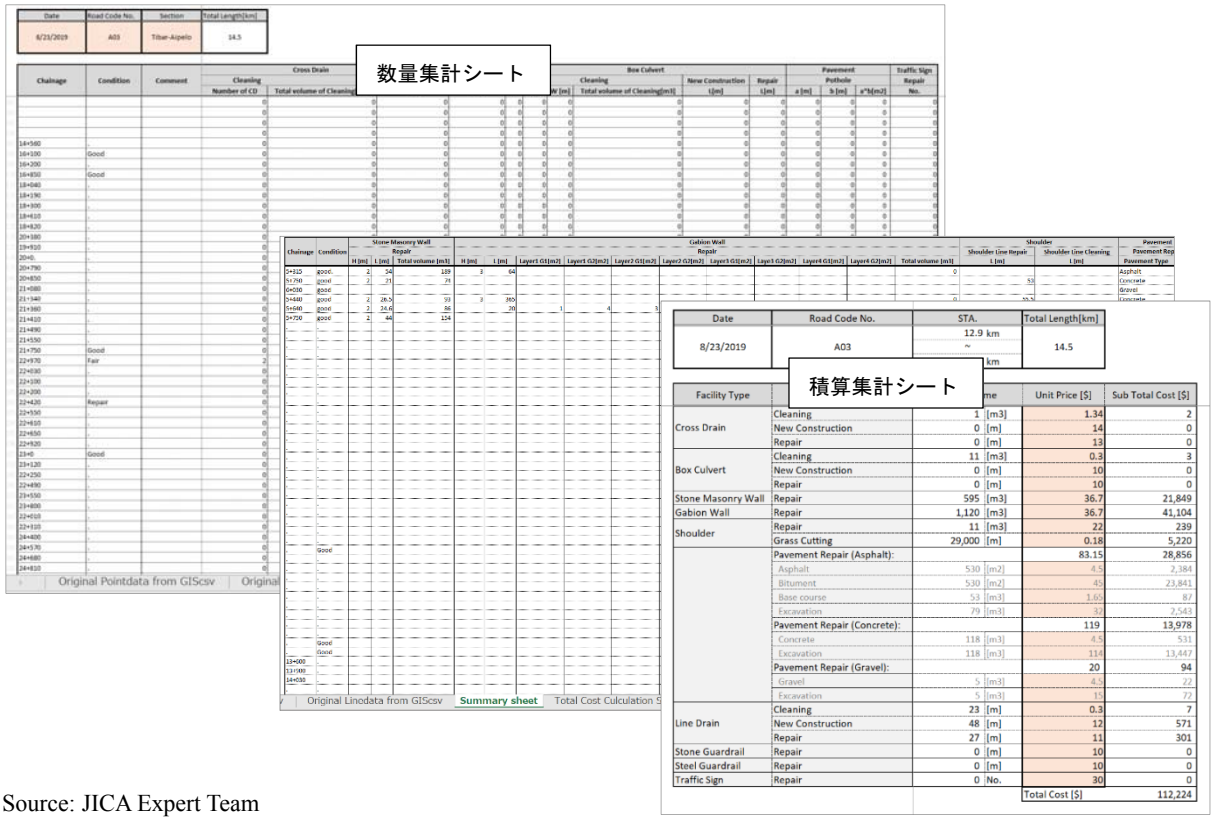
The cost estimations are calculated based on the work items implemented by the Department of Maintenance. The work items include minor repair of side drains, cross drainage, retaining walls, potholes, and minor road shoulder collapse. In addition, other work items for maintenance are included, such as cleaning and weeding of drainage. The method to estimate the total cost is as follows: 1) set the unit costs

of the work items for repair or maintenance; 2) estimate the quantities of work based on the inspection results; and finally 3) multiply the unit costs by the quantities of work (1 × 2).



Source: JICA Expert Team

Figure 2.10 Example of the main components of the cost estimation system



Source: JICA Expert Team

Figure 2.11 Example of the main components of the cost estimation system of Microsoft Excel

Cost estimation for maintenance budget 2018

In this project, the fiscal year 2018 maintenance budget for 4 routes was calculated on a trial basis. The work items and quantities were calculated based on the results of inspections conducted with C/P. The total estimated costs were used when applying for the maintenance budget. The estimations of the required maintenance budgets for the target road sections are as follows:

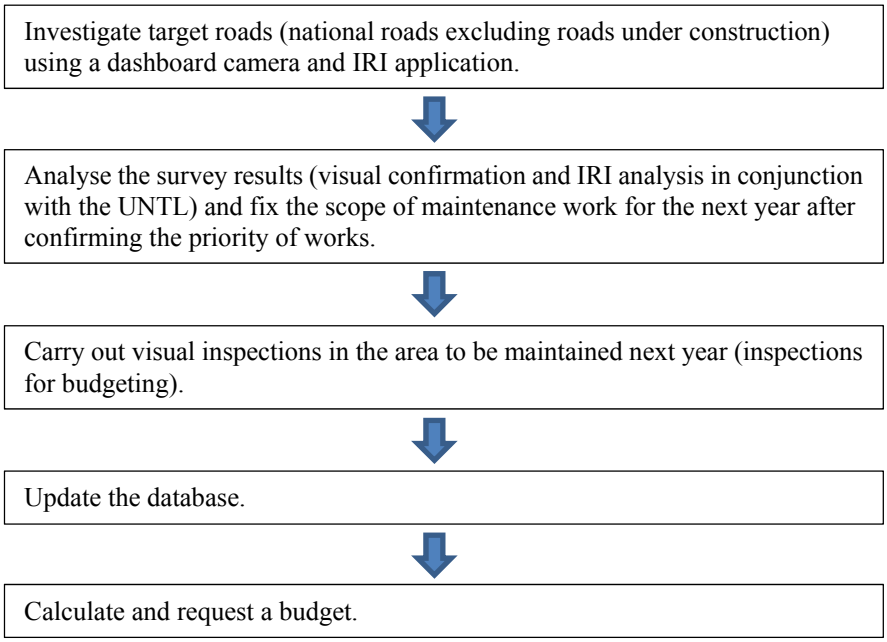
- A08-a Lospalos – Iliomar – Irebere Bridge = $ 957,794 (USD)
- A11 Ermera Lama JCT – Maliana = $ 79,088 (USD)
- A12 Lourba – Zumalai = $ 64,629 (USD)
- A16 Salele – Oeleu = $ 546,482 (USD)

b) Technical transfer activity

A seminar about how to use the estimation system was conducted in August 2019. The interface of the estimation system is intuitive and the way of inputting inspection results is simple, so no system engineering skills are required to use this system. This means that any level of engineer can use the system, and a system is in place to support the work of the regional officers in the Department of Maintenance.

(5) Support for formulating annual work plans for maintenance work

Maintenance work should be implemented efficiently by following the flowchart shown in Figure 2.12, because it needs to be conducted within budget constraints.



Source: JICA Expert Team

Figure 2.12 Flowchart for formulation of annual work plans

(6) Implementation of maintenance work based on the annual work plan

As of June 2019, approximately 720 km of national roads were being rehabilitated with the support of the World Bank, JICA or ADB, and many of them are close to completion. In 2022, the construction of approximately 720 km of roads will be completed. The contractors agree to a defects liability or maintenance period of one year after completion and, after that, a two-year performance maintenance contract with the DRBFC. Between 2022 and 2024, the contractors are going to hand over the roads in good condition to the

DRBFC, after a total of three years of being maintained by the contractors.

In 2019, the state of road maintenance for 1,426 km of national roads was that maintenance work for 15% of 11 roads was completed, which constituted 219 km; 41% of 8 roads were under construction, which constituted 581 km; and 44% of 15 roads remained unmodified, which constituted 626 km.

In the five-year plan for national road rehabilitation starting in 2019, a total length of about 800 km is planned to be completed by 2021, which comprises the completion of 581 km of 8 roads that are currently under construction, and 218 km of 13 roads with plans to be rehabilitated (see Table 2.3). As a result, 1,020 km (71%) of the total length of 1,426 km of national roads will be maintained by 2024, which comprises the above-mentioned 800 km planned for completion and the 219 km that has already been completed. However, regarding whether this completed road can stay well maintained, it is considered that large-scale road deformation will be less than a few percent of the rehabilitated length within a few years after completion, depending on the subsequent maintenance status. Therefore, it is expected that the length of road that is in good condition is expected to exceed the target of 60%, and potentially reach 70%, of the 1,400 km of national roads, which are the target of this project. The handover of roads in good condition to DRBFC will be carried out sequentially from 2022 to 2024.

Table 2.3 Five-year plan for national road maintenance starting in 2019

BUDGET FOR THE MAINTENANCE WORKS (National roads, Municipal roads and Urban roads)

FIVE YEARS PLAN for MAINTENANCE of ROADS

No.Link	Name Link	Length(KM)	Proposal	2019		2020		2021		2022		2023	
				Implement ation km	BUDGET USD (000)	Implement ation km	BUDGET USD (000)	Implement ation km	BUDGET USD (000)	Implement ation km	BUDGET USD (000)	Implement ation km	BUDGET USD (000)
I. NATIONAL ROADS													
A01	DILI - COM	202.90	15.30	15.30	45.90	15.30	45.90	15.30	45.90	15.30	45.90	15.30	45.90
A02	DILI - SUAI	178.30	168.50	42.10	126.30	42.10	126.30	59.02	177.06	59.02	177.06	136.40	409.20
A02'	Mota Ulun - Sarlala	19.75	19.75		-		-		-	19.75	59.25	19.75	59.25
A03	DILI - MOTA AIN	118.30	73.30	73.30	219.90	73.30	219.90	73.30	219.90	73.30	219.90	73.30	219.90
A03'	BATUGADE - MALIANA	35.80	35.00	35.80	107.40	35.80	107.40	35.80	107.40	35.80	107.40	35.80	107.40
A04	TIBAR - ERMERA	45.00	45.00	45.00	135.00	45.00	135.00	45.00	135.00	45.00	135.00	45.00	135.00
A05	AITUTO - BETANO	53.60	50.00		-		-	50.00	150.00	50.00	150.00	50.00	150.00
A07	VIQUEQUE-NATARBORA	48.80	48.80	48.80	146.40	48.80	146.40		-		-		-
A08	LAUTEM - VIQUEQUE	153.90	108.80	108.80	326.40	108.80	326.40		-		-		-
A09	MANATUTO - NATARBORA	85.20	79.77		-		-		-		-	79.77	239.31
A10	ERMERA - HAUBA	68.50	68.50	68.50	205.50	68.50	205.50	68.50	205.50		-		-
A12	MALIANA - ZUMALAI	50.90	11.00	11.00	33.00	11.00	33.00	11.00	33.00		-		-
A13	AIASSA - CASSA	24.60	24.60	24.60	73.80	24.60	73.80		-		-		-
A14	NATARBORA - BETANO	48.50	48.50	48.50	145.50	48.50	145.50	48.50	145.50		-		-
A16	TILOMAR - UELEO	68.70	62.30	62.30	186.90	62.30	186.90	62.30	186.90		-		-
TOTAL			1,202.75	859.12	1,752.00	584.80	1,752.00	468.92	1,406.16	278.43	894.51	483.72	1,365.96

Source: DRBFC

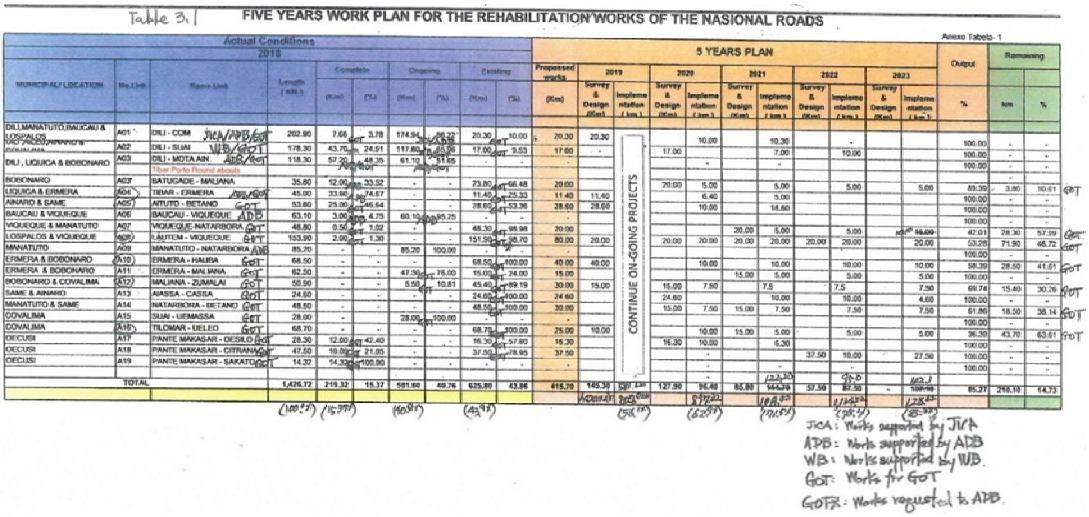
路線名	維持管理延長 / 道路延長
A01	15.30 / 202.90
A02	188.25 / 198.05
A03	108.30 / 154.10
A04	45.00 / 45.00
A05	50.00 / 53.60
A07	48.80 / 48.80

路線名	維持管理延長 / 道路延長
A08	108.80 / 153.90
A09	79.77 / 85.20
A10	68.50 / 68.50
A12	11.00 / 50.90
A13	24.60 / 24.60
A15	62.30 / 68.70

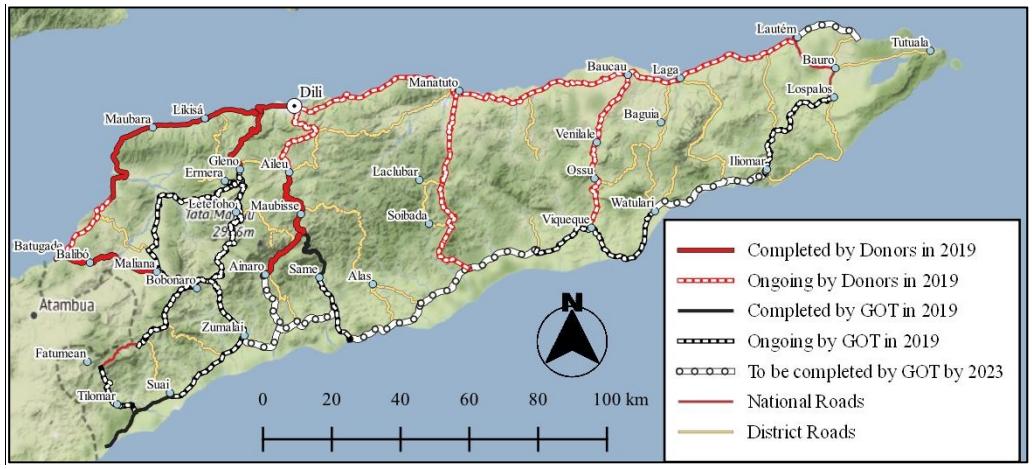
Source: JICA Expert Team

Figure 2.13 National road maintenance by 2019

Table 2.4 Five-year plan for national road rehabilitation starting in 2019



Source: DRBFC



Source: JICA Expert Team

Figure 2.14 National road rehabilitation by 2019 and by 2023

Based on this 5-year plan, an annual work plan will be formulated in accordance with the flowchart described in Section (5), above.

(7) Proposal of appropriate database management system

This database is to be managed and operated by the GIS section of the Department of Projects, and technology transfer was conducted mainly for Ms. Letigia dos Reis H. Corbafo, who is in charge of the GIS section. This GIS section was established by R4D-SP, with DFAT funding, and it manages all GIS databases prepared by the DRBFC, including the GIS database constructed by R4D-SP. The purpose of this database was to manage construction and maintenance sections throughout the country, so operation guidance and technology transfer were implemented for the GIS section. However, although the GIS section builds this database, it is necessary to carry out the information gathering process jointly with the Department of Maintenance, Department of Construction, Department of Projects and Department of External Cooperation.

Collaboration with the Department of Construction

It is necessary to obtain information from the Department of Construction regularly because the progress of complete repair work by the Timor-Leste government is carried out by the Department of Construction. The database construction was conducted while holding discussions between the GIS section of the Department of Projects and the Department of Maintenance in the form of on-the-job training.

Collaboration with the Department of External Cooperation

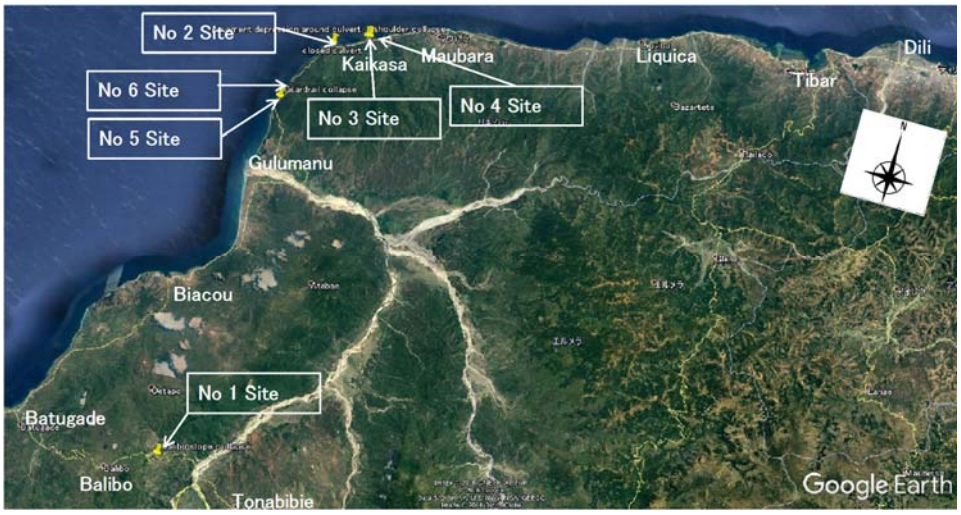
The Department of External Cooperation manages the progress of the loan project implemented in Timor-Leste, and this information is also entered into the database. A proposal of a management system was constructed by the JICA Expert Team, and the Department of Projects and Department of External Cooperation agreed to jointly manage the database.

(8) Support for emergency inspection and emergency restoration work

1) Damage to national road A03

On 8 February, 2017, the JICA Expert Team, the Department of Construction and the Department of Maintenance, DRBFC, conducted a joint site inspection of national road A03 and national road A05, which were damaged by rainfall (15 participants). The damaged section of national road A03 occurred where construction had been completed with support from the ADB. Furthermore, on 17 February, 2017, the JICA Expert Team held a workshop to report on the results of the survey, to point out the causes of the damage such as the lack of rolling pressure on the road shoulders and insufficient capacity / improper installation of drainage, and provided advice on repair / countermeasures and future inspections.

Through this activity, JICA Expert Team gave advice on the causes of damages and about repair / countermeasures using examples of disasters that frequently occur on national roads in Timor-Leste due to the effects of rain. Based on the causes of these disasters, it is necessary for the DRBFC to select road rehabilitation measures for the disaster-stricken sites in the future. Figure 2.15 shows the location of the affected areas and Figure 2.16 shows the road conditions on the sites.



Source: JICA Expert Team / Google Earth

Figure 2.15 Location map of the national road damaged by rainfall

Site No.1 Site No.2

Site No.3 Site No.4

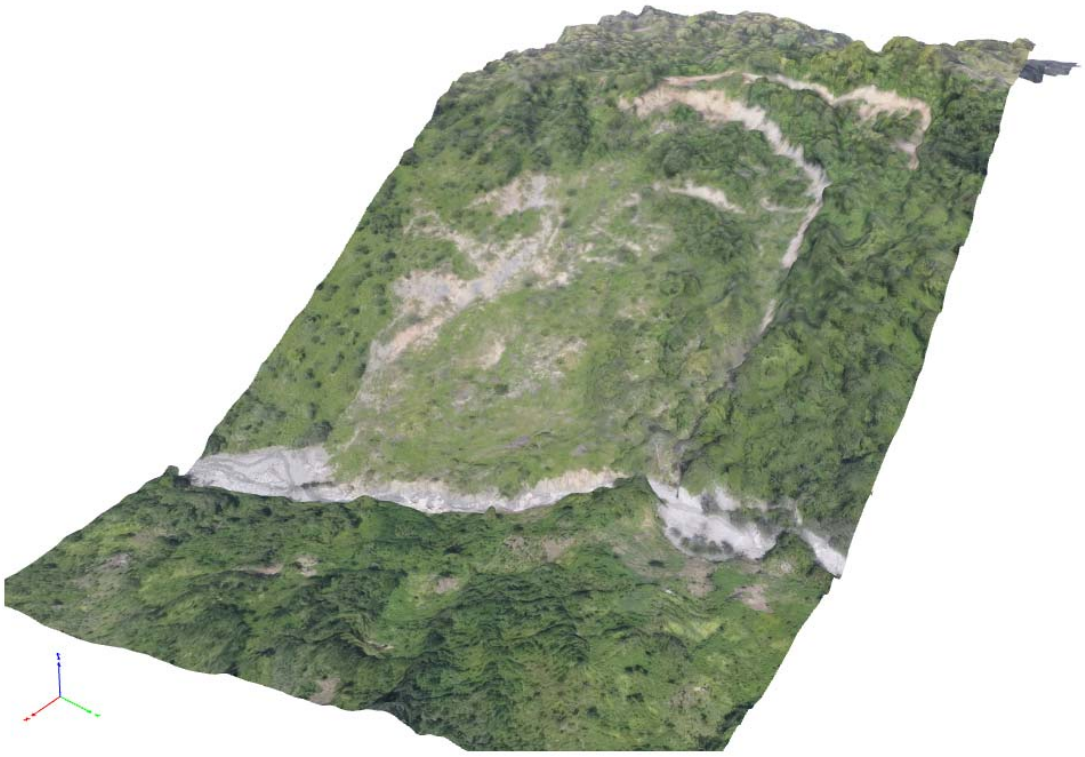
Site No.5 Site No.6

Source: JICA Expert Team

Figure 2.16 Damage to national road A03

2) Jakarta II Landslide

A landslide occurred during the rainy season on national road A02 (about 25 km south of Ainaru). Before the survey, the road had collapsed over a width of about 100m and the form of disaster was unknown. At the request of the DRBFC, a topographic survey was conducted by unmanned aerial vehicle (UAV) and the disaster turned out to be a large-scale landslide. The topographic survey produced orthophotos and detailed topographic maps, which were used for surveying and design of countermeasures. A 3D topographic model produced during this activity is shown in Figure 2.17.



Source: JICA Expert Team

Figure 2.17 3D topographic model produced from UAV survey results

3) Comoro River damage

In May 2019, the JICA Expert Team held discussions with the Chief of the Department of Maintenance regarding the substructure of the existing bridge over the Comoro River, which was damaged by the heavy rains that occurred in March 2019.

Damage of existing bridge substructure

Retaining wall damage

The recent disaster on the Comoros River involved the collapse of the groundsill (a structure in middle of the river to reduce the speed of the river flow during the rainy season), which was downstream of the exiting bridge, and exposure of the bridge foundation due to scouring.

Repair of the groundsill is necessary for protection of the substructure of the existing bridge. The DRBFC have not collected basic data around the disaster area, such as topographical data, despite the changes to the river bed due to the heavy rains in March 2019 and the collapse of the groundsill. Therefore, a site survey from the Hinode Bridge (upstream, completed in 2018) to the existing bridge and the collapsed groundsill

was conducted in order to estimate the river flow during heavy rains and determine the basic data necessary for the restoration of the collapsed right embankment. The JICA Expert Team provided support for cooperation between the Department of Maintenance and the Department of Projects in order to formulate work plans, conduct site surveys, and develop an approach to the work and designs using the basic data.

The support was provided with the following points in mind.

- DRBFC staff will conduct topographic surveys using auto levels, which are relatively easy to handle and so that the surveys can be carried out independently and without the need for specialists.
- The initiative of DRBFC staff will be fostered in order to promote problem solving skills.
- The work will be carried out in collaboration with a candidate trainer for technical guidelines from the Department of Projects. Furthermore, the candidate trainer has worked with the JICA Expert Team during preparation of technical guidelines, classroom study and practical training, and has worked with the trainer candidate belonging to the Department of Maintenance.

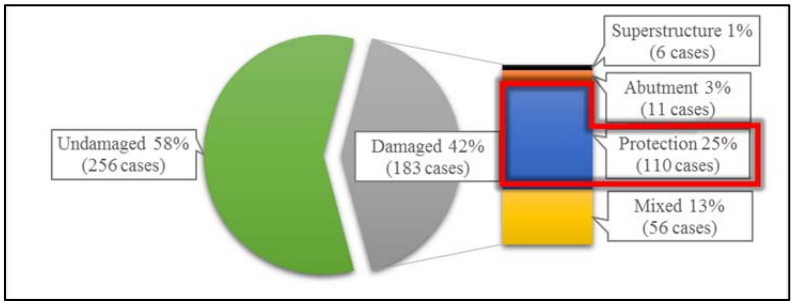
As a result, the DRBFC staff used the technical guidelines and were able to decide for themselves what basic information was required to use the technical guidelines for designing emergency measures.

2.2.3 Activities for Output 2

"Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country."

(1) Selection of construction case studies and target sites

As shown in Figure 2.18, the main causes of road damage in Timor-Leste are pavement damage, slope collapse, drainage damage and shoulder erosion. Of these, slope failure and damage to cross drainage have occurred repeatedly because countermeasures have been implemented without sufficient analysis of the cause of the damage. For this reason, there is a need for technical support for specific research, analysis and design. In Timor-Leste, 42% of all bridges are damaged. This damage is mainly caused by insufficient protection of the revetments and bridge substructures, because amongst the damaged bridges, 60% of the damage is caused by scouring. Furthermore, the scouring has repeatedly damaged bridge substructures and only coping techniques for countermeasures have been taken, so there is a considerable need for technical support for specific investigation, analysis and design, because bridge damage is directly linked to road traffic safety.



Source: JICA Expert Team

Figure 2.18 Causes of Bridge Damage in Timor-Leste

At the start of this project, baseline tests about planning and design were conducted in July 2016 to confirm the activities and capabilities of the counterparts. The test results showed that the percentage of correct

answers by the counterparts was not high.

Table 2.5 Baseline test results (planning and design)

	Planning and design				
	1. Surveying	2. Drainage	3. Retaining walls	4. Slope protection	Percentage of correct answers
Department of Maintenance (12 people)	50%	17%	27%	12%	26%
Department of Projects (7 people))	57%	34%	46%	9%	36%
Department of Construction (6 people)	47%	53%	27%	23%	38%
Total (25 people)	51%	30%	32%	14%	32%

Source: JICA Expert Team

Based on the above, the JICA Expert Team conducted engineering investigations in three areas that directly affect and significantly damage roads in Timor-Leste: slope failure, bridge scour and cross-drainage damage. The works of 1) to 3), below, were selected as case studies for the engineering investigations.

Baseline tests for quality control were conducted on the same day as the planning and design tests. The percentage of correct answers was low, so the JICA Expert Team provided the DRBFC with technical support to improve the capacity for construction management concerning various types of work.

Table 2.6 Baseline test results (quality control)

	Quality control				
	1. Concrete	2. Aggregate Subbase course	3. Aggregate Base Course	4. Aggregate Surface Course	Percentage of correct answers
Department of Maintenance (12 people)	28%	22%	20%	15%	21%
Department of Projects (7 people))	34%	23%	26%	9%	23%
Department of Construction (6 people)	43%	23%	27%	17%	28%
Total (25 people)	34%	22%	23%	14%	23%

Source: JICA Expert Team

The case study sections were selected from national roads considering whether they have various types of work, whether they are supervised by the DRBFC, whether the supervising ability of the DRBFC is appropriate and whether the work will be started during the project period. The Ex-Japan Road improvement work, which was supervised by the Department of Construction, and the Humboe–Letefoho emergency repair work, which was supervised by the Department of Maintenance, were selected as candidates, and the following works 4) to 6) were selected as case studies through consultation with the DRBFC.

1) Design against slope failure – Aitutu landslide investigation

Site surveys were conducted on a section of national road A05 where damage had repeatedly occurred. In the site survey, the locations where the existing measures could not control the landslides were introduced as those with difficulties to restore. In response to this, a location in Aitutu was selected as the case study site for

a landslide investigation to confirm landslide behaviour. Details of activities are described in Section 2.2.3.

2) Design against bridge scour – Sahen River scour countermeasures

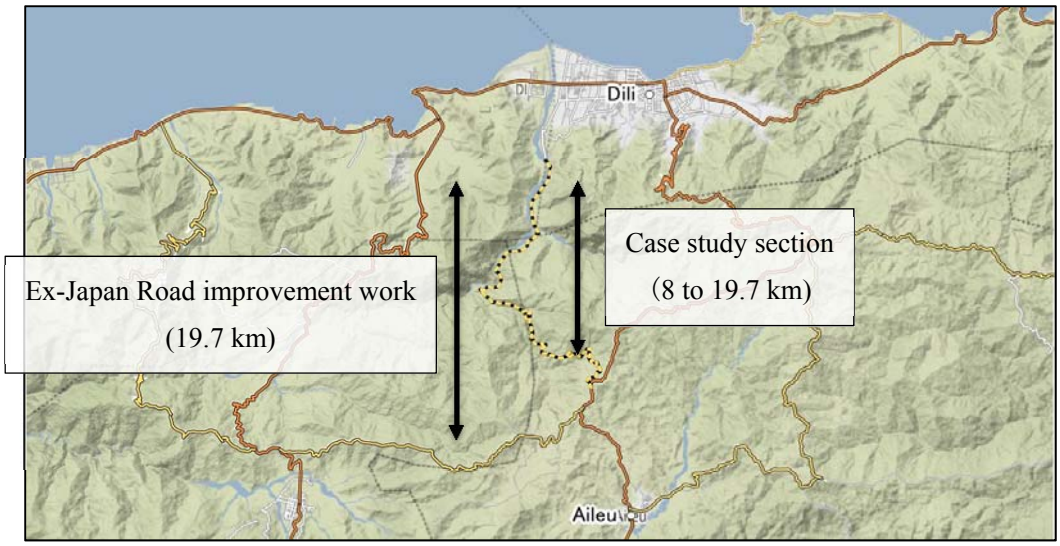
Most of the damage to bridge substructures in Timor-Leste is because they are not protected by concrete blocks or other footing protection, so the bridge substructures become scoured during floods and cavitation occurs around and under the footings. Located in southern Timor-Leste, the Sarai Bridge is also in a dangerous condition, where the bottom of the pier has been scoured and the footing of the piers are visible. If scouring continues in this way, the bridge would suffer from subsidence and vehicles would not be able to pass, so this site was selected as a case study for measures against scouring. The activities are described in Section 2.2.3.

3) Design of cross drainage – Sesurai River culvert repair

Road damages caused by poor drainage have occurred at the many points where roads cross waterways. Overtopping is thought to be a common cause of damage. The causes of overtopping include insufficient culvert capacity for probable rainfall events (inadequate design), reduced culvert capacity due to sedimentation (inadequate design and/or maintenance), and extreme or improbable rainfall events (beyond design basis). The Sesurai culvert was affected by overtopping. It was selected as a case study for design of cross drainage in order to mitigate the hydrological risk of overtopping. The activities are described in Section 2.2.3.

4) Construction management – Ex-Japan Road improvement work

In July 2016, the Ex-Japan Road, which was a new two-lane road improvement work that was supervised by the Department of Construction, was selected as a case study site for construction management. The Ex-Japan Road was selected as a case study for construction management because it is located near Dili and it includes various types of work, including construction of masonry side drains, retaining walls, cross drainage, embankments and road subbase course as part of phase I (9 work areas), and road base course and asphalt surface course as part of the work ordered in September 2017 (2 work areas).



Source: JICA Expert Team

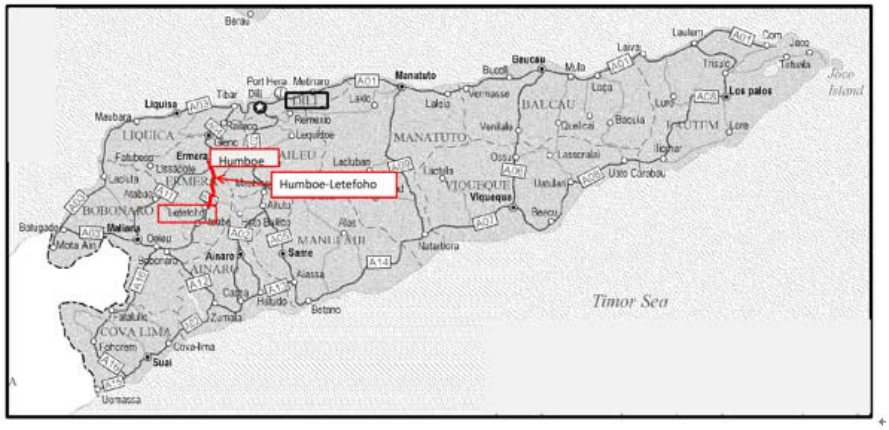
Figure 2.19 Location Map of Ex-Japan Road case study

5) Construction management – Ex-Japan Road cross drainage

The construction of new cross drainage in work area No. 2 on the Ex-Japan Road was selected as a case study for construction management in order to conduct a series of work: from surveying and planning, to design and construction supervision.

6) Construction management – Humboe–Letefoho emergency repair work

The Humboe–Letefoho emergency repair work was contracted in September 2017, it is under the supervision of the Department of Maintenance, and it involves repair work on national road A10. This work will be completed in 2019 during the project period and it includes various types of works, such as construction of road structures and road surface course. In addition, this site was selected as a case study for application of the checklists for construction supervision, quality control and safety management (hereinafter referred to as Checklists for Construction) because it is close to Dili.



Source: JICA Expert Team

Figure 2.20 Location Map of Emergency repair work on Humboe–Letefoho)

(2) Preparation of Checklists for Construction

As a result of site visits, the following problems and inappropriate cases were confirmed. Major problems and inappropriate cases are shown in Table 2.7.

Table 2.7 Problems and inappropriate cases confirmed on site

Work type	Problem or inappropriate case	Details
Quality management	Discrepancy between drawings and site	・Drawings have not been brought to site ・Drawings have not been confirmed in advance
	Collapse of road shoulder embankment	・Inappropriate levelling thickness ・Insufficient rolling ・Insufficient bearing capacity of foundations
	Settlement of the pavement surface above the cross drainage	・Inappropriate levelling thickness ・Insufficient rolling of backfill soil ・Insufficient bearing capacity of foundations ・Inappropriate backfill material
	Masonry retaining walls	・Inappropriate materials ・Insufficient rolling of backfill soil

Work type	Problem or inappropriate case	Details
		・Inappropriate position of drain pipes (weeping drains)
	Drainage gutters	・Untreated ground water in excavations ・Insufficient bearing capacity of foundations ・Insufficient rolling of backfill soil
	Structure with reinforcing bars	・Reversal of the main reinforcement and distribution reinforcement (drawing not checked) ・Insufficient spacers and inappropriate materials ・Insufficient cover soil thickness ・Inappropriate backfill material ・Inappropriate levelling thickness ・Insufficient rolling of backfill soil
Safety management	Personal protective equipment (clothing)	・Helmet not worn ・Safety shoes not worn ・High-visibility vest not worn
	Separation of road and site	・No barricades installed ・No traffic observers arranged
	Safety patrol	・Lack of safety management for contractors ・Low awareness of DRBFC safety
Construction management	Construction schedule control	・Construction schedule control affects construction company payments if construction is delayed, but DRBFC staff are less aware because it does not directly affect DRBFC site activities.

Source: JICA Expert Team

After considering these cases and confirming the abilities of DRBFC staff, the JICA Expert Team provided support for construction supervision through case studies and prepared Checklists for Construction as a tool to allow DRBFC staff to sustainably carry out construction supervision. The Checklists for Construction have supplementary explanations with diagrams and they are written in English and Tetun so that they can be understood by various DRBFC staff.

The Checklists for Construction consist of a checklist for quality control, a checklist for safety, and a checklist for construction management. In addition, the JICA Expert Team proposed that the DRBFC staff make corrections, additions and revisions to the checklists as necessary while using them on site. The contents of the Checklists for Construction are shown below.

I. Quality Control
10_Earth Work
- Excavation
- Embankment
- Aggregate Surface Course (Crushed Aggregate Course on Existing Pavement)
- Widening of Embankment

20_Small Structures
- Pipe Culvert
- Stone Masonry Drainage
- Stone Masonry Retaining Wall
- Concrete Drainage
- Gabion Mat

30_Box Culvert
40_Road Pavement works
- 41_Base Course and Sub-base
- 42_Asphalt Pavement
  - Design and specification
  - Check Points of Daily Quality Control on Site
  - Core Sampling Test

II. Safety Control
- 10_Daily Safety Checking
- 20_Regular Safety Activities
- 30_Safety organization and management
- 40_Check List for Safety Patrol

III. Construction Management
- 10_Tender document (Drafting; reference only)
- 20_Daily, Interim payment and Final Inspection
- 30_Drawing

(3) Implementation of case studies

1) Ex-Japan Road activities

a) Quality control for improvement and restoration work

The activities for construction supervision of improvement and restoration work included on-the-job training using the Checklists for Construction on the Ex-Japan Road case study site, workshops on the site of the Project for Construction of the Upriver Comoro Bridge, and lectures in the DRBFC conference room. A list of the activities conducted are shown in Table 2.8. In particular, the workshops of the Upriver Comoro Bridge involved technology transfer of the high quality and safety management practices of Japan, including construction supervision of earthwork, pavement and bridge construction; quality control with various material tests and compressive strength tests of concrete; and safety management through appropriate placement of safety facilities, safety patrols and safety meetings.

Table 2.8 Details of Ex-Japan Road activities

Date	Case study items	Activity description	Participants
19 August, 2016	Site inspection	Site inspection	2 DRBFC engineers
24 August, 2016	Workshop	Quality control with concrete material and compression testing	4 DRBFC engineers

6 September, 2016	Site inspection	Site inspection	2 DRBFC engineers
6 October, 2016	Observation of safety activities	Safety patrol of the Construction of the Upriver Comoro Bridge	6 DRBFC engineers
13 October, 2016	Safety management course (1)	Current state and general safety measurement of DRBFC sites	17 DRBFC engineers
19 October, 2016	Site inspection	Site inspection	3 DRBFC engineers
20 October, 2016	Site inspection	Confirmation of on-site progress	3 DRBFC engineers
4 July, 2017	Observation of safety activities	Safety patrol of the Construction of the Upriver Comoro Bridge	11 DRBFC engineers
24 August, 2017	Site inspection	Unresolved issues concerning site work	4 DRBFC engineers
12 September, 2017	Progress management course	Ex-Japan Road improvement work and Ainaru emergency repair work	16 DRBFC engineers
19 September, 2017	Safety Patrol / Safety Committee	Safety patrol of the Construction of the Upriver Comoro Bridge	15 DRBFC engineers
24 November, 2017	Safety management course (2)	DRBFC role and proposal of safety activities	22 DRBFC & R4D-SP engineers
12 and 15 December, 2017	Asphalt pavement workshops 1 and 2	Material and formulation design, laboratory quality control and Marshall testing	26 DRBFC engineers
2 February, 2018	Asphalt pavement workshop 3-1	Temperature control and core sampling	8 DRBFC engineers
28 February, 2018	Asphalt pavement workshop 3-2	Site inspection of the Construction of the Upriver Comoro Bridge using a checklist	10 DRBFC engineers
Total			149 people

Source: JICA Expert Team

Progress management course about the Ex-Japan Road improvement work and Ainaru emergency repair work (12 September, 2017)

Marshall test during asphalt pavement workshop 2 (15 December, 2017)

On-the-job training for quality control on Ex-Japan Road (19 October, 2016)

Safety patrol of the Construction of the Upriver Comoro Bridge (19 September, 2017)

b) Safety patrol

In Timor-Leste, although the DRBFC staff, as the client, are aware that "safety is the responsibility of the contractor," it is important that the client also be responsible for safety management, as an employer, and assist in site safety patrols as part of construction management. The JICA Expert Team conducted a safety patrol workshop on site of the Construction of the Upriver Comoro Bridge, incorporated the safety patrol approach and methods learned at the workshop into the Ex-Japan Road work, and assisted the DRBFC to implement safety patrols themselves.

On 21 February, 2018, the Director of DRBFC instructed the Department of Construction to carry out safety activities on its own. In response to this, the Department of Construction assigned sections No. 3, No. 8 and Phase II of the Ex-Japan Road, which all had pavement under construction, as safety patrol sites.

In addition, the JICA Expert Team selected the Chief of the Department of Construction to be the chairperson of a site safety committee and selected the engineers in charge of the construction to be the coordinators. Due to the nature of safety activities, it is essential for the construction contractors involved in the construction to participate, so representatives of the contractors for the Ex-Japan Road construction work became members of the committee. The safety committee were part of case study activities, and two staff from each of the other departments, such as the Department of Projects, joined the committee as observers.

On 13 June, 2018, the Chief of the Department of Construction issued a request to the contractors and each committee member to hold the first site safety meeting. As shown in Table 2.9, the “Safety Committee” and “Safety Patrol” were held twice, and DRBFC staff recognized the need for safety management and safety promotion activities in construction supervision.

Table 2.9 Details of Ex-Japan Road safety patrol

Date	Location	Case study items and activities	Participants
26 June, 2018	DRBFC meeting room, Dili	1st Site Safety Committee	16 people (4 engineers from DRBFC Department of Construction, 10 other DRBFC engineers, 2 construction contractors)
	No. 9 on Ex-Japan Road	Safety patrol of footpath construction	
	No.3 on Ex-Japan Road	Safety patrol of masonry retaining wall construction	

19 September, 2018	DRBFC meeting room, Dili	2nd Site Safety Committee	15 people (3 engineers from DRBFC Department of Construction, 9 other DRBFC engineers, 3 construction contractors)
	17.85 to 18.00 km on Ex-Japan Road	Safety patrol of aggregate base course construction	
	7 to 8 km on Ex-Japan Road	Safety patrol of masonry retaining wall construction	
	6.27 km on Ex-Japan Road	Safety patrol of laying of cross drainage	
Total			31 people (26 people not including construction contractors)

Source: JICA Expert Team

The DRBFC learned the method of conducting safety activities through implementing the "Safety Council" and "Safety Patrol" twice by themselves. An instruction from the Director of DRBFC to the Chief of the Department of Construction is essential in order to continue these safety activities in the future and to start new initiatives, such as was the case with repeatedly coordinating through safety lectures.

Safety patrol of masonry retaining wall on Ex-Japan Road (26 June, 2018)

Safety patrol of laying of cross drainage on Ex-Japan Road (19 September, 2018)

2) Construction supervision activities for cross drainage

The JICA Expert Team used the cross drainage planned for the Ex-Japan Road as a case study and conducted a series of surveys, planning, design and construction supervision in collaboration with the working group that prepared the Culvert Design Guideline. A basic survey was conducted by the working group for culvert design, including a preliminary survey and calculation of the estimated flow rate. The results of the case study were announced by the working group at the 4th JCC meeting held on 26 September, 2018.

Condition of the proposed site for cross drainage on Ex-Japan Road

Inspection with DRBFC staff on Ex-Japan Road (6 February, 2018)

3) Humboe–Letefoho activities

Site quality control using Checklists for Construction was conducted in order to improve the construction supervision ability of the Department of Maintenance.

Table 2.10 Details of Humboe–Letefoho activities

Date	Location	Case study items and activities	Participants
14 June, 2018	Humboe–Letefoho emergency repair work on A10 road	Site inspection of road subbase course	1 person (Department of Maintenance)
25 June, 2018	DRBFC meeting room, Dili	Explanation of Checklists for Construction	22 people (Department of Maintenance, Department of Construction, Department of Projects, and others)
12 September, 2018	Humboe–Letefoho emergency repair work on A10 road	On-the-job training using checklists for road subbase, masonry side drains and crossing drainage	3 people (Department of Maintenance)
3 October, 2018	DRBFC meeting room, Dili	Workshop on inspections of Humboe–Letefoho emergency repair work and Ex-Japan Road improvement work using checklists	4 people (Department of Construction and Department of Maintenance)
10 October, 2018	DRBFC meeting room, Dili	Explanation and dissemination of Checklists for Construction	7 people (Department of Construction, Department of Maintenance, and Department of Analysis and Evaluation）)
		Total	37 people

Source: JICA Expert Team

On-the-job training using checklists for masonry retaining walls on Humboe–Letefoho emergency repair work (28 June, 2018)

On-the-job training using checklists for masonry retaining walls on Humboe–Letefoho emergency repair work (12 September, 2018)

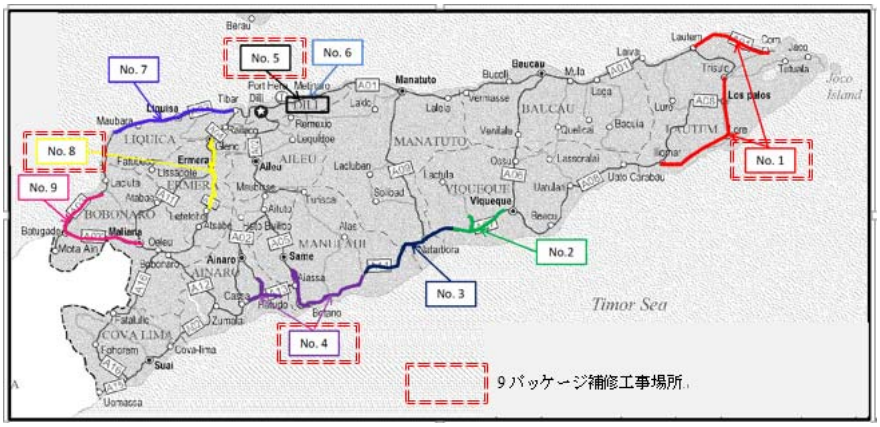
On-the-job training using checklists for cross drainage on Humboe–Letefoho emergency repair work (28 June, 2018)

On-the-job training using checklists for cross drainage on Humboe–Letefoho emergency repair work (12 September, 2018)

(4) Other activities

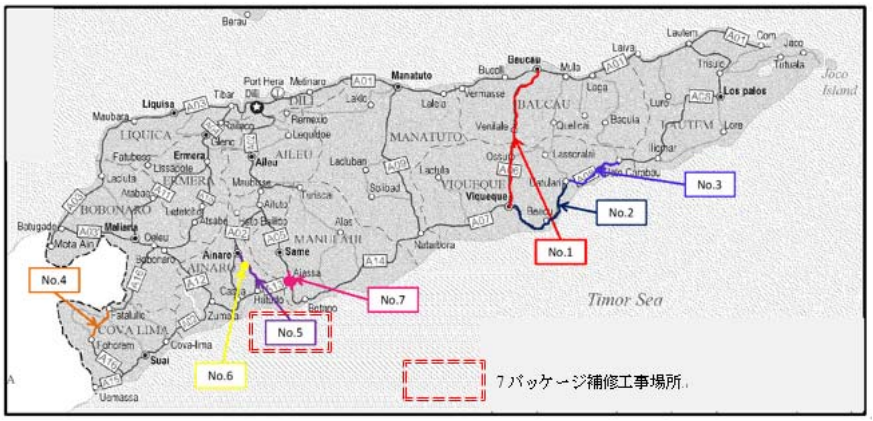
1) 9 Packages and 7 Packages activities

In 2016 and 2017, the design and construction supervision work being conducted by Department of Maintenance was selected as supplementary sites for case studies. Package No.1 (Lospalos-Iliomar), No.4 (Betano-Dotic), No.5 (Mariana) and No.8 (Gleno) were selected from amongst the 9 Packages, and package No.5 (Ainaru-Hatudo) was selected from amongst the 7 Packages as case study sites. The works mainly consisted of gutter cleaning and construction of masonry retaining walls, masonry side drains, cross drainage and crushed stone pavements. The sites were judged to be the suitable for training C/P in the Department of Maintenance, who had little construction supervision experience, because they mainly consisted of periodic inspections and basic construction work.



Source: JICA Expert Team

Figure 2.21 Location map of 9 Packages sites



Source: JICA Expert Team

Figure 2.22 Location map of 7 Packages sites

The JICA Expert Team mainly provided support for construction supervision through on-the-job training using Checklists for Construction on site and through workshops in the DRBFC meeting room that pointed out problems concerning supervision with construction examples, because the Department of Maintenance handling the supervision of repair work had little experience of supervision. In addition, the workshops concerning the Construction of the Upriver Comoro Bridge involved technology transfer of the high quality and safety management practices of Japan.

Table 2.11 Details of 9 Packages and 7 Packages activities

Date	Location	Case study items and activities	Participants
9 August, 2017	Gleno site on A04 road (No. 8 of 9 Packages)	Site inspection and confirmation of progress	3 people (Department of Maintenance)
15-16 & 21-22 August, 2017	Betano-Dotic site on A14 road (No.4 of 9 Packages)	OJT for site inspection and quality control	12 people (Department of Maintenance)
	Emergency construction of Sesurai culvert on A05 road	Site inspection and contract management	
	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	OJT for site inspection and quality control	
24 August, 2017	Gleno site on A04 road (No. 8 of 9 Packages)	Site inspection and improvement recommendations	2 people (Department of Maintenance)
29-30 August, 2017	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	OJT for safety and quality control	2 people (Department of Maintenance)
	Betano-Dotic site on A14 road (No.4 of 9 Packages)	OJT for quality control of drainage	
12 & 14 September, 2017	Betano-Dotic site on A14 road (No.4 of 9 Packages)	OJT for site inspection and quality control of drainage and road base construction	2 people (Department of Maintenance))
	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	Site inspection and confirmation of progress	

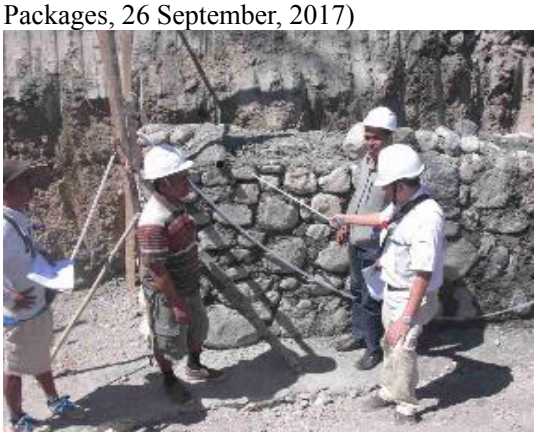
Date	Location	Case study items and activities	Participants
25-27 September, 2017	Iliomar and Lospalos sites on A08 road (No. 1 of 9 Packages)	OJT for regular maintenance inspections and quality control of concrete pavement construction	2 people (Department of Maintenance)
21-22 November, 2017	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	Site inspection and confirmation of progress	2 people (Department of Maintenance))
	Casa-Same site on A13 road (No. 5 of 9 Packages)	Site inspection	
Total			24 people

Source: JICA Expert Team

OJT for quality control of drainage on Betano-Dotic site on A14 road (No.4 of 9 Packages, 30 September, 2017)

OJT for quality control of concrete pavement on Iliomar and Lospalos sites on A08 road (No.1 of 9 Packages, 26 September, 2017)

OJT for quality control of concrete mixes on Iliomar and Lospalos sites on the A08 road (No. 1 of 9 Packages, 26 September, 2017)



OJT for quality control of retaining walls on Ainaru-Hatudo site on C23a road (No.5 of 7 Packages, 21 August, 2017)

2) Regional office support activities

Thus far, the JICA Expert Team has provided construction supervision support for the purpose of improving DRBFC capacity. At the 5th JCC meeting held in March 2019, there was a request from the head of a regional office asking for support to improve the construction supervision ability of the engineers in regional offices. In response to this, construction supervision support activities were also carried out on a construction site being supervised by a regional office of the Ministry of Public Works. The details of construction supervision support for a regional office are shown in Table 2.12.

Table 2.12 Construction supervision support for a regional office

Date	11 April, 2019
Location	Likisá
Contents	Conducting workshops using checklists for regional office staff
Target office	Likisá Municipal Road Department (2 persons), Department of Maintenance (1 person)
Project name	Road and Drainage Rehabilitation Project, Emergency Road at Tibalau and Karimbala Likisá, (on A03, Infrastructure Fund 2018 No.287), Work type: Retaining wall
Trainer	Sabino da Costa Ventura, engineer of DRBFC Department of Maintenance

The construction supervision support activities were carried out for the participants from the target office by a DRBFC trainer, who had been trained by the JICA Expert Team. The trainer conducted a workshop about the checklists and on-the-job training using checklists on the above-mentioned construction site.

3) Confirmation of improvement in construction management capability

Comprehension tests were conducted twice in order to evaluate the improvement of construction supervision ability. The contents of the comprehension test included questions about quality control, safety control and construction management.

The first round of tests were taken by 20 participants on 26 June, 2018, and the average percentage of correct answers was 27%. The second round of tests were taken by 19 participants on 24 April, 2019, and the average percentage of correct answers was 56%. The results of these comprehension tests show that abilities for quality control and safety management have been improved; however, abilities for construction management have not improved. The reason for construction management abilities not improving is that construction schedule management, which is a main part of construction management, affects the payment of the construction company if the construction is delayed; however, it is not directly affected by the site activities of DRBFC, so the DRBFC staff may not be actively interested. Therefore, it is assumed that a lack of interest is the cause for no improvement in the level of understanding. Table 2.13 shows the results of the comprehension tests for construction supervision.

Table 2.13 Comprehension test results for construction supervision

Test	Subject			
	Quality management	Safety management	Construction management	Average
1st test	24%	30%	43%	27%
2nd test	64%	63%	37%	56%
Improvement rate	40%	33%	-6%	29%

Source: JICA Expert Team

The results of the final tests conducted in July 2019 are shown in Table 2.14.

Table 2.14 Final test results (quality control)

	Quality management				
	1. Concrete	2. Aggregate Subbase course	3. Aggregate Base Course	4. Aggregate Surface Course	Percentage of correct answers
Department of Maintenance (9 people)	42%	40%	49%	40%	43%
Department of Projects (9 people)	38%	47%	22%	31%	34%
Department of Construction (6 people)	50%	43%	33%	43%	52%
Department of Highway Construction Management (1 person)	37%	43%	27%	30%	55%
Total (25 people)	43%	43%	36%	38%	40%

Source: JICA Expert Team

The results of the final test demonstrated an increase by 17% compared to the results of the baseline tests, as shown in Table 2.6. Amongst the final test results, two trainer candidates answered 65% correctly for quality control. The two trainer candidates, from the Department of Maintenance and the Department of Construction, were trained through case studies in order to allow the DRBFC to continue improving its construction supervision ability in the future. It will be important for each trainer to instruct the DRBFC's young engineers, who are expected to increase in the future, to conduct construction management continuously.

(5) Proposal of an appropriate construction supervision system

1) Preparation and utilization of Checklists for Construction

The Checklists for Construction were prepared to support the construction supervision system for road improvement work and repair work through case studies. In the case studies of this project, the experienced senior engineers of the DRBFC applied on-site quality control and safety management. The Checklists for Construction were designed to facilitate the implementation of quality control and safety management on construction sites, and they were compiled as a tool for junior engineers, regional engineers and DRBFC staff in charge of construction management who have little experience in construction management.

The Checklists for Construction were prepared for quality control of construction sites, and also for safety management and construction management. The Checklists for Construction include a checklist for quality control, a checklist for safety and a checklist for construction management. In addition, the JICA Expert Team proposed that the DRBFC correct, supplement and revise the Checklists for Construction as necessary by using them on site.

2) Utilization of regional offices

Due to the shortage of headquarters staff, insufficient construction supervision in the regions is also a problem for the Department of Maintenance and the Department of Construction. For example, construction supervision in the Lospalos region requires a business trip of 2 nights and 3 days away from Dili.

It is necessary to examine measures to strengthen cooperation between the Ministry of Public Works and the State Department in order to improve the construction supervision system, such as by improving the infrastructure-related technical staff currently affiliated with the local government under the State

Department and reassigning them as on-site construction supervisors under the DRBFC.

3) Enhancement of construction supervision training

The number of young and inexperienced staff is expected to significantly increase in the future and, in order to enhance the construction supervision ability within the DRBFC, it is necessary to raise the skills of these staff by training them using on-the-job training under skilled construction supervisors as trainers. At that time, it is desirable to improve their capacity through practical training using the Checklists for Construction.

2.2.4 Activities 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."

The activities carried out to achieve Output 3 are described in the following two sections: (1) scour protection and cross drainage, and (2) slope protection and landslide investigations.

(1) Activities for scour protection and cross drainage

1) Review of existing technical documents

In Timor-Leste, the *Bridge Design Standards & Manual* (Ministry of Public Works, Transport and Communication, 2012) is used as technical guidelines. It was designed based on bridge standards from AASHTO (American Association of State Highway and Transportation Officials), Australia, and Indonesia. The focus of the *Bridge Design Standards & Manual* is basic information that is necessary for the preliminary design of bridges. While the calculation formula for river discharge and other such fundamentals is included, there is no information regarding substructure scouring.

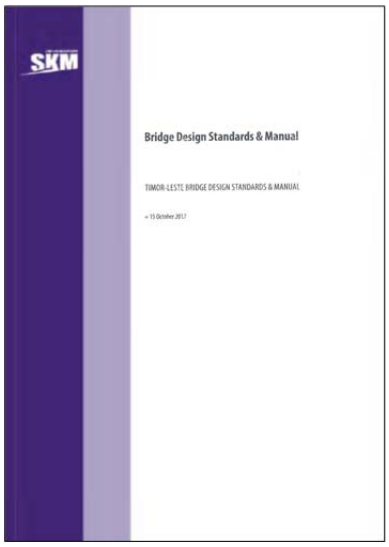


Figure 2.23 *Bridge Design Standards & Manual* (Ministry of Public Works, Transport and Communication, 2012)

Regarding drainage and culverts, the *Bridge Design Standards & Manual* (Ministry of Public Works, Transport and Communication, 2012) gives basic guidance on selection of a bridging structure and basic structural requirements for culverts in Section 2, and guidance about hydrological studies and hydraulic design for bridges in Section 5. While the Rational Method has been recommended for small catchments, the

manual does not include how to apply the method to culvert design. The *Standard Specifications* (Ministry of Public Works, Transport and Communication, 2014) gives basic guidance about material requirements and quality control for drainage construction in Section 600. The specification was designed to facilitate construction management and references standards from AASHTO. The *Road Geometric Design Standards* (Ministry of Infrastructure, 2010) gives minimum requirements for roadside ditches in Section 6.7. The standard includes no information about drainage design for culverts.

Figure 2.24 *Standard Specifications* (Ministry of Public Works, Transport and Communication, 2014) (left) and *Road Geometric Design Standards* (Ministry of Infrastructure, 2010) (right)

2) Analysis of past damage cases

a) Scour of bridge substructures

The damage to bridge substructures in Timor-Leste is due to the lack of foot protection works, such as concrete blocks, which would protect bridges from scouring damage. Without this protection, scour holes have been developing around and under the footings. In the case of Kelan Bridge, in southern Timor-Leste, scouring at the bottom of the abutment has resulted in the development of a large crack in the abutment. Emergency measures are necessary. Also in southern Timor-Leste, Sarai Bridge is also in dangerous condition as it has scour damage at the bottom of the bridge pier, and the bottom of the footing has become exposed.

Scouring under abutment (Kelan Bridge)

Scouring under pier (Sarai Bridge)

Figure 2.25 shows an example from Japan, are examples of the potential danger of allowing scouring to continue. In these cases, the large amount of settlement damage required the restriction of vehicle traffic on the bridge due to safety concerns.

Figure 2.25 Example of damage due to scouring (Japan)

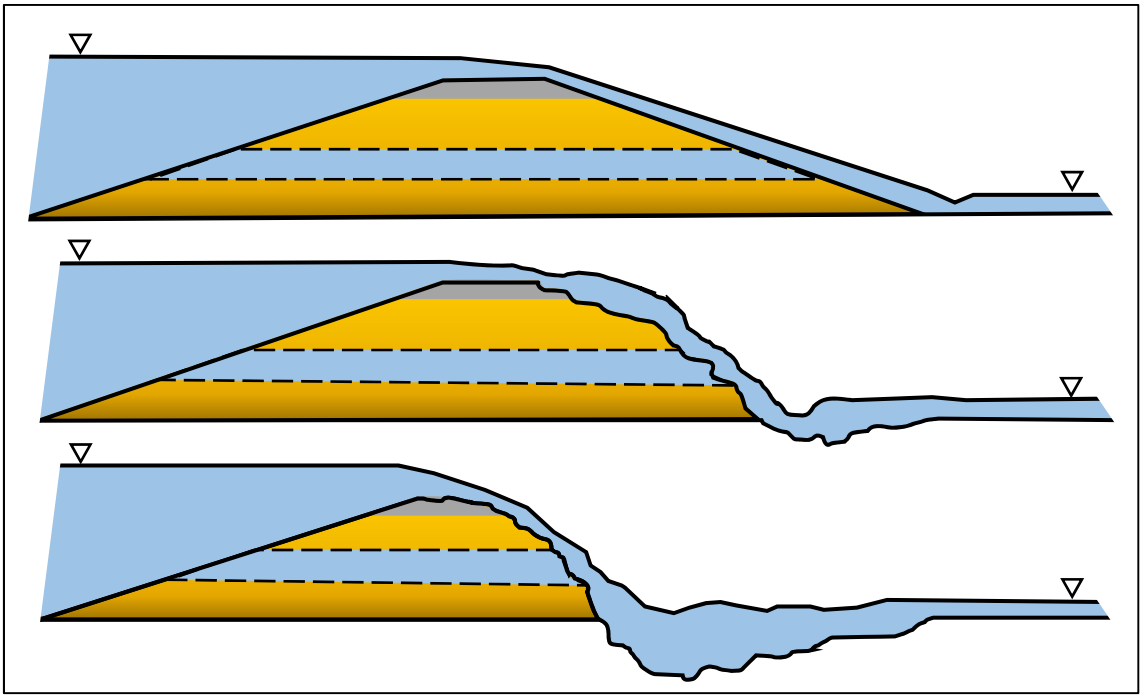
b) Overtopping and erosion of cross drainage

The damage due to drainage issues is prevalent where roads cross watercourses and thus where culverts are necessary. Cases of road structure damage in Timor-Leste are shown below.

A05 Road structure damage (Sesurai)

A03 Road structure damage (Likisá)

A common failure mechanism of the road structure for these cases is overtopping with free fall on the downstream side, as shown in Figure 2.26. The causes of overtopping include insufficient culvert capacity for probable rainfall events (inadequate design), reduced culvert capacity due to sedimentation (inadequate design and/or maintenance), and extreme or improbable rainfall events (beyond design basis). The appropriate design of discharge for cross drainage can mitigate the hydrological risk of overtopping onto roads.



Source: Minimizing Embankment Damage during Overtopping Flow (Clopper & Chen, 1988)

Figure 2.26 Progressive stages of road structure erosion due to overtopping

3) Civil engineering training for appropriate design verification

a) Training for bridge substructure protection

To ensure the appropriate and effective implementation of scouring protection measures for bridge substructures, it was found necessary to train DRBFC staff in basic river-related civil engineering. Therefore, lectures were held prior to this case study. The topics covered and schedule of the lectures are shown in Table 2.15

The participants of the training included not only the members of the case study working group (to be discussed in 3.3.5 (3)) but also all DRBFC staff. As can be seen in the table below, a large variety of topics was covered in the lectures, including both theory and example calculations to provide thorough explanations.

Table 2.15 Training schedule for bridge substructure protection

Training Topic	Date
Calculation example of Comoro River discharge (rational formula)	July 2016
Foot protection works for scouring	January 2017
Weather resistance big sand bag method for damage site	April 2017
Groin study using Loes River	November 2017
Case study for Sahen	March 2018
Explanation of Bridge Substructure Protection Guidelines	June 2018

Source: JICA Expert Team


Civil engineering training

b) Training for cross drainage

It was necessary to provide DRBFC staff with knowledge on a basic planning and design procedure for culverts that was appropriate for their level of ability and needs. Table 2.16 shows the topics that were included as part of the training. Lectures for training topics involving design calculations were accompanied by workshops for practical skills in order to practice the relevant design steps and demonstrate the case study. The lectures and workshops were attended by DRBFC staff and staff of other donor projects (R4D-SP), and the number of attendees for each training session was 8 people on average with the most attended training having 19 people. In total, 25 hours of training were provided

Table 2.16 Training schedule for culvert planning and design

Training Topic	Date
Catchment basin analysis	February 2017
Rainfall (frequency) analysis and runoff analysis (Rational Method)	August 2017
Calculation of drainage structure capacity (open-channel hydraulics)	November 2017
Consideration of erosion protection measures	February 2018
Summary of case study of Sesurai culvert on A05 road	March 2018
Explanation of draft guidelines for planning & design of culverts	June 2018
Progress of case study of Sarlala culvert on Ex-Japan Road, and presentation of key points from guidelines for planning & design of culverts	September 2018
Presentation of findings from the case study of Sarlala culvert on Ex-Japan Road, and presentation of key points from guidelines for planning & design of culverts	March 2019

Source: JICA Expert Team

4) Preparation of draft guidelines

a) Bridge substructure protection guidelines

A draft of the Bridge Substructure Protection Guidelines was submitted to DRBFC in June 2018. It was drafted starting in February 2018 based on the opinions of DRBFC staff and underwent editing before being submitted to the DRBFC. As with the lectures, the guidelines contain not only theory but also example calculations. Additionally, materials (including example calculations) from the lectures are included in the guidelines. By allowing DRBFC staff to personally review these calculations, it is easier to understand how to use the formulas correctly. This provides materials that can easily be understood and used by DRBFC staff.

Presentation about the Bridge Substructure Protection Guideline

b) Culvert Design Guidelines

The drafting of the Culvert Design Guidelines began in November 2017 based on the procedure used for a design case study and the needs of DRBFC staff during the training lectures. An outline of the guidelines was proposed to the DRBFC in February 2018 and also discussed with technical staff of R4D-SP. In June 2018, a complete draft of the guidelines (DG) was submitted to the DRBFC and a presentation was held to explain its contents. Following the presentation, feedback from stakeholders was collected and counterpart staff of the DRBFC made the necessary changes to finalise the guideline. In September 2018, the final draft guidelines (FDG) was submitted to the director of DRBFC and subsequently prepared for submission to the Minister of Public Works for approval.

The Culvert Design Guidelines comprised the main guidelines and a separate annex. The annex included a demonstration of the design procedure through its application to the case study of the Sesurai culvert, the presentation materials that were used during the training lectures, and reference information about weather stations.

Presentation about the Culvert Design Guidelines (DG)

5) Inclusion of case studies in draft guidelines

For activities for Output 3, the case study of bridge scour protection works was completed as follows.

a) Case study work for bridge substructure protection and reflection in draft guidelines

Selection of scour protection case study sites

Sahen Bridge was selected as the site of the case study based on its accessibility from Timor-Leste's capital, Dili, the urgency of repairs, and requests from DRBFC.

Source: JICA Expert Team

Figure 2.27 Location of Sahen Bridge

The conditions at the case study site (Sahen Bridge) are as follows. There is scouring damage in front of the abutment and below the bridge pier footing, both on the right bank side. Urgent measures are necessary.

Abutment scouring damage (Sahen Bridge)

Bridge pier scouring damage (Sahen Bridge)

Working Group

The case study working group is comprised of three staff from the DRBFC Maintenance Department (Region 3), one staff from the Department Municipal, and one staff from the Project Department who received river training in Japan under the JICA training program.

Table 2.17 Scour protection case study working group

部署	名称
Department of Maintenance (Region 3)	Cristovao da Costa Monteiro
Department of Maintenance (Region 3)	Celestino Evangelino Ximenes
Department of Maintenance (Region 3)	Antonio Araujo
Same Municipal Road Department	Aniceto Aquio Andrade
Department of Projects	Letigia dos Reis Hanjan Corbafo

Working group engaged in a group discussion

Activities

The activities are shown in Table 2.18. Through collaboration between the JICA Expert Team and the working group, the following investigations necessary for the case study were conducted: a survey of riverbed materials, river surveying, joint site surveys, studies of velocity of river flow and discharge, and studies of protection work using foot protection blocks. Then, in March 2018, the JICA Expert Team gave a presentation to DRBFC staff about the information regarding countermeasures obtained from case studies.

In order to disseminate the information to all departments, the working group gave a presentation about the information gathered during the case study to all DRBFC staff.

Table 2.18 Case study activities

Activity	Contents
Riverbed materials survey (subcontracted to local surveying company)	Explanation of purpose of survey and contents
River surveying (subcontracted to local surveying company)	Explanation of purpose of survey and contents
Case study investigation	・joint site surveys ・study of river discharge ・study of river velocity ・studies of protection work using foot protection blocks

Activity Schedule

Activity 3 was carried out according to the schedule shown in Table 2.19

Table 2.19 Schedule of Activity 3

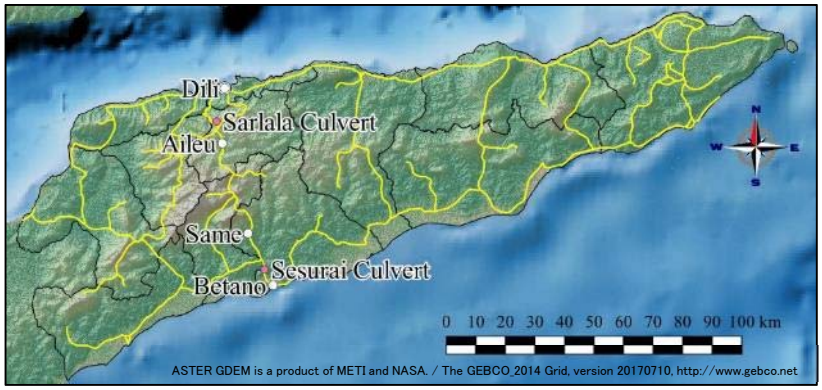
Activities		2016							2017												2018						
		Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul
1. River surveying																	━	━									
2. Riverbed materials survey																		━									
3. Case study investigation	3-1 Joint field surveys											●									●						
	3-2 Study of river discharge																		━	━							
	3-3 Study of river velocity																		━	━							
	3-4 Study of protection work using foot protection blocks																				━	━					
4. Development of guidelines																						━	━	━	━		
5. Civil engineering training	5-1 Calculation example of Comoro River discharge (rational formula)		●																								
	5-2 Foot protection works for scouring								●																		
	5-3 Weather resistance big sand bag method for damage site											●															
	5-4 Groin study using Loes River																		●								
	5-5 Case study for Sahen																					●					
	5-6 Explanation of Bridge Substructure Protection Guidelines																									●	

Source: JICA Expert Team

b) Case study work for culvert design and reflection in draft guidelines

Selection of a case study for culvert design and a working group

Regarding culvert planning and design, two case studies were carried out: the Sesurai culvert on A05 Road was used to determine the guidelines procedure and demonstrate their application, and the Sarlala culvert on the Ex-Japan Road was used to assess the DRBFC staff's ability to apply the guidelines' procedure and undertake culvert design. The location of the case study sites are shown in Figure 2.28.



Source: JICA Expert Team

Figure 2.28 Location of Sesurai and Sarlala culverts

The conditions of the case study sites at the start of the investigations are shown below.

Damaged road and culvert (Sesurai culvert)

Culvert for improvement (Sarlala culvert)

The Sesurai culvert and A05 road were damaged in the 2016–2017 rainy season. The rationale for selecting the Sesurai culvert as a case study was as follows.

- Importance: the A05 is a national road and thus the DRBFC considered it an urgent case that required emergency repairs and provision of appropriate drainage.
- Accessibility: the site was located near a major municipal town, within 60 minutes' drive from a municipal office of the DRBFC and the general security in the region was good.
- Generality of work item: the case study concerned a new construction of a culvert for cross drainage under a road. Once completed, the knowledge obtained by the case study could be applicable to other areas of Timor-Leste.

The Sarlala culvert and Ex-Japan Road were part of an ongoing road improvement project that was started in 2015. The rationale for selecting the Sarlala culvert as a case study was similar to the Sesurai culvert except for the importance being lower, which was due to the project not being emergency repairs, and the accessibility being better, because the project was close to Dili. The working groups for the case studies are shown in Table 2.20

Table 2.20 Working groups for culvert planning and design case studies

Name	Department
Sesurai culvert case study (Region 3)	
Cristovao da Costa Monteiro	Department of Maintenance (Region 3)
Pedro Cortereal Noronha	Department of Maintenance (Region 3)
Aniceto Aquio Andrade	Same Municipal Road Department
Sarlala culvert case study	
Manuel Soares	Department of Projects
Letigia dos Reis Hanjan Corbafo	Department of Projects
Celestino Evangelino Ximenes	Department of Highway Construction Management
Fernando Fortunato Freitas	Department of Highway Construction Management

Working group conduct site investigation for Sarlala culvert case study

In order to facilitate the data collection and planning, the members of the working group for the Sesurai culvert case study were selected primarily because the site was under their jurisdiction within DRBFC and because of their familiarity with the region.

In order to evaluate applicability of the prepared guideline, the members of the working group for Sarlala culvert case study were selected based on their level of comprehension of the guidelines and their motivation to participate.

Working group activities and reflection in draft guide

Under the guidance of the JICA Expert Team, the working group conducted drainage capacity checks for case studies, including data collection and joint site surveys, rainfall and runoff analyses, acquisition of topographic data, and consideration of erosion prevention measures. Based on the first case study in Sesurai, case study results and procedures, and feedback from the training were compiled into the technical guideline. DRBFC engineers conducted the second case study in Sarlala while referring to the technical guideline.

To further disseminate the information, the working group presented to other DRBFC staff about the progress of the Sarlala case study, along with important information from the technical guideline, as described in the following Section "Dissemination of guidelines". These presentations were also an opportunity to try autonomous internal training.

Table 2.21 shows the activities of case studies related to the preparation and training of technical guidelines.

Table 2.21 Schedule of culvert case studies, guidelines development and training

Activities		2016			2017													2018												2019		
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Case study						3) Sesurai culvert																5) Sarlala culvert										
1. Data collection	1-1. Joint field survey					▲						▲										▲										
	1-2. Review of existing drawings																															
2. Rainfall analysis & runoff analysis	2-1. Confirmation of catchment																															
	2-2. Estimation of discharge volume																															
3. Survey	3-1. Preparation for survey																															
	3-2. Topographic survey																															
4. Culvert capacity	4-1. Confirmation of flow capacity																															
	4-2. Advice for basic design																															
5. Guideline development	5-1. Preparation of draft guideline																															
	5-2. Collection of feedback																															
	5-3. Finalisation of guideline																															
	5-4. Dissemination of guideline																															
6. Training lectures & workshops	6-1. Assessment of catchment basin						▲																									
	6-2. Rainfall & runoff analysis											▲																				
	6-3. Culvert discharge capacity														▲																	
	6-4. Erosion protection measures																	▲														
	6-5. Case study summary / progress																		▲						▲							△
	6-6. Explanation of guideline																					▲			△							△

Source: JICA Expert Team

6) Dissemination of guidelines

In June 2018, the working group members gave a presentation on the Bridge Substructure Protection Guidelines to all DRBFC staff. After the presentation, the participants asked many questions, indicating that there was a high level of interest.

In June 2018, the JICA Expert Team gave a presentation about the Culvert Design Guidelines to DRBFC staff. After the presentation, electronic copies of the draft guidelines were distributed to the department on CDs and made available to other stakeholders via download. In September 2018, the working group gave a presentation about the Culvert Design Guidelines to other DRBFC staff in Tetun to facilitate understanding.

In March 2019, the JICA Expert Team collaborated with a rural road development project to hold a seminar where the DRBFC staff repeated the presentation of the Culvert Design Guidelines for representatives of municipal offices, DRBFC interns and R4D-SP engineers. Again in March 2019, the JICA Expert Team held a one-day seminar to introduce all guidelines to representatives of municipal offices, other donor projects and higher education institutes.

Presentation of Culvert Design Guidelines at joint seminar

Presentation and discussion of guidelines at a one-day seminar

(2) Activities for slope protection and landslide investigation

1) Review of existing technical documents

Although not official, the DRBFC normally uses standard drawings that have been used in aid projects, such as by ADB, for domestic projects. The JICA Expert Team checked 106 project drawings stored in the Department of Projects regarding the frequency of use for commonly-used drawings. The results are shown in Table 2.22. The JICA Expert Team judged that these commonly-used drawings practically fulfil the role of standard drawings

Table 2.22 Frequency of use for commonly-used drawings in the Department of Projects

Project	Side drains	Cross drains	Gravity Retaining Walls	Gabion	Pavement
106	36	13	30	62	19

Source: JICA Expert Team

Slope Protection Guideline (2008) are existing guidelines related to slope protection; however, they are

rarely used. The cause of this low usage was considered to be the following:

- The contents stay within schoolbook general theory and introduction of techniques; therefore, it is necessary to search and refer to design examples separately in order to design countermeasures for actual problems.
- Readers must read on till reach useful information for their pending problems among wide coverage and big volume of textual information.
- There are broad descriptions and a lot of text, so considerable reading is required and it is difficult to quickly reach useful information.
- The guidelines require readers' knowledge, such as technical terms for engineering geology.

Therefore, the guidelines are good for enriching basic knowledge as a textbook; however, they require improvement as guidelines for to solving practical engineering problems.

2) Analysis of past damage cases

a) Slope Protection

The JICA Expert Team observed repeatedly damaged sites along A02 and A05 with guidance by the staff of the Department of Maintenance from 27 to 29 July, 2016. Existing countermeasures against slope disaster by DRBFC were re-cutting of slopes using heavy equipment and many installations of gabion walls for structural countermeasures. Currently, the slope protection works are only implemented by planting vegetation, and protection structures are not being constructed. The site investigation found that there was a problem that could not be controlled by these existing measures and that it was estimated to be a surface layer collapse or landslide of about 2 m in depth.

Surface layer collapse

Scarp (long, steep slope) suspected of landslide

From the above review of existing technical documents and analysis of past damage cases, a discussion was held in December 2016 about changing Output 3 from preparation of standard drawings to preparation of technical guidelines, as a means to prevent repeated damages and contribute to improving the road maintenance capacity of DRBFC. This change to Output 3 was approved at the 2nd JCC held on 16 February, 2017.

b) Landslide

According to the above proposal, two kinds of technical guidelines for shallow slope failure and landslide as mass movement phenomenon were prepared in this project.

3) Civil engineering training for appropriate design verification

a) Slope Protection

In existing condition DRBFC executes few geological investigation and survey in-site. Design engineer must stand on information of ground shape and content for suitable countermeasure design. A soil layer inspection rod named Dokenbo was introduced by the project and some training for usage was implemented to remind importance of site investigation. Nearly none uses total station which provided ex-project therefore training of cross section survey using the total station was also implemented.

Classroom lecture has a tendency that participants often become passive through only hearing. The team headed to workshop style to make participants be active through calculation, drawing and presentation of their own idea.

The JICA Expert Team implemented activities related slope protection as shown in Table 2.23.

Table 2.23 Training schedule for slope protection and landslide investigation

#	Date	Title	Number of Participants
1	30 Nov. 2016	Introduction of Slope Protection	15
2	25 May 2017	Stability Calculation of Gravity Retaining Wall	21
3	1 Jun. 2017	Bearing Capacity of Plane and Slope Ground	9
4	8 Jun. 2017	Stepped Cut Foundation for Retaining Wall	6
5	14 Sep. 2017	How to Use Dokenbo, How to Record the Result	17
6	28 Sep. 2017	Dokenbo Shear Strength Test	7
7	16 Nov. 2017	How to use the Total Station	12
8	21 Nov. 2017	Slope Stability Calculation	12
9	30 Nov. 2017	Slope Collapse Countermeasure	12
10	14 Dec. 2017	Practical Works of Cross Section Survey and DSST	8
11	26 Apr. 2018	Case Study; Estimation of the Collapse Conditions Evaluation Safety of the Slope	7
12	3 May 2018	Case Study; Countermeasure Study	6
13	8 May 2018	Guideline; Slope Stability	7
14	11 Sep. 2018	Guideline; Retaining Wall	14
15	14 Sep. 2018	Case Study; Continuous Observation on the Collapsed Slope and Isolated Cross Section Survey	13
16	20 Sep 2018	Case Study; Slope Collapse Countermeasure Study Based on Site Observation	6
17	10 May 2019	Practical Works of Disaster Investigation	7
18	13 May 2019	Conference of Disaster Investigation	6

Source: JICA Expert Team

b) Landslide

Through this activity, the JICA Expert Team indicates as the good case study that suggests necessity and important process of investigation before planning basic and design of counter measures. The contents of technical transfer are shown as follows.

c) Preparation of Ortho photo and detailed topographic map used by unmanned aerial vehicle (UAV) survey

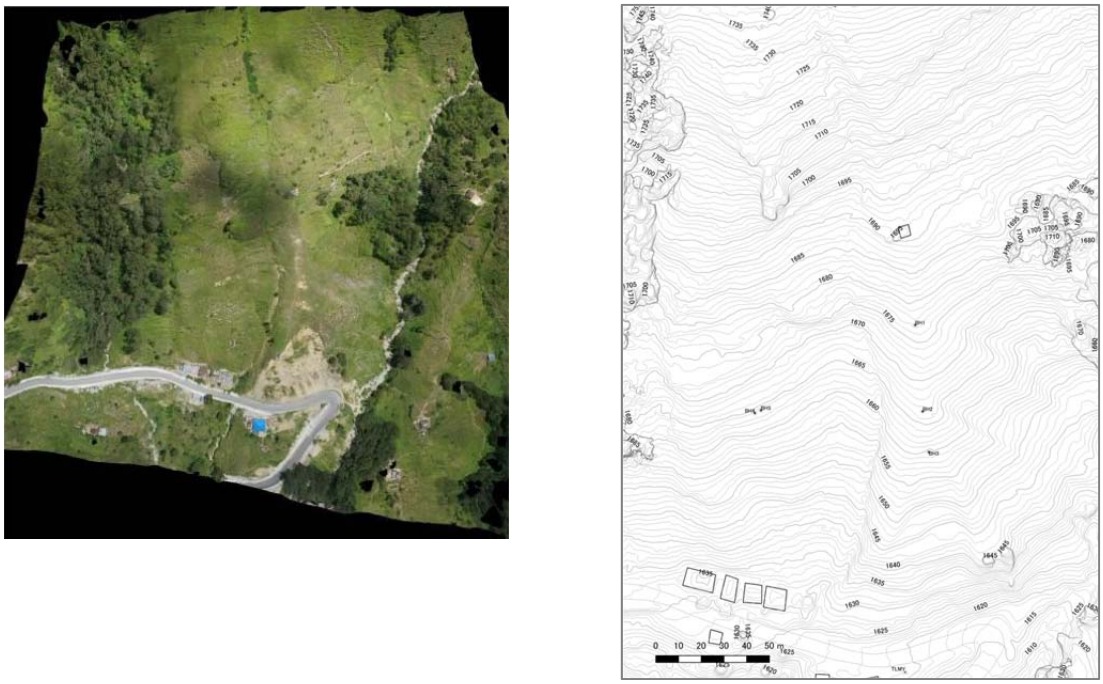
In Timor-Leste, there are no accurate topographic maps that can be used for extracting landslide topography, so orthophotos and detailed topographic maps were prepared using a UAV. The target areas of the survey were the Aitutu landslide, which was the case study site for a landslide survey and observation, and the Jakarta II landslide, which was a large-scale landslide that occurred during the rainy season. The JICA Expert Team conducted activities on site and seminars to introduce the DRBFC to the way of processing data and the results that can be achieved with UAV surveying. This activity did not aim for complete technology transfer to allow the C/P to conduct surveys by themselves; instead, it introduced the concept of UAV surveying and provided the DRBFC with the necessary information to consider whether C/P could conduct these surveys in the future.

Site OJT for UAV Survey

Introduction of data analysis in room seminar

d) Aitutu Landslide

This site was selected as the case study of Landslide. The purpose of orthophoto and detailed topographic map is to utilize the reconnaissance survey and detailed cross section analysis. The orthophoto and detailed topographic map prepared in this activity is shown in Figure 2.29.

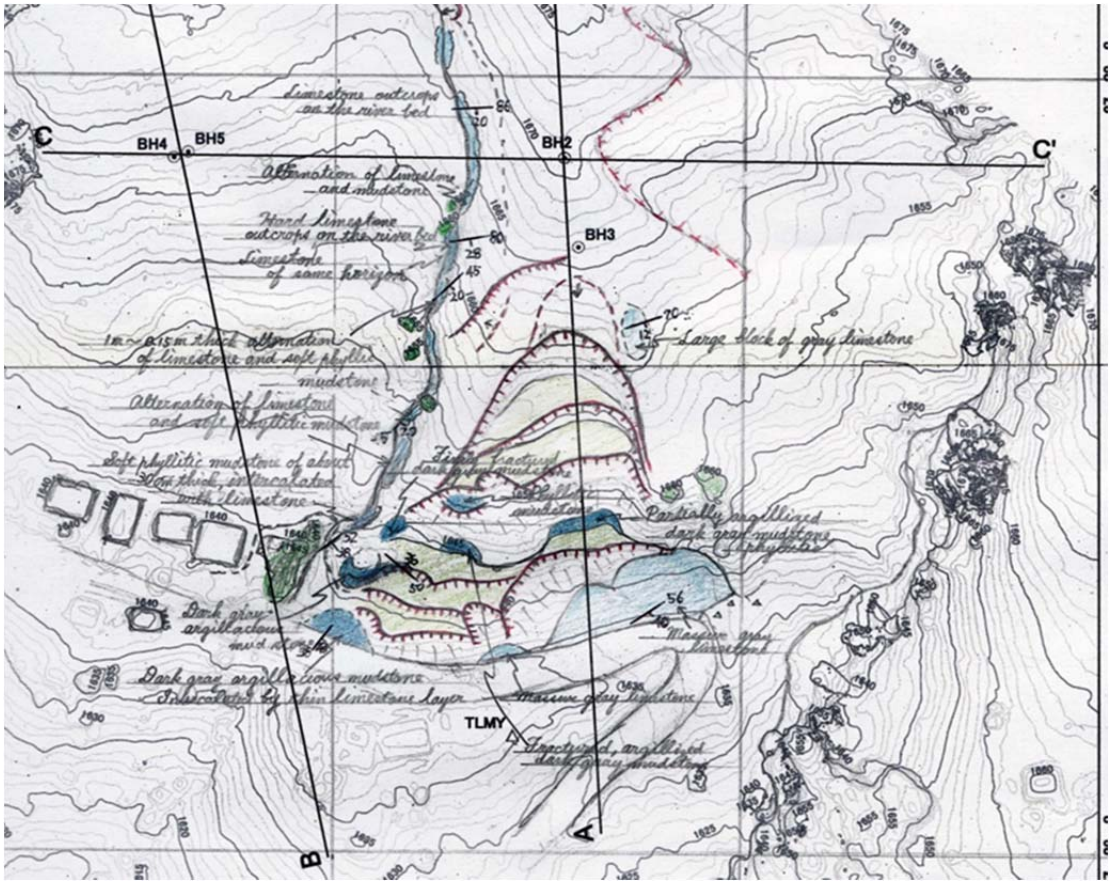


Source: JICA Expert Team

Figure 2.29 Ortho photo and detailed topographic map used by UAV survey

e) Reconnaissance survey with utilization of detail topographic map

By utilizing detail topographic map in Figure 2.29, Reconnaissance survey was conducted to understand the general overview of landslide and to plan observation equipment installation. When DRBFC staff conducts a survey of slope disaster, detail topographic maps had not been utilized; thus, this activity also aims to demonstrate the importance of utilization of topographic map at the survey. Figure 2.30 is an example of result of reconnaissance survey. Based on this survey result, an assumption of a landslide cross section was also prepared.



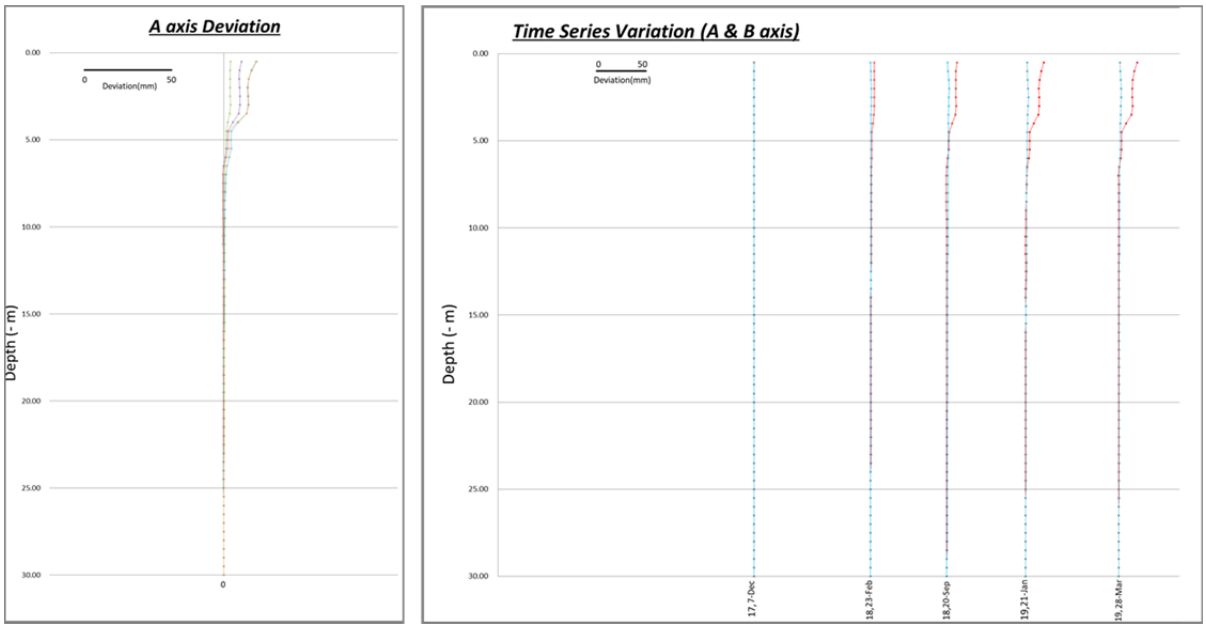
Source: JICA Expert Team

Figure 2.30 Detail topographic map reflecting the result of reconnaissance survey

f) Installation of landslide observation equipment and regular observation

In this case study activity, installation of borehole inclinometers（3 points）、groundwater level（2points）and regular observation was conducted for the purpose of Landslide system, estimation of deformation value, identification of main slip surface and suggestion of appropriate countermeasure construction design. Regular observation was operated with the lead of the Department of Maintenance, DRBFC and IPG staff were also involved in the process. Observation frequency was determined as every three month in dry season and every month in wet season in principle; however, by considering the limitation of travel budget of C/P, observation frequency in dry season was decided to the extent possible.

Figure 2.31 demonstrates an example of a borehole inclinometer observation result. Since a borehole inclinometer detected slip surface at the depth of 5 meters near a shallow layer, necessity of continuous observation and a countermeasure construction and its appropriate design was discussed with C/P.



Source: JICA Expert Team

Figure 2.31 Example of observation results of the borehole inclinometer (borehole No.3)

g) Result of investigation and explanation on result of a stability analysis

Based on analysis and observation result described above, a seminar on landslide phenomenon, the result of the investigation, and the stability analysis was conducted. Regards to a stability calculation, a practical work on division of a cross-section and safety factor analysis with utilization of Excel were explained. Necessity of discussion on appropriate countermeasures and a borehole inclinometer observation by conducting the current stability calculation and trial calculations by changing criteria were confirmed.

4) Preparation of draft guidelines

a) Slope protection

"Roads Guidelines-Slope Protection-Retaining Wall and Slope Collapse" was prepared along contents of project activities in parallel with the activities. The content is as below.

Contents

These guidelines 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.

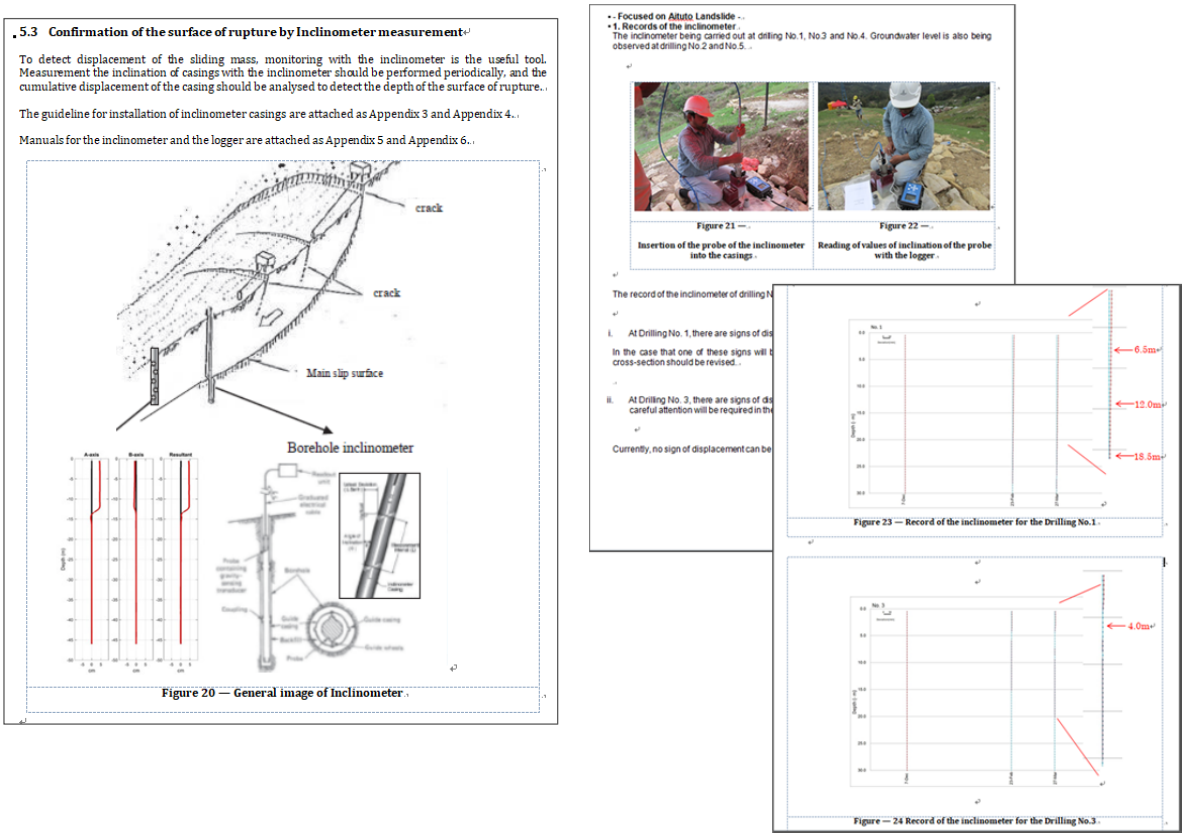
Clause 8 to 12 treat slope stability. Clause 8 and 9 present general information of slope and slope disaster as background knowledge of slope stability. Clause 10 introduces a method of slope stability calculation. Clause 11 is influence analysis on safety factor of slope by surface gradient, shear strength 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.

b) Landslide

Technical guidelines on landslide "Road Guidelines – Slope Protection – Landslide Investigation" was prepared in accordance with the purpose and contents of this case study activity. Contents are the following.

Contents

These technical guidelines initiates the general theory on landslide and describes the whole process of basic investigation→ detail investigation→ analysis→ planning for countermeasures. In addition, contains the general theory at each phase and combines an example of case study activity in this project at Aitutu landslide, which contributes to understand the content easily with the practical experience. An example of configuration is shown in Figure 2.32.



Source: JICA Expert Team

Figure 2.32 Explanation of borehole inclinometer observation from technical guideline

5) Inclusion of case studies in draft guidelines

a) Slope protection

Jamming of accommodation daily pay for DRBFC staff disturbed the project activity at outside of one day trip. Therefore, the team selected a slope collapse occurring site at Ex-Japan road STA14 within one day trip area as case study site for slope protection. Improvement works of Ex-Japan road were already constructed as design-build style. The contractor built gabion wall instead of masonry concrete wall at the collapsed site.

Soon after occurring

Rehabilitation by gabion wall

It is difficult to control slope collapse with depth deeper than 2m by existing countermeasure as re-cut, gabion and vegetation in Timor-Leste. The team presented combination of sewing bar and surface cover

structure as a countermeasure plan for the case study site. This method has been applied for so many slope collapses cases in Japan. The method shall be introduced to Timor-Leste with high priority.

This design example is included in the guidelines as Clause 12 to reflect the lessons learned from the case study.

b) Landslide

This case study implements the regular observation of the borehole inclinometer and groundwater level during the project period, and its result is included in the technical guideline. Moreover, this regular observation is comprehensively evaluated and the plan of countermeasures for the case study construction work.

6) Dissemination of guidelines

a) Slope protection

The activities of this project can be dissemination of the guidelines because contents of the guidelines have tight relation with the activities. The team distributed soft copy of guidelines and related excel worksheets to encourage usage in actual works. Staff of DRBFC implemented presentation and discussion as below to disseminate the guidelines and to keep sustainability.

・4th JCC Meeting on 26 Sep. 2018
・One day workshop of presentation and discussions on 15 Mar. 2019
・Guest lecture at Dili Institute of Technology (DIT) on 26 Apr. 2019

b) Landslide

Introduction sessions of the technical guidelines were organized through inside seminars. Seminars were jointly organized by DRBFC and IPG with a purpose of clarifying the institutional role at each item since the content of the technical guidelines are intended not only for DRBFC but also IPG to work collectively.

Moreover, dissemination activity towards related personnel of DRBFC and other institutions were organized as the following with presentation by DRBFC and IPG staff.

・4th JCC Meeting on 26 Sep. 2018
・Guest lecture at Dili Institute of Technology (DIT) on 26 Apr. 2019

The whole workflow from investigation on landslide, stability analysis, and evaluation and proposal of countermeasures are described based on the case study. Appropriate investigation and evaluation of countermeasures in accordance with the technical guidelines only by DRBFC with no staff specialized in geology are difficult because the content includes geological knowledge and decisions are necessary. For this reason, the project decided to have a technical partnership with IPG, a governmental institution specialized in analysis and evacuation of the geological field, and assisted in preparing a draft of technical partnership agreement and a structural framework for DRBFC and IPG to work collectively from an investigation stage which requires a geological decision on landslide investigation to a stage of suggesting countermeasures.

The technical collaboration agreement clearly states to share the technical knowledge related to landslide and slope disaster, to maintain a long-term cooperative partnership as an implementation structure, and to share the acquired information. It is also written that to form a project in case of disaster, both institutions shall provide technical staff to create a collaborative project team. In addition, other noted items are described below.

Budget allocation

At an investigation stage, before it is formed as the disaster response project with a prepared budget, the fact that each institution shall acquire the budget of trip cost etc. shall be determined, and it shall be clearly stated.

Period of validity for cooperation

Since this technical partnership is the first trial, period of validity of this partnership is 5 years. To extend the period, it shall be discussed and decided with a period 6 months.

(3) Confirmation of improvement of planning / design capability

The capacity of DRBFC staff rose on average by 12 percent as a result of the capacity development for planning and design, based on the results of the baseline test shown in Table 2.24 and the final test conducted in July 2019.

Table 2.24 Final Test Results (Planning and Design)

	Planning and design				
	1. Surveying	2. Drainage	3. Retaining walls	4. Slope protection	Average
Department of Maintenance (9 people)	62%	47%	47%	24%	45%
Department of Projects (9 people)	53%	42%	49%	16%	40%
Department of Construction (6 people)	70%	47%	43%	27%	47%
Department of Highway Construction Management (1 person)	80%	40%	40%	40%	50%
Total (25 people)	62%	45%	46%	22%	44%

Source: JICA Expert Team

Amongst these, the final test results of the staff who were in charge of preparing the guidelines were as follows:

- Bridge substructure protection: combining 1. Surveying and 2. Drainage, the percentage of correct answer was 60%
- Cross drainage design: combining 1. Surveying and 2. Drainage, the percentage of correct answer was 60%
- Slope protection: combining 1. Survey, 3. Retaining walls and 4. Slope protection, the percentage of correct answer was 40%
- Landslide investigations: combining 1. Survey, 3. Retaining walls and 4. Slope protection, the percentage of correct answer was 60%

It is possible for each of the above people to teach about the guidelines as a trainer. However, the percentage of correct answers was low for slope protection because it is a technically difficult area. Therefore, the DRBFC should continue technical alliances, such as sharing technical knowledge about landslides and slope disasters and maintaining long-term cooperation, with the IPG, which is a government agency specializing in geological analysis and evaluation.

2.2.5 Outputs and indicators

The level of achievement of Outputs is shown in Table 2.25.

Table 2.25 Level of achievement of Outputs

<table>
<tr><th>Output</th><th>Level of achievement</th></tr>
<tr><td colspan="2">Output 1: Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.</td></tr>
<tr><td>Indicator 1-1: More than 30% of requested budget for road maintenance are distributed.</td><td>→Achieved
The national road maintenance costs (invoiced amount and allocated amount) from 2017 to 2019 are shown below. In each year, the budget allocation exceeded 30%, which indicates that Indicator 1-1 was achieved.
<table>
<tr><th></th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>Requested amount</td><td>10.1</td><td>5.8</td><td>1.8</td></tr>
<tr><td>Allocated amount</td><td>3.1</td><td>2.4</td><td>3.7</td></tr>
<tr><td>Allocation rate</td><td>30.0%</td><td>41.3%</td><td>205.5%</td></tr>
</table>
(Units: million US dollars)</td></tr>
<tr><td>Indicator 1-2: Improved road database is utilized for preparing the annual work plan of road maintenance.</td><td>→Expected to be achieved in the revised plan
In preparation of the maintenance budget, the 5-year plan was revised in 2018 with the establishment of the new government and, at that time, the maintenance plan was formulated considering the road inspection results produced with support by this project. On the other hand, it was not possible to prepare a budget document for the budget request for 2019 fiscal year, because the database preparation work was delayed. The reason for this was that the required site survey could not be conducted because of a significant delay in budget disbursement.
The DRBFC will use the improved database to prepare a road maintenance budget for the 2020 fiscal year and submit it to the Ministry of Public Works in October 2019. If the budget is approved by the National Parliament and the Ministry of Finance, an annual work plan will be formulated.</td></tr>
<tr><td colspan="2">Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation including slope protection is improved through case studies in the whole country.</td></tr>
<tr><td>Indicator 2-1: At least 3 case studies for construction and 3 case studies for design are conducted (Totally 6 case studies).</td><td>→Achieved
The construction case studies and design case studies conducted are as follows.
<table>
<tr><th>Construction case studies (3 studies)</th><th>Design case studies (3 studies)</th></tr>
<tr><td>• Ex-Japan Road (safety management and quality control)
• A10 Humboe–Letefoho emergency repair work
• Ex-Japan Road (cross drainage)</td><td>• Aitutu landslide investigation
• Sahen River scour countermeasures
• Sesurai River cross drainage design</td></tr>
</table></td></tr>
<tr><td>Indicator 2-2: More than 60% of trainees pass the achievement (accuracy rate of 40% passed).</td><td>→Achieved
The pass rates of the baseline test conducted in July 2016 and the final test conducted in July 2019 are as follows.
<table>
<tr><th></th><th>Quality control tests</th><th>Planning & design tests</th></tr>
<tr><td>July 2016 (baseline test)</td><td>8%</td><td>28%</td></tr>
<tr><td>July 2019 (final test)</td><td>60%</td><td>64%</td></tr>
</table></td></tr>
<tr><td colspan="2">Output 3: Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.</td></tr>
<tr><td>Indicator 3-1: Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.</td><td>→Achieved
Four technical guidelines were prepared for slope protection, landslide investigation, bridge substructure protection and crossing drainage planning and design. As for landslide protection, good technical guidelines prepared by another JICA project were added as an appendix, and the technical guidelines</td></tr>
</table>

Output	Level of achievement
	of this project could refer to those guidelines for details about countermeasures from more detailed investigations. Currently, it is waiting for approval from the Minister and, thereafter, it will be an official document in DRBFC in the future.

Source: JICA Expert Team

2.2.6 Project purpose and indicators

Table 2.6 shows the project objectives, indicators, and achievements.

Table 2.26 Level of achievement of Project Purpose

Indicators	Level of achievement
Project purpose: Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	
Indicators 1: Total length of maintained national roads become 400 km.	→Expected to be achieved According to the road maintenance budget prepared in 2016, DRBFC's national road maintenance target was 460 km, but 170 km was implemented. However, due to the significant reduction in the national budget accompanying the transition of the government, DRBFC's target for road maintenance in 2017 was significantly delayed from the approved budget for the national road of 440 km, with 180 km being implemented. There is no budget allocation for 2018, and road construction and maintenance have been greatly affected by the significant delay and reduction of the national budget accompanying the transition of government from 2017 to 2018. However, the budget for 2019 tends to recover gradually, and the road maintenance target for DRBFC in 2019 is about 760 km of national roads to eliminate the stagnation in the past two years. As of 6 November, 2019, it has been confirmed that the road maintenance length of 83 km has been finalized and the total length of national road maintenance has reached 312 km during the project period, which is equivalent to 78% achievement of this indicator. The DRBFC is preparing for further road maintenance of 150 km (40%) of the 390 km for which budget was allocated in 2019. If this road maintenance work is implemented, the project indicator of 400 km can be achieved.

Source: JICA Expert Team

2.2.7 Project Overall Goal and indicators

The expected achievement of the Overall Goal is shown in Table 2.27.

Table 2.27 Expected achievement of Overall Goal

Indicator	Prospects of achievement
Overall goal: The maintenance conditions of major roads are improved in Timor-Leste.	
OG1: More than 60% of major national roads is in good condition.	→ High probability of achievement The index indicates that over 60% of the total length of 1,400 km of the major national roads, more than about 840 km, is in good condition. In terms of the project, many of the 720 km national road development projects supported by JICA, the World Bank, and the Asian Development Bank will soon be completed. In 2022 at the time of evaluation, the construction of 720 km of the target road is planned to be completed. In addition, DRBFC has completed a total of 1,110 km (78% of the total) of approximately 220 km of the completed section and 170 km planned to be completed by 2022, and will be handed over to DRBFC in good condition for maintenance (see Table 2.4). On the other hand, in the national road maintenance five-year plan, although approximately 580 km of roads will be maintained from 2019 to 2020, it will gradually decline and 280 km will be subject to maintenance in 2022. DRBFC is planning a maintenance contract after the construction, and adding that will result in a good state of maintenance and management of about 1,000 km, so the Overall Goal is likely to be achieved (see Table 2.3).

Source: JICA Expert Team

2.3 PDM revision history

2.3.1 Version 1 (updated June 2016)

Version 0 of the PDM was sanctioned as part of the R/D on 19 October, 2015. Version 0 of the PDM was updated and Version 1 of the PDM was approved at the 1st JCC meeting held on 23 June, 2016. Table 2.28 shows the revisions and reasons.

Table 2.28 List of revisions and reasons for Version 1 of PDM

Version 0	Version 1	Reason for revision
Expected Outputs: **Output 1:** Appropriate road maintenance for major roads is realized the Dili area and introduced in other areas by improving cycle of road maintenance.	Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.	The Output was revised from the beginning to suit the target area, rather than being introduced and popularized in Dili, because the target area of this project is not only around Dili but also the national roads.
Activities to achieve the expected Outputs **[Activity for Output 1] 1.1** To formulate annual work plan and annual budget plan concerned with road maintenance and repair/ rehabilitation works.	To review existing management structure condition of maintenance and rehabilitation for major roads.	It was revised through assessing the current situation with the C/P, because no activity / budget plan had been prepared.
Activities to achieve the expected Outputs **[Activity for Output 1] 1.2** To conduct routine inspections and necessary repair works/ rehabilitation of roads and bridges.	To conduct periodic/routine inspection.	The inspection and repair work were corrected to conduct inspections in parallel.
Activities to achieve the expected Outputs **[Activity for Output 1] 1.3** To update the database in accordance with [daily/] routine inspections and repair/rehabilitation works of roads and bridges.	To update the database based on the [routine] inspection result and repair/rehabilitation works of roads and bridges.	"Daily/routine inspections" was revised to "routine inspections", because the database is updated mainly by routine inspections and not daily inspections.
Activities to achieve the expected Outputs **[Activity for Output 1] 1.7** Maintenance framework for major roads in region is improved with considering the head quarter's support.	To propose appropriate framework of road maintenance and rehabilitation for major roads.	It was revised to “propose appropriate framework”, because this project should make a proposal including the relationship between the headquarters and local offices.
Activities to achieve the expected Outputs **[Activity for Output 2] 2.2** To conduct plan, design, procurement, construction and supervision as well as budgeting of case studies.	To conduct the case studies for the planning, design check, and construction supervision of the project.	It was revised to "planning, design check, and construction supervision", because the C/P is not an organization that performs design and construction itself.
Activities to achieve the expected Outputs		

Version 0	Version 1	Reason for revision
[Activity for Output 2] 2.3 To propose the necessary manpower for construction management for rehabilitation in HQs and regional offices through case studies.	To propose preferable structures for construction management for repair/rehabilitation works through case studies.	This revision was necessary because it is not enough to propose a personnel structure at the headquarters and regional offices.
Impact **Japanese input** Team Leader / Road Maintenance 1 Road Construction Supervision Quality Control Road Design / Structure Design Database / Project Coordinator Road Repair Evaluation / Monitoring	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	It was revised in order to facilitate operations and provide flexibility, because it was necessary to improve the capacity of related organizations, such as the C/P.

Source: JICA Expert Team

2.3.2 Version 2 (updated October 2016)

Version 1 was updated to Version 2 in line with the monitoring sheet submission. However, there was no revisions made to the PDM contents.

2.3.3 Version 3 (updated February 2017)

Based on Version 2, Monitoring Sheet 1 was updated through consultations with the C/P. The revisions were necessary because it was found that there were already standard drawings, because an understanding of the design procedures based on investigations was necessary for proper design, and because qualitative indicators had been set quantitatively. The Version 3 of the PDM was approved at the 2nd JCC meeting held on 16 February, 2017. Table 2.29 shows the revisions and reasons.

Table 2.29 List of revisions and reasons for Version 3

Version 2	Version 3	Reason for revision
Overall Goal: **Indicator** Conditions of major roads are improved. - International Roughness Index (IRI), - Travel speed	More than 60% of major national roads is in good condition.	The indicator was revised to a quantitative indicator.
Overall Goal: **Means of Verification** DRBFC annual report	Periodic road inspection	Means of verification was revised according to the revision of the indicator.
Project Purpose: **Indicator** Budget implementation rate (actual use/plan) increase from **% to **%. Fixation degree (maintenance cycle, standard operation procedure) of road maintenance management is improved.	Total length of maintained national roads become 400 km.	The indicator was revised to a quantitative indicator.
Project Purpose: **Means of Verification**		

Version 2	Version 3	Reason for revision
Budget plan and report Monitoring sheet	Periodic road inspection	Means of verification was revised according to the revision of the indicator.
Expected Outputs: **Output 1: Indicator** 1-1: Important sections of major roads in TL are improved to better passable roads. 1-2: Updated road data is used for cycle of road maintenance.	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.	It was revised to include a quantitative indicator and to be in line with the activities to achieve the expected Output of Version 2.
Expected Outputs: **Output 1:** **Means of Verification** 1-1: Project report 1-2: Project report	1-1: Budget report 1-2: Monitoring sheet	Means of verification was revised according to the revision of the indicator.
Pre-Conditions: **<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 carryout case study.	Issues and countermeasures were added.
Expected Outputs: **Output 2:** **Indicator** 2-1: Number of case studies. 2-2: Understanding level of DRBFC staff in construction management.	2-1: At least 3 case studies for construction and 3 case studies for design are conducted. (Total 6 case studies). 2-2: More than 60% of trainees pass the achievement test for construction supervision and design.	The indicator was revised to a quantitative indicator.
Expected Outputs: **Output 2: Indicator** 2-1: Case study report 2-2: Examination sheet	2-1: Monitoring sheet 2-2: Achievement test	Means of verification was revised according to the revision of the indicator.
Expected Outputs: **Output 3:** Standard drawing of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	Technical guideline of investigation and design for maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	It was found that there were already standard drawings. An understanding of the design procedures based on investigations was necessary for proper design.
Expected Outputs: **Output 3: Indicator** 3-1: Number of standard drawings prepared 3-2: Number of maintenance projects improved to be better passable in the whole country by using the standard drawings.	Technical guideline of investigation and design for slope protection, drainage and measures against scouring are prepared.	Means of verification was revised along with the revision of the deliverables.
Expected Outputs:		

Version 2	Version 3	Reason for revision
Output 3: Indicator 3-1: Standard drawings prepared 3-2: DRBFC annual report	Technical guideline prepared	Means of verification was revised according to the revision of the indicator.
Activities to achieve the expected Outputs **[Activity for Output 3] 3.3** To prepare a book of draft standard drawings for rehabilitation.	To acquire necessary knowledges of civil engineering for design through classroom lectures and case studies.	Activity 3 was revised because Output 3 was revised from standard drawings to technical guidelines.
Activities to achieve the expected Outputs **[Activity for Output 3] 3.4** To reflect the case studies in Activity 2-3 to the book of draft standard drawings.	To prepare the technical guideline of investigation and design.	Activity 3 was revised because Output 3 was revised from standard drawings to technical guidelines.
Activities to achieve the expected Outputs **[Activity for Output 3] 3.5** To prepare guidelines for using the standard drawings.	To reflect the lessons learned from case studies to the technical guideline.	Activity 3 was revised because Output 3 was revised from standard drawings to technical guidelines.
Activities to achieve the expected Outputs **[Activity for Output 3] 3.6** To disseminate the book of standard drawings for each regional office.	To disseminate the technical guideline for concerned parties.	Activity 3 was revised because Output 3 was revised from standard drawings to technical guidelines.
Impact **Japanese input** 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	Team Leader / Road Maintenance 1 Deputy Team Leader / Road Maintenance 2 Road Construction Supervision Quality Control / Road Repair Disaster Restoration Landslide Road Design / Project Coordinator Structure Design Database Topographical Analysis Evaluation / Monitoring	Along with the revision of Output 3, specialists for landslides and topographical analysis were added.

Source: JICA Expert Team

2.3.4 Version 4 (updated October 2018)

Based on Version 3, Monitoring Sheet 1 was updated through consultations with the C/P. The revisions were necessary because of delays to case study activities due to substantial delays in budget allocation accompanying the government changes in 2017 and 2018. For this reason, it was necessary to extend the period of the project from 3 years to 3 years and 9 months and this extension was proposed at the 4th JCC meeting held on 26 September, 2018. The update was officially approved as Version 4 of the PDM. Table

2.30 shows the revisions and reasons.

Table 2.30 List of revisions and reasons for Version 4

Version 3	Version 4	Reason for revision
Period of Project: 3 years	3 years and 9 months	It was revised along with the extension of the project period.

Source: JICA Expert Team

2.4 Other

2.4.1 Joint Coordinating Committee (JCC)

The JCC meetings were held six times during the project period. At the meetings, reports were presented to confirm about the progress of the project, and activity plans for up to the next JCC meeting were discussed and approved. Table 2.31 shows the dates and overview of JCC meetings.

Table 2.31 JCC meeting dates and overview

	Date	Overview
1st	23 June, 2016	・Discussion and approval of work plan ・Approval of PDM ・Report and approval of activity plan for up to the next JCC meeting
2nd	16 February, 2017	・Progress report for each activity ・Approval of PDM revisions ・Report and approval of activity plan for up to the next JCC meeting
3rd	19 March, 2018	・Progress report for each activity ・Evaluation of each activity, and discussion and approval of achievement ・Report and approval of activity plan for up to the next JCC meeting
4th	26 September, 2018	・Progress report for each activity ・Evaluation of each activity, and discussion and approval of achievement ・Report and approval of activity plan for up to the next JCC meeting
5th	19 March, 2019	・Progress report for each activity ・Evaluation of each activity, and discussion and approval of achievement ・Report and approval of activity plan for up to the next JCC meeting
6th	13 September, 2019	・Report on level of achievement of project objectives and on recommendations ・Approval of project activity results and Outputs

Source: JICA Expert Team

2.4.2 Training in Japan

According to the terms of reference, training in Japan would only be conducted when it was deemed necessary within the project period. In this project, the training in Japan was deferred, because members of

the DRBFC had already participated in the road maintenance training conducted by the JICA International Center in Japan and, even if advanced techniques were taught, such techniques could not be implemented locally and so the expected effect of training in Japan would not be much.

2.4.3 Publicity

(1) Support for publicity activities using the media

Regarding support for publicity, the publicity activities mainly involved publishing articles in a local newspaper, on the internet and on social media. The media used are summarised in Table 2.32 and a list of articles in included in Appendix 1.

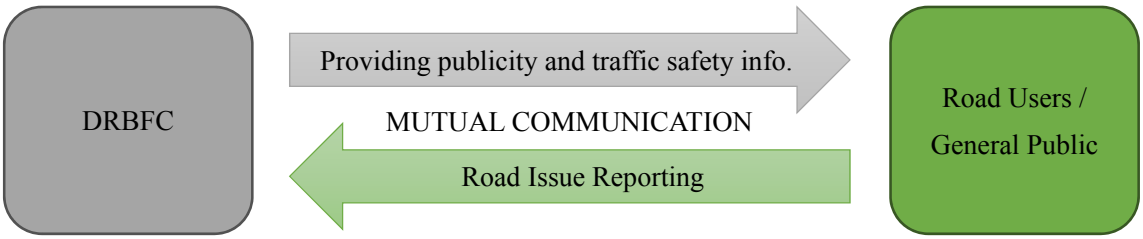
Table 2.32 Summary of publicity activities using the media

Media type	Name	Description	No. of items
Newspapers	Timor Post	A major newspaper in Timor-Leste	1 time
Websites	JICA ODA Visualization Site	Project outline, evaluation, and photos (https://www.jica.go.jp/oda/project/1300671/index.html)	4 times
	JICA Project Website	Project outline and periodic news articles about activities produced by CDRS team (https://www.jica.go.jp/project/easttimor/005/index.html)	26 times
Social media	Facebook page for CDRS Project	Periodic news articles produced by CDRS team since 26 September, 2016 (https://www.facebook.com/JICATimorLeste/)	33times
	Facebook page for JICA Timor-Leste	Periodic news articles produced by JICA Timor-Leste office (https://www.facebook.com/CDRSTimorleste/)	23 times
	Facebook page for DRBFC	Periodic news articles produced by DRBFC since 22 February, 2019 (https://www.facebook.com/Direc%C3%A7%C3%A3o-Nacional-de-Estradas-Pontes-e-Controlo-de-Cheias-812477005768807/)	2 times
		Total number of publicity items	89 times

Source: JICA Expert Team

(2) Enhancing mutual communication through C/P publicity activities

The advantages of communicating with the general public are that additional reports about road issues can be gained from road users and information about road issues can be imparted to road users. This mutual communication can improve the DRBFC's ability to meet the demands for road infrastructure services and improve the awareness of road users regarding safety issues.



The following 3 criteria for sustainability of road issue reporting and publicity were considered when selecting publicity tools for the DRBFC:

- Low expense (it should use minimal software licenses and have few operating costs);
- Ease of use (it should be capable of being managed without the help of experts);
- Transmission speed (it should be able to quickly and easily send and receive information).

The media options that were identified for the DRBFC are shown in Table 2.33. From these options, the WhatsApp Messenger service and the Facebook social media were identified as the two most viable options for facilitating mutual communications, being directly controlled by the directorate and having minimal associated expenses. Furthermore, Facebook has more users in Timor-Leste than WhatsApp Messenger, which is a subsidiary for Facebook. Therefore, the JICA Expert Team supported publicity via Facebook social media, instead of signboards and radio that were initially proposed in the project plan.

Table 2.33 Summary of media types, costs and capabilities

Medium	Associated fees	Coverage (area of influence)	Newsflash / Bulletin	Mutual Communication
Signboards beside roads	Fabrication cost + Setup cost	Local	Possible (8:00-17:00)	No
RTTL radio broadcast	$ 20/time	Timor-Leste	No	No
GMN radio broadcast	$ 25/min.	Timor-Leste	No	No
WhatsApp Messenger*	Free†	International	Yes	Yes
Facebook** (social media)	Free†	International	Yes	Yes
Official government homepage	Web design fee + Web hosting fee	International	Yes	No
*Note: Other messenger services (WeChat, Viber, LINE, etc.) have fewer users in Timor-Leste (and in general globally), so WhatsApp was proposed. **Note: Other social media (Google+, Twitter, Instagram, etc.) have fewer users in Timor-Leste (and in general globally), so Facebook was proposed. †Note: Internet access fee of $ 0.5/day for the general public (users) could be expected.				

Source: JICA Expert Team

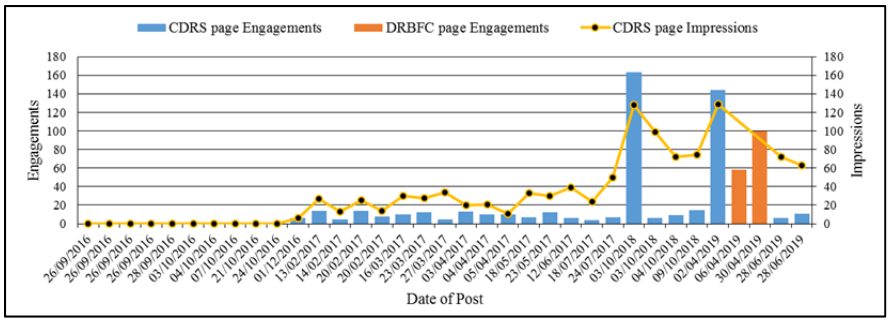
As of June 2019, the aggregated results of "engagement"[1] and "impression"[2] on the CDRS and DRBFC Facebook pages are shown in Figure 2.33. The CDRS Facebook page was launched in September 2016 and the JICA Expert Team posted articles about the project activities. The CDRS Facebook page was introduced

[1] "Engagement" is the number of viewers' favourable actions such as "Like!", "Share", "Comments", etc., and is an index indicating the degree of interest with respect to the postings of the viewers.

[2] "Impression" is an index representing the number of posts viewed.

on the Facebook page of JICA Timor-Leste Office in December 2016. Since then, about 280 people followed the CDRS Facebook page and the number of impressions for each article increased. In particular, the number of engagements for an articles on 3 October, 2018, about a safety patrols, and on 2 April, 2019, about on-the-job training for construction supervision was high, which indicates that the viewers were interested in the above-mentioned site activities.

The DRBFC Facebook page was launched in February 2019 by the DRBFC, which received support from this project. Articles on site conditions, construction supervision, staff education activities, organizational activities (conferences, contract orders, etc.) have been published, and articles on this project have been published twice. As a result of posting, the DRBFC Facebook page is followed by about 4,070 people and has gained many engagements.



Source: JICA Expert Team

Figure 2.33 Statistics for Facebook pages of CDRS Project and DRBFC

(3) Publicity through personal protective equipment

In June 2018, seventy high-visibility vests were designed and procured for use by DRBFC staff and JICA Expert Team during safety patrols and other activities on site. The vests had custom designs printed on the backs featuring acronyms of the DRBFC (DNEPCC) and this project (CDRS), and logos of the Government of Timor-Leste and JICA. The purpose of the vests was to raise awareness for the work of this project while promoting the use of personal protective equipment for good health and safety practices on site, as shown in Figure 2.34. A post on the CDRS Facebook page on 2 October, 2018, depicting the high-visibility vests being used by DRBFC staff during a safety patrol, had a significantly higher number of engagements. The safety vest raised awareness about safety management gear and also promoted awareness of this project.

Figure 2.34 Custom project logo and high-visibility vests in use on site

(4) Activities involving external parties

In this project, external parties, such as other donors and university officials, were invited to participate in meetings, seminars and activities with counterparts as needed, in an effort to promote unity and cooperation towards the outputs, and to disseminate the results of this project. The participating organizations are shown

below.

- ADB: Asian Development Bank
- ADN: National Development Agency
- AdP: Águas de Portugal group
- CADEFEST: JICA's project for Capacity Development of the Faculty of Engineering, Science and Technology, the National University of Timor-Lorosa'e, Phase 2
- DIT: Dili Institute of Technology
- IPG: Institution of Petroleum and Geology–Public Institute
- R4D-SP: Roads for Development Support Programme (by International Labour Organisation)
- UNIPAZ: Universidade da Paz
- UNITAL: Universidade Oriental Timor Lorosa'e
- UNTL: National University of Timor Lorosa'e

For a list of workshops and conferences in which organizations have participated, please refer to Attachment 1.

In cooperation with IPG, the case study of the Aitutu landslide survey was conducted and related seminars were held. There was a good relationship between DRBFC and IPG and it is expected that the DRBFC and IPG will continue this technical cooperation in the future. Through improved communication with R4D-SP, the participation rate of R4D-SP stakeholders in the activities of this project increased, and as a result, a joint seminar was held to disseminate the results of this project with R4D-SP local staff. The DIT requested the JICA Expert Team to explain the results of activities of this project to their students, and an explanatory meeting was held at their institution. This provided the opportunity to interact with the next generation of engineers.

Joint seminar with R4D-SP

Guest lecture at DIT

Publicity activities for external parties

2.4.4 Environmental and social considerations

There are no noteworthy environmental and social considerations concerning this project.

2.4.5 Consideration of gender, peacebuilding and poverty reduction

In this project, women's participation in project activities was called for as much as possible and

consideration was given to gender balance. In addition, consideration was given to providing a forum for women to present about the project in order for women to participate in the decision-making concerning project activities. Furthermore, this project tried to promote the employment of women, such as hiring women as assistants, while considering gender equality concerning employment conditions.

Chapter 3 Project Evaluation and Lessons Learned

3.1 Evaluation based on JICA Project Evaluation Guidelines

The evaluation was performed based on the following.

- Level of achievement of Outputs (see Section 2.2.5)
- Evaluation and analysis in the five evaluation items (validity, effectiveness, efficiency, impact and sustainability, as shown in Table 3.1) of the JICA Project Evaluation Guidelines (see Section 3.2)
- Key factors affecting implementation and Outputs (see Section 3.2)
- Evaluation of project risk management results (see Section 3.2)

3.2 Five evaluation items of JICA Project Evaluation Guidelines

Table 3.1 shows an overview of the evaluation items and evaluation viewpoints of the JICA Project Evaluation Guidelines.

Table 3.1 Overview of DAC[3] evaluation items and evaluation viewpoints

Evaluation items	Overview of perspective
Validity	Evaluate whether Japan's aid policy is consistent with the development policy of Timor-Leste, and whether it matches the needs of the target group and the needs of the region.
Effectiveness	Evaluate whether there are prospects for achieving the Project Purpose, whether there are obstacles to achieving the Project Purpose, and whether the outputs were sufficient to achieve the Project Purpose.
Efficiency	Evaluate whether outputs are expected to be achieved, whether there were any factors that hindered achievement of outputs, whether there were enough activities or enough inputs to produce the outputs, whether there was any influence by external conditions, and whether there was any excess or deficiency in carrying out activities according to the plan.
Impact	Evaluate whether the Overall Goal is expected to be manifested as a project effect or the Overall Goal is achieved, whether there are any obstacles to achieving the Overall Goal, whether there is a discrepancy between the Overall Goal and the Project Purpose, and whether effects / impacts other than the Overall Goal are expected. In particular, if a negative impact is assumed, verify whether measures are taken to reduce it.
Sustainability	Evaluate whether the Project Purpose, Overall Goal and other project outputs are expected to persist after the project ends. Evaluate any factors that may contribute to or inhibit the sustainability of these effects from the perspectives of policy / system, organization, finance and technology.

Source: JICA Expert Team

The evaluation contents of five items (validity, effectiveness, efficiency, impact, sustainability) are described below.

3.2.1 Validity

The relevance of this project was "high" in terms of consistency with the development policy of Timor-Leste, Japan's assistance policy for Timor-Leste and the needs of the region.

Consistency with the development policy of Timor-Leste

In the "Strategic Development Plan (SDP) 2011-2030" announced in July 2011, it was cited that Timor-Leste has four issues to be tackled: (1) social capital, (2) infrastructure development, (3) economic development, and (4) institutional framework. In (2) infrastructure development, the promotion of

[3] DAC: Development Assistance Committee

economic infrastructure development such as roads and bridges has been promoted. Amongst them, the government places priority not only on the hard aspects such as road maintenance but also the soft aspects such as road maintenance management.

Consistency with Japan's assistance policy for Timor-Leste

"Country Assistance Policy for Timor-Leste (May 2017)" defines "Support for Sustainable National Development Foundation" as our basic policy (major goal), stability and prosperity in Southeast Asia and human safety from the perspective of security. The three priority areas (medium goals) are (1) development and improvement of economic and social infrastructure (infrastructure), (2) promotion of industrial diversification, and (3) dissemination and expansion of social services. For the development and improvement of the economic and social infrastructure in (1), in order for Timor-Leste to develop sustainably and stably, it is necessary to give priority to support that will not only revitalize economic activities but also provide high-quality infrastructure including support for maintenance.

In light of the above, this project is consistent with Japan's assistance policy for the country.

Consistency with local needs

The national roads (19 routes from A01 to A19) in the target area, Timor-Leste, are the only routes that connects cities and are controlled by DRBFC. Although there are unpaved sections on the routes, some sections are being paved with assistance from other donors. Since pavement is given priority and being the only network road, the national road is very important and the relevance of this project is high.

3.2.2 Effectiveness

The effectiveness of this project was "medium", because of the level of achievement of the Project Purpose and because the degree to which the Outputs contributed to achievement of the Project Purpose was sufficient.

Achievement of Project Purpose

Table 3.2 shows road extensions for each year in which road maintenance was conducted during the project period (2016-2019).

Table 3.2 Extension of roads where maintenance was performed (2016-2019)

	2016	2017	2018	2019	Total
Planned maintenance	295 km	405 km	212 km	469 km	2,040 km
Actual maintenance	0 km	17 km	212 km	66 km	295 km

Source: JICA Expert Team

Although the planned amount of maintenance and budget for road maintenance are increasing, the actual amount of maintenance carried out was less than planned due to budget allocation and reduction of execution following the transition of government in 2016 and 2017. The cumulative amount carried out in 2018 was 212 km. Efforts were made to secure the budget after that, and a budget of 3.7 million dollars was allocated in

2019, and 469 km of road maintenance was scheduled to be carried out by the end of 2019. However, as of 6 November, 2019, maintenance of 66 km of road has been finalized and so the total length of road maintenance carried out in the project period has reached 295 km. However, DRBFC is continuing its work to implement road maintenance, and is preparing for road maintenance of 150 km (40%) out of the 390 km for which budget was allocated in 2019.

Logic from achievement of Outputs to achievement of Project Purpose

The three Outputs of this project cover all the elements necessary for strengthening the DRBFC's national road maintenance capacity, and it can be said that the achievement of the Outputs directly leads to the achievement of the Project Purpose. For the Overall Goal of "the maintenance conditions of major roads [being] improved in Timor-Leste", a series of maintenance management cycles, such as (1) data input → (2) planning → (3) inspection → (4) evaluation / judgment → (5) maintenance / repair / improvement plan →(6) maintenance / repair / improvement → (7) data entry (update) must be properly functioning. In this project, activities to make up for the elements lacking in DRBFC were introduced through Outputs 1 to 3. Therefore, Outputs 1 to 3 were clear and effective for achieving the Project Purpose, and the Project Purpose and Output logic was judged to be appropriate.

External conditions from Outputs to Project Purpose

The following external conditions from Outputs to Project Purpose were satisfied.

1) Road maintenance budget was secured.
2) DRBFC staff trained continue to work (did not resign).
3) There were no unexpected natural disasters that damaged the sites used for the case studies.

However, concerning 1), the budget was not secured in 2017 and 2018 due to the change of government.

3.2.3 Efficiency

The efficiency of this project was "slightly high" considering the level of Outputs produced by the inputs.

Achievement of each Output

As shown in Section 2.2.2, regarding Output 1, the data input for the GIS database had been completed in August 2019, and the road maintenance work plan and draft road maintenance budget were formulated in October. It can be said that it will be achieved. Regarding Output 2, three construction case studies and three design case studies were conducted. Participants from the DRBFC learned the construction supervision know-how of civil engineering, pavement and bridge construction. In addition, checklists that can confirm the matters necessary for construction management were prepared. Regarding Output 3, if the four types of technical guidelines prepared in the project are officially approved by DRBFC during the rest of the project so that they can be used continuously after the project ends, it can be judged that Output 3 is achieved. For Output 1 and Output 3, the possibility of being achieved by the end of the project is high.

Input of experts from Japan

The planned and actual input of experts from Japan for this project are shown in Table 3.3.

Table 3.3 Dispatch of experts from Japan

Experts	Initial planned input		Actual input	
1	Team Leader / Road Maintenance 1	10.20 MM	No change	10.83 MM
2	Deputy Team Leader / Road Maintenance 2	12.45 MM	No change	12.23 MM
3	Road Construction Supervision	16.00 MM	No change	11.50 MM
4	Quality Control / Road Repair	9.07 MM	No change	8.23 MM
5	Road Design / Project Coordinator	9.70 MM	No change	10.07 MM
6	Structure Design	8.40 MM	No change	9.60 MM
7	Disaster Restoration	8.40 MM	No change	10.00 MM
8	Database	7.00 MM	No change	10.27 MM
9	Evaluation / Monitoring	4.27 MM	No change	5.15 MM
10			Landslide (additional)	3.00 MM
11			Topographical Analysis (additional)	2.00 MM
Total	13 roles / 9 experts	85.49 MM	15 roles / 11 experts	92.83 MM

Source: JICA Expert Team

The number of man-months (MM) for the JICA Expert Team was finally 92.83 MM against the initial plan of 85.49 MM, an increase of 7.34 MM. The reason for this was that it was judged that landslide observation and topographic analysis were necessary, and 2 people and 5.00 MM worth of assignment were added.

In addition, the project activities were delayed and consequently extended due to the delay in budget disbursement by the Timor-Leste government. Therefore, an extension of 2.34 MM was distributed amongst the experts. Regarding the additional of 2 people, it was judged that the inputs were necessary to achieve Outputs 2 to 3. Although the extension would have been unnecessary under normal circumstances, it was a reasonable increase in input considering the circumstances of Timor-Leste.

Introduction of equipment

After the start of the project, Output 3 was changed in order to preserve the technology transferred to the DRBFC through Output 3. Output 3 was changed because it was necessary to improve technical guidelines that showed the basic concepts and procedures for investigations and design related to maintenance and repair work, including slope protection. The following equipment necessary for the Slope Protection Guideline were added. The DRBFC stated that, "we are glad that appropriate design verification can be conducted and that technical guidelines which are of practical use have been prepared, and we want to further disseminate the technical guidelines." Based on the above, it was judged that these equipment contributed to the achievement of Output 3.

Table 3.4 Additional equipment

Initial planned input	Actual input	
None	• In-hole inclinometer • Inclinometer embedded material (casing)	• Dokenbo soil penetrometer • Desktop computer

	• Water level indicator

Source: JICA Expert Team

Project period

The project period was planned to be 37 months from 22 February, 2016 to 29 March, 2019. However, it was extended by nine months and is scheduled to end on 27 December, 2019. The reason for the extension of the project period was that the project activities were delayed due to the delay in budget disbursement by the Timor-Leste government. If the project period had not been extended, it would have been difficult to achieve Output 2 and the Project Purpose. Therefore, this extension was necessary.

External conditions from Activities to Outputs

The "road maintenance budget [being] secured" was an external condition from the Activities to the Outputs. Although this condition was eventually satisfied, the budget was not secured in 2017 and 2018 due to the transition of the government.

3.2.4 Impact

The impact of this project was "medium", because of the prospects of achieving the Overall Goal, there being no discrepancy between the Project Purpose and the Overall Goal, and the positive impact of the project towards the achievement of the Overall Goal.

Expected achievement of the Overall Goal

The total length of the main national road is about 1,400 km, and about 840 km, 60% of that, needs to be in good condition three years after the end of the project. On the other hand, approximately 720 km of national roads are currently being developed with the support of JICA, World Bank, ADB, etc. It is natural that the road under construction as of June 2019, which is scheduled to be completed in 2022, is in good condition in 2022, three years after the completion of the project. In order to achieve the Overall Goal, it is judged that 120 km of the remaining 560 km has to be in good condition. Since the 390 km is planned to be improved from 2019 to 2022, if the next five-year plan is properly implemented, the Overall Goal is likely to be achieved (see Table 2.3 and Table 2.4).

Ripple effect of the project

In this project, "Technical Guide" and "Construction Checklist" were prepared as technical guidelines. The guidelines and checklists became official documents of the DRBFC on 19 September, 2019, with the approval of the Deputy Minister.

In addition, C/P has established a platform that can be used as a forum for discussions involving many people, not just those involved in this project. Amongst them, C/P is making use of this platform for explanation of these guidelines. This was used outside of this project and has a positive impact.

On the other hand, no negative impact was confirmed through this project.

External conditions from "Project purpose" to "Overall goals"

Securing of the road maintenance budget is an external condition connecting the Project Purpose to the Overall Goal, and whether this condition will be met in 2020 could not be confirmed at the 6th JCC held on 13 September, 2019. However, the road maintenance budget for 2020 is being deliberated. The MOP regards road maintenance as important, and securing of a road maintenance budget is considered a high priority.

3.2.5 Sustainability

The sustainability of this project was “medium”, considering the reasonable possibility of ensuring sustainability from a policy aspect, and concerns about ensuring sustainability from organizational, technical and financial aspects.

Policy aspect

As described in Section 3.2.1, infrastructure development is one of the four priority issues raised by Timor-Leste. Since SDP is planned until 2030, it is judged that the policy to ensure the sustainability of the project effect on the Timor-Leste side will be maintained.

Organizational aspect

For improvement of DRBFC's organizational system, proposals were made for collaboration with other organizations and universities to strengthen DRBFC's capacity and ensure durability, such as separation of design and construction for projects, strengthening of construction management system, and introduction of contingency for road maintenance. As a result, the above-mentioned organizational system has been improved starting with the 2019 budget, cooperation with other institutions and universities has begun, and basic reforms for future sustainability have begun.

In addition, as described in Section 3.2, it has been confirmed that C/P have started activities beyond the scope of the project, and that the DRBFC has started to take ownership.

Technical aspect

Based on the activities and Outputs of this project, the Slope Protection Guidelines for relatively small to medium surface collapses, the Culvert Design Guidelines and the Bridge Substructure Protection Guidelines were prepared and are expected to be used for future design work. In addition, it is expected that these technologies will be passed on by trainers to young engineers and propagated for use by private companies.

On the other hand, the slope failure occurring in Timor-Leste has caused various road damages such as large-scale surface collapses and deep-layer collapses, rockfall accidents due to large rocks, large-scale road shoulder collapses, and road loss due to debris flow. In the future, countermeasures from the viewpoint of disaster prevention is necessary. It is also necessary to establish medium-term and long-term maintenance cycles for pavement maintenance after the large number of national roads have been developed.

Financial aspects

During the project period, the road maintenance budget was not disbursed as planned due to regime changes in Timor-Leste. Although there was a partial improvement, problems remain in securing a long-term budget.

Regarding the road maintenance by the DRBFC, the 9 Packages national road maintenance project, which started in earnest in 2016, is a multi-year maintenance project that is allowed to be financed by infrastructure funds. However, normal maintenance after the end of the project will be under single-year budgets from the ministry. It is indispensable to establish new road maintenance resources that meet the increasing demand for national road maintenance, which is progressing substantially. As mentioned above, there is a problem with the current single-year budgets, so it is necessary to consider the introduction of gasoline taxes borne by road users and infrastructure funds that have multi-year budgets.

Chapter 4 Implementation Issues, Ingenuity and Lessons Learned

Many problems were found in project implementation and management. The Japan Expert Team and DRBFC discussed solutions to these issues through JCC meetings and tried to solve them.

4.1 Preparation of technical guidelines and checklists

Issues

As described in Output 3 (see Section 2.2.4), the level of understanding and how to proceed with work is not unified by the staff due to the lack of specific work implementation guidelines at each stage of DRBFC planning, design and construction supervision. As a result, there was a problem that the quality of construction could not be maintained.

Ingenuity and lessons

Therefore, design guidelines that clarified the design method for the most problematic work type confirmed during the project period were prepared, and checklists of precautions for construction supervision were compiled. Details are described in the results of activities in Output 2 of this project (see Section 2.2.3). In order to sustain these results, a trainer is required to train young engineers on the contents of the technical guidelines and checklists. However, since the DRBFC does not have the above-mentioned trainer, TOT was conducted for several trainees who had the capability to become trainers from amongst the C/P trainees for each output. After that, the trainers worked to gain experience and confidence as trainers by conducting seminars.

In the future, the importance of training in-house trainers to train staff must be understood, instead of relying only on external specialists to train staff.

4.2 Proposal for improvement of DRBFC's budgeting and operations accompanying transitions

Issues

Planning and design of the DRBFC's infrastructure projects were done based on proposals from contractors, and subsequently orders for construction were made. The selection of contractors was not conducted by general competitive bidding, but by a selection committee led by the Minister of Construction. For this reason, the design details, details of construction and quality of projects were not sufficiently checked, because the DRBFC staff did not need to fully consider designs and relied on the supervision ability of contractors without supervising the works themselves. As a result, road disasters occurred after completion.

Ingenuity and lessons

Therefore, as mentioned above, the JICA Expert Team proposed for separation of design and construction, private orders for design and construction supervision, and a significant improvement in budgeting. In response to this proposal, DRBFC decided to separate design and construction for new projects from the 2019 budget based on discussions with the new government established in 2018, and to switch both design and construction to a bid system.

In the future, it is expected that more rational facility scale and functions can be designed by utilizing the design guidelines described above.

4.3 Development of efficient inspection and evaluation methods in cooperation with universities

Issues

Concerning inspection surveys and evaluation methods that are the basis of road maintenance, an intricate method requiring detailed surveys was introduced in the technical cooperation project implemented before this project. However, the DRBFC staff were unable to continue the process, because the survey method was complicated and the evaluation method was difficult, so the surveying was discontinued and no database was prepared. The surveyed data was dissipated and difficult to reproduce. In addition, there were only a small number of people in charge of inspection and database in the Department of Maintenance.

Ingenuity and lessons

In order to improve the inspection method to be efficient and effective, the JICA Expert Team examined a way of simplifying and automating the inspection method.

Specifically, JICA is currently implementing a capacity building technical cooperation project for teachers at national universities. As part of this, a dispatched faculty member studying at Gifu University is developing an application that can observe the international roughness index (IRI) of roads using a smartphone. Therefore, a program that can be used for road inspection in Timor-Leste using the developed method, and an IRI analysis of the aggregated data by a computer in UNTL was also under development. In addition, the JICA Expert Team helped to visualize the results in the database by investigating the video of the current road conditions using a dashboard camera.

In this way, in collaboration with UNTL and technical cooperation projects, more efficient and effective inspection and evaluation methods are being developed. In addition, depending on the future collaboration between the DRBFC and universities, it is expected to contribute greatly to the autonomous development of road inspection and evaluation methods.

4.4 Cooperation with other organizations for landslide observation and countermeasures

Issues

Timor-Leste is an island country that is narrow from north to south, and the northern coast is Palaeozoic geology that has been weathered by mountains and has a lot of rainfall. For this reason, there are many road disasters along the national roads, such as collapse of steep slopes and falling rocks. In addition, there is a Mesozoic geological massif with an altitude of 2,500 m or more in the central part. The rainfall is about 3,000 mm per year, and road disasters such as landslides, slope failures and road loss occur.

Ingenuity and lessons

For this reason, this project targeted landslide areas where large-scale landslides are a concern. The JICA Expert Team conducted on-the-job training, training and lectures with case studies of topographic surveys of landslides by UAV and landslide movement and groundwater level observation methods using inclinometers, and worked to strengthen the capabilities of DRBFC staff. However, since landslide countermeasures is a technical field that requires very specialized knowledge and experience, education and training through landslide observation and analysis were conducted in collaboration with highly competent IPG staff in order to strengthen the DRBFC's capacity sustainably. Furthermore, in order to ensure such cooperation with IPG continues, an agreement for technical cooperation regarding landslide observation and analysis between the

MOP and the IPG was confirmed.

4.5 Strengthening of construction supervision system by reviewing DRBFC's operations

Issues

With the transition of the government from 2017, the DRBFC's local organization was transferred to the State Department, and it became apparently that there were difficulties regarding supervision and quality assurance of many local works.

Ingenuity and lessons

For this reason, the review of the functions and operational fields of each organization within DRBFC at the 3rd JCC meeting in March 2018 was considered, the JICA Expert Team proposed capacity enhancements including supplementing internal construction supervisory personnel to strengthen the construction supervision system, strengthening orders with construction companies, and personnel exchanges with experienced construction staff. In response to these proposals, the DRBFC decided to hire 50 additional engineers for construction supervision from the 2019 budget to ensure the quality of local construction, and conducted recruitment in June 2019.

4.6 Securing a DRBFC emergency budget

Issues

The payment of business trip expenses to DRBFC staff for on-site construction supervision, road inspections and site surveys for design was delayed.

Ingenuity and lessons

This project proposed the submission of business trip plans one month in advance and the receipt of temporary payment in order to secure staff expenses for inspections of emergency disaster sites, on-site construction supervision and construction inspection that occur irregularly, and road inspections and on-site design confirmation. In response to this proposal, the DRBFC began budgeting from 2019.

Chapter 5 Recommendations for Achievement of Overall Goal after Project Completion

5.1 Expected achievement of Overall Goal

As shown in the previous section 3.1, it is judged that it is possible to achieve the Overall Goal.

However, it is expected that sudden slope failures and embankment collapses will occur in Timor-Leste, where natural conditions are severe. For this reason, it is pointed out that there is a need for capacity building for preventative investigations and countermeasures against these natural disasters. For this purpose, nationwide inspection surveys should be implemented to identify unstable slopes and facilities that are susceptible to various natural disasters in Timor-Leste. Based on the survey results, disaster prevention measures can be selected, and more knowledge and specific application know-how for design and construction can be accumulated by on-the-job training through the implementation of pilot projects, so that maintenance and repair measures including more practical disaster prevention measures can be implemented.

As indicated by the decision about the achievement of the Overall Goal, a number of donor support works will be completed in 2022, and after the contractor's one-year service period, the DRBFC will conclude maintenance contracts with the contractors. In the contract conditions of the maintenance contracts, it is necessary to set specific conditions about the standards of maintenance or road service, and which survey and inspection methods should be used to measure these standards. Specifically, after conducting an IRI survey of the pavements under development in this project, applying a technical evaluation method to many roads and conducting a technical evaluation that the results are reasonable, it is necessary to prepare medium-term and long-term road maintenance plans for roads developed by DRBFC and donors. To that end, for more practical facilities and paving maintenance capacity improvement, capacity building of DRBFC engineers who investigate, select, design, and construct maintenance and repair methods for each pavement type should be conducted through training and also through the implementation of pilot projects.

5.2 Plans and measures for the operation implementation system of Timor-Leste

In order to implement preventative measures and maintenance for natural disasters as shown above, it is necessary to improve the capacity of DRBFC staff for preventative measures against natural disasters. Furthermore, in order to achieve the Overall Goal and Project Purpose, approximately 720 km of national roads completed with the support of donors in the next few years will be subject to the maintenance of the DRBFC. The road pavements, drainage and slopes need to be fully maintained.

Therefore, it is necessary to conduct training to improve the skills necessary for long-term maintenance of road pavements and slopes. In addition, it is expected that the management organization system for this capacity improvement is proposed from the following future technical cooperation activities.

5.3 Recommendations for future technical cooperation

It is necessary to implement a technical cooperation project aiming at preventative measures against road disasters and capacity development necessary for medium-term and long-term maintenance of road facilities.

It is believed that the following contents are appropriate for the overall goals and project purpose of specific technical cooperation projects (see Table 5.1).

Next, with regard to the outputs of the project, Output 1 should be to discover slope disaster hazards, such as slope failures, shoulder collapses and landslides, along national roads and to formulate investment plans for road disaster prevention measures. Regarding Output 2, in order to prevent such road disasters, it is essential to check the groundwater level and assess the risk of disaster based on rainfall data, as well as the geological structure of areas along roads, the shape and quality of shoulder construction and slope construction. However, all rainfall data in Timor-Leste analysed in this project is the result of daily rainfall observation, and there is no hourly rainfall observation network for drainage design and rainfall. For this reason, in order to design various facilities, landslide countermeasures and slope failure countermeasures, it is necessary to install an observation network for hourly rainfall in the DRBFC and analyse the observation data. For this reason, Output 2 should be to establish a rainfall observation network in the DRBFC.

Output 3 should be to prepare technical guidelines and standard estimation data for observation, survey and design for countermeasures for slope disasters, and to conduct on-the job training and training through pilot construction of countermeasures. Regarding Output 4, it is expected that the number of roads subject to maintenance will increase in the future, so the standard of road service should be set appropriately by applying the road inspection and evaluation method that was developed in this project to national roads. Output 4 should be to develop more practical skills, and to prepare technical guidelines and necessary materials by implementing training for selection, design and construction of countermeasures that correspond to the damage of each pavement type on the priority sections identified by the road inspections.

Table 5.1 shows the overall goal, project purpose, outputs and main activities of a new technical cooperation project that will be required in the future.

Table 5.1 Outline of Proposed Project

Item		Contents
Overall goal		Road disaster prevention and maintenance conditions of the national roads in Timor-Leste will be improved.
Project purpose		The competence of the DRBFC for implementing road disaster prevention and maintenance of national roads will be improved.
Output 1		The inventory of slope disaster risk points along the national roads are integrated into the road maintenance database, and based on this, an investment plan for road disaster prevention and maintenance is formulated.
Output 2		A DRBFC rainfall observation network will be established for road disaster prevention and maintenance, and will be used for investigation and design of facilities and counter measures.
Output 3		Draft technical guidelines and standard cost estimation materials for observation of, survey of and design against slope disasters will be prepared, and the capacity of the DRBFC for slope disaster countermeasures will be improved.
Output 4		Draft guidelines related to surveying methods for pavement damage, and technical guidelines and standard cost estimation materials for pavement work will be prepared, and the capacity of the DRBFC for road maintenance will be improved.
Activity of Output 1	1-1	Identify unstable slopes along national roads based on high-quality topographic data and aerial imagery.
	1-2	Construct a road disaster prevention and maintenance system, based on the road maintenance database, which integrates slope disaster hazards.
	1-3	Formulate medium-term and long-term investment plans for priority measures based on the technical guidelines and standard cost estimation materials prepared by Outputs 3 and 4,
Activity of Output 2	2-1	Plan a national rainfall observation network and procure the necessary

Item	Contents	
		equipment for measurement, communication and management of rainfall data.
	2-2	Reflect the data obtained from the national rainfall observation network in the technical guidelines of Output 3, and analyse the rainfall criteria for disaster occurrence based on the slope disaster information obtained in Output 1.
	2-3	Establish a maintenance system for the rainfall observation network, and prepare a rainfall observation manual.
Activity of Output 3	3-1	Select 3 pilot sites (1 slope failure, 1 shoulder failure, 1 landslide) based on the priority sections for measures in Output 1.
	3-2	Carry out the necessary topographic surveying, investigation, design and construction on each pilot site.
	3-3	Prepare drafts of technical guidelines and standard cost estimation materials for slope failure, shoulder collapse and landslide countermeasures based on examples of surveying, design and construction on the pilot site.
Activity of Output 4	4-1	Evaluate the extent of damages on the national road network using the automatic evaluation method for pavement damage, and select priority sections for measures for Output 1.
	4-2	Select two pilot sites, one asphalt pavement and one gravel pavement, from the priority sections for measures, and design measures for the extent of damages and carry out the necessary repair work.
	4-3	Prepare drafts of technical guidelines and standard cost estimation criteria for repair work based on the repair work cases on the pilot sites.

Source: JICA Expert Team

5.4 Proposals for Project Purpose and main activities

The purpose of this project is to improve the competence of the DRBFC for maintenance of major roads nationwide. As a specific indicator, the target length of national road to be maintained as a result of capacity development will be 400 km, which is 28.5% of the 1,400 km total length of national roads. In order to achieve this goal, as mentioned above, a total of 1,110 km of national roads will be planned, consisting of approximately 220 km of national roads that were completed in 2019 and approximately 890 km of national roads that will be completed by 2022. Furthermore, these national roads are planned to be maintained including the maintenance contract period, which will be ordered by the DRBFC. For this reason, the 1,110 km planned for national road improvement is expected to be subject to DRBFC maintenance (see Table 2.4).

Along with this increase, the number of roads subject to maintenance in the future will gradually increase from 940 km to 1,110 km from 2019 to 2022, and other national road maintenance targets will be set for 2023 along with the development of other national roads. The target road extension for the 5-year plan is expected to be 1,200 km (see Table 2.3). For this reason, the road maintenance budget needs to increase with the increase in the length of the developed national roads, and it is necessary to consider the establishment of a dedicated road maintenance fund for this purpose. Specifically, the following measures are proposed.

Implementation of multi-year maintenance using infrastructure funds

Currently, road maintenance is disbursed from the investment budget of the Ministry of Public Works, because the individual projects are small. This investment cost should be tendered every year and the expenditure should be completed in that fiscal year. Specifically, bidding procedures start around April to June, which is the time for budget allocation every year, and contracts are made after a period of about six months. However, there is a tendency for the period of implementation to be significantly short. For this

reason, in the system that will separate design and construction starting from fiscal year 2019, it is expected that a considerable number of unexecuted operations will be returned to the national treasury without being processed.

The JICA Expert Team propose to use infrastructure funds as a means to eliminate such inefficient single-year maintenance bidding procedures. Specifically, it is proposed that by making road maintenance work for several national roads and prefectural roads in a certain area as a package, the project scale per project will be about 1 million dollars, and the conditions for infrastructure fund application will be met. Also, bidding for multi-year maintenance work for local and domestic contractors should be held. This makes it possible to avoid inefficient bidding work by using the investment expenses of each province and to carry out maintenance work flexibly and at an appropriate time.

Utilizing infrastructure funds for road maintenance in this way is desirable for efficient maintenance work. However, infrastructure funds have additional investment targets and a project can be rejected if it is considered unacceptable. Therefore, when applying infrastructure funds, it is necessary to request the central government and parliament to apply infrastructure funds only for the maintenance of the most important roads such as national roads. The overall maintenance, including municipal roads and urban roads, should be carried out by the establishing the road maintenance fund as described below.

New gasoline tax as target tax and new road maintenance fund

Road maintenance and management will gradually increase with the completion of the road improvement projects, and it is safe to say that the level of road service is determined by the level of maintenance and management.

For this reason, countries around the world collect various taxes and usage fees for road maintenance, and use it as a financial resource for maintenance. These taxes include vehicle acquisition tax at the time of purchasing the vehicle, toll road fee, vehicle ownership tax and gasoline tax. Amongst them, road tax is collected according to the frequency of use. Moreover, the minimum tax collection method is gasoline tax. In Timor-Leste, fuel is imported by ship because there is no fuel refining facility, so it is taxed at the customs clearance at the port and this is the easiest tax to collect. Moreover, even if the taxation level is the minimum at the time of introduction, it is possible to adjust the tax amount to meet the maintenance demand by gradually increasing the taxable unit price due to price fluctuations, which is a method already been introduced by many countries.

In Timor-Leste, it is recommended to introduce a small taxation on gasoline tax in order to fund road maintenance, which is expected to increase with demand in the future.

Annex

Annex 1: Results of the Project (List of Dispatched Experts, List of Counterparts, List of Trainings, etc.)

Annex 2: Products of the Project (Checklists, Guidelines, Materials, etc.) (Separate volume)

Annex 3: Project Monitoring Sheets (Project Design Matrices)

Annex 4: Record of Discussions (R/D) and Minutes of Kick-off and JCC Meetings (MM)

Annex 5: Presentations of Kick-off and JCC Meetings

Annex 1: Results of the Project

List of dispatched experts

Role	Name	Affiliation	Man-months (MM)		
			TL	Japan	Total
Team Leader / Road Maintenance 1	Hisashi Muto	Ingerosec Corporation	10.63	0.20	10.83
Deputy Team Leader / Road Maintenance 2	Makoto Matsuura	Ingerosec Corporation	4.80	0.20	5.00
Deputy Team Leader / Road Maintenance 2	Mitsuhide Saito	Ingerosec Corporation	6.98	0.25	7.23
Road Construction Supervision	Johji Koizumi	Ingerosec Corporation	11.50	-	11.50
Quality Control / Road Repair	Sueo Hirose	Ingerosec Corporation	8.23	-	8.23
Disaster Restoration	Shutaro Sakanaka	Ingerosec Corporation	6.80	-	6.80
Disaster Restoration 2 (reinforcement)	Kazuharu Koishikawa	Ingerosec Corporation	3.20	-	3.20
Landslide (reinforcement)	Masahiko Hayashi	Earth System Science Co., Ltd.	3.00	-	3.00
Road Design / Project Coordinator (predecessor)	Yoshiyuki Akagawa	Ingerosec Corporation	3.30	0.10	3.40
Road Design / Project Coordinator (successor)	Nicholas Brooker-Jones	Ingerosec Corporation	6.57	0.10	6.67
Structure Design	Kenji Minegishi	Earth System Science Co., Ltd.	9.60	-	9.60
Database	Takashi Saito	Earth System Science Co., Ltd.	10.27	-	10.27
Topographical Analysis	Sohshi Mikami	Earth System Science Co., Ltd.	2.00	-	2.00
Evaluation / Monitoring (reinforcement)	Teresa Nao Tsujimura	Ingerosec Corporation	1.10	4.05	5.15
		Total	87.93	4.90	92.83

Source: JICA Expert Team

List of counterparts (DRBFC)

Designation	Name	Location	Remarks
Director General of Public Works	Eng. Jose Gaspar R. C. Piedade	Dili	Until 2018
	Eng. Rui Hernani Freitas Guterres		Since 2018
Director of DRBFC	Eng. Rui Hernani Freitas Guterres	Dili	Until 2018
	Eng. Milton Ramanata de Castro Monteiro		2018
	Eng. João Mario Gama de Sousa		Since 2019
Chief, Department of Projects (temporary)	Eng. João Mario Gama de Sousa	Dili	Until 2019
	Simão C. Armindo Laranjinha		Since 2019
Chief, Department of Analysis and Evaluation	Eng. Isabel Maria Lay Guterres	Dili	
Chief, Department of Construction	Eng. João Gregorio de Carvalho	Dili	
Chief, Department of Maintenance	Eng. João Pedro Amaral	Dili	
Chief, Department of Highway Construction Management	Eng. Milton Ramanata de Castro Monteiro	Dili	Until 2019
	Eng. Fernando Fortunato Freitas		Since 2019
Chief, Department of Training and Cooperation	Eng. Nene Lobato	Dili	
Director, Lautein Municipal Road Department	Eng. Abrao Vieira	Lospalos	Portugese: Lautém
Director, Manufahi Municipal Road Department	Eng. Aniceto Aquino T. de Andrade	Same	
Director, Kovalima Municipal Road Department	Eng. Nelson M. L. Amaral de Araujo Baris	Suai	Portugese: Cova Lima
Director, Baukau Municipal Road Department	Eng. Pedro Alexandre G. Pereira	Baukau	Portugese: Baucau
Director, Dili Municipal Road Department	Aleixo Humberto G. L. da Cruz	Dili	

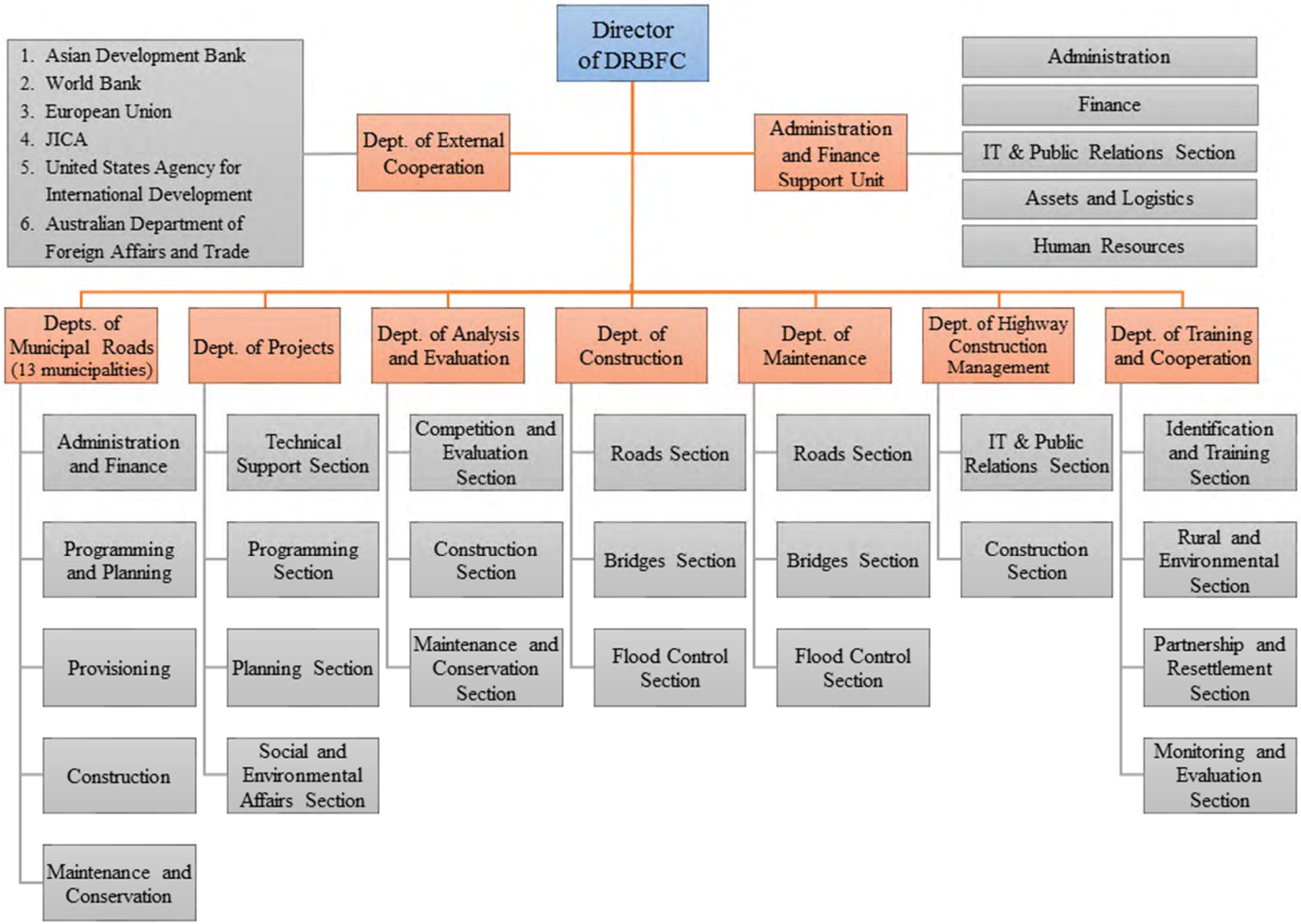
Designation	Name	Location	Remarks
Director, Likisá Municipal Road Department	Devi Emanuel E. Faria de Sousa	Likisá	Portugese: Liquiçá
Director, Aileu Municipal Road Department	Gaspar dos Santos Amaral	Aileu	
Director, Ermera Municipal Road Department	Sertorio Pereira B.E.	Ermera	
Director, Bobonaru Municipal Road Department	Antonio Soares	Maliana	Portugese: Bobonaro
Director, Vikeke Municipal Road Department	Mario do Rego	Vikeke	Portugese: Viqueque
Director, Ainaru Municipal Road Department	Jose Maria da C. de Deus do E. Santos	Ainaru	Portugese: Ainaro
Director, Manatutu Municipal Road Department	Eng. Geraldo da Conceição Lemos Soares	Manatutu	Portugese: Manatuto
Department of Projects	Letigia dos Reis H. Corbafo	Dili	
Department of Projects	Rogerio da Costa Freitas	Dili	
Department of Projects	Santino Barreto	Dili	
Department of Projects	Julius Luan Kehy	Dili	
Department of Projects	Lourenço Luis	Dili	
Department of Projects	Valeria Esperança G. de Jesus	Dili	
Department of Projects	Agata Maria Orleans Alves	Dili	
Department of Projects	Manuel Soares	Dili	
Department of Projects	Belsa dos Reis Gama	Dili	
Department of Projects	Armando Gama	Dili	
Department of Projects	Marcus Filomeno da Costa	Dili	
Department of Projects	Joaquim da Costa	Dili	
Department of Projects	Vital Araujo	Dili	

Designation	Name	Location	Remarks
Department of Projects	Sabino de Jesus Lobato	Dili	
Department of Analysis and Evaluation	Ligia Mediadora A. Soares	Dili	
Department of Analysis and Evaluation	Maria Gama	Dili	
Department of Analysis and Evaluation	Paula Guterres Gama	Dili	
Department of Analysis and Evaluation	Leonarda Brites da Silva	Dili	
Department of Analysis and Evaluation	Lourenco Pereira da Costa	Dili	
Department of Construction	Eng. Martinho Barreto de Sousa	Dili	
Department of Construction	Eng. Nazario de Jesus Freitas	Dili	
Department of Construction	Pricilla Ines dos Reis Gomes	Dili	
Department of Construction	Juliana Pereira das Neves	Dili	
Department of Construction	Eng. Estevao de Carvallio	Dili	
Department of Construction	Luis Sarmento da Cruz	Dili	
Department of Construction	Abillo da Silva Bena	Dili	
Department of Construction	Yosifina Jusefa Usfinit	Dili	
Department of Maintenance	Eng. Domingos Ximenes	Dili	
Department of Maintenance	Sabino da Costa Ventura	Dili	
Department of Maintenance	Antonio de Araujo	Dili	
Department of Maintenance	Altino Fernandes da Costa	Dili	
Department of Maintenance	Mouzinho Tilman	Dili	
Department of Maintenance	Pedro Corte Real Noronha	Dili	
Department of Maintenance	Filomena Correira Carvalho de Almeida	Dili	
Department of Maintenance	Bernardo Ferreira	Dili	
Department of Maintenance	Francisco Barbosa Gama	Dili	

Designation	Name	Location	Remarks
Department of Maintenance	Duarte Ximenes de Deus	Dili	
Department of Maintenance	Domingos da Silva Barbosa S.T	Dili	
Department of Maintenance	Cristovao da Costa Monteiro	Dili	
Department of Maintenance	Agostinho de Ataide da Costa	Dili	
Department of Highway Construction Maintenance	Celestino Evangelino Ximenes	Dili	
Department of Training and Cooperation	Inacia Quiteria Iku I. Freitas	Dili	
Department of Training and Cooperation	Alfredo Escurial dos Santos	Dili	
Department of Training and Cooperation	Angelo Ribeiro	Dili	

Source: DRBFC

Organisation chart of DRBFC (as of 2019)



Source: DRBFC

List of activities

Date	Activity	Details	Location	Participants
2016-07-19	Bridge Substructure Protection	Calculation example of Comoro River discharge (rational formula)	DRBFC Meeting Room	9
2016-08-19	Construction Management of Ex-Japan Road Improvement Works	Site inspection	Ex-Japan Road	2
2016-08-24	Construction Management of Ex-Japan Road Improvement Works	Workshop on quality control with concrete material and compression testing	DRBFC Meeting Room	4
2016-09-06	Construction Management of Ex-Japan Road Improvement Works	Site inspection	Ex-Japan Road	2
2016-10-06	Construction Management of Ex-Japan Road Improvement Works	Observation of safety activities: Safety patrol of the Construction of the Upriver Comoro Bridge	Upriver Comoro Bridge Project	6
2016-10-13	Construction Management of Ex-Japan Road Improvement Works	Safety management course (1): Current state and general safety measurement of DRBFC sites	DRBFC Meeting Room	17
2016-10-19	Construction Management of Ex-Japan Road Improvement Works	Site inspection	Ex-Japan Road	3
2016-10-20	Construction Management of Ex-Japan Road Improvement Works	Site inspection: Confirmation of on-site progress	Ex-Japan Road	3
2016-11-30	Slope Protection	Introduction of Slope Protection	DRBFC Meeting Room	15
2017-02-21	Bridge Substructure Protection	Foot protection works for scouring	DRBFC Meeting Room	
2017-02-28	Drainage Design	Catchment basin analysis seminar	CDRS Office	4
2017-05-05	Bridge Substructure Protection	Weather resistance big sand bag method for damage site	DRBFC Meeting Room	
2017-05-25	Slope Protection	Stability Calculation of Gravity Retaining Wall	DRBFC Meeting Room	21
2017-06-01	Slope Protection	Bearing Capacity of Plane and Slope Ground	DRBFC Meeting Room	9
2017-06-08	Slope Protection	Stepped Cut Foundation for Retaining Wall	DRBFC Meeting Room	6
2017-07-04	Construction Management of Ex-Japan Road Improvement Works	Safety meeting for the Construction of the Upriver Comoro Bridge	Upriver Comoro Bridge Project	11

Date	Activity	Details	Location	Participants
2017-08-09	Construction Supervision of 9 Package Repair Work	Site inspection and confirmation of progress	Gleno site on A04 road (No. 8 of 9 Packages)	3
2017-08-09	Drainage Design	Site investigation for case study of Sesurai culvert	Manufahi 県 Sesurai 町（A05 道路）	1
2017-08-15	Construction Supervision of 9 Package Repair Work	OJT for site inspection and quality control	Betano-Dotic site on A14 road (No.4 of 9 Packages)	12
2017-08-16	Construction Supervision of 9 Package Repair Work	Site inspection and contract management	Emergency construction of Sesurai culvert on A05 road	12
2017-08-16	Drainage Design	Rainfall (frequency) analysis and runoff analysis (Rational Method) seminar	CDRS Office	9
2017-08-18	Drainage Design	Rainfall (frequency) analysis and runoff analysis (Rational Method) workshop	DRBFC Meeting Room	6
2017-08-21	Construction Supervision of 9 Package Repair Work	OJT for site inspection and quality control	Betano-Dotic site on A14 road (No.4 of 9 Packages)	12
2017-08-21	Drainage Design	Rainfall (frequency) analysis and runoff analysis (Rational Method) workshop	DRBFC Meeting Room	3
2017-08-22	Construction Supervision of 7 Package Repair Work	OJT for site inspection and quality control	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	12
2017-08-24	Construction Management of Ex-Japan Road Improvement Works	Site inspection: Unresolved issues concerning site work	Ex-Japan Road	4
2017-08-24	Construction Supervision of 9 Package Repair Work	Site inspection and improvement recommendations	Gleno site on A04 road (No. 8 of 9 Packages)	2
2017-08-25	Drainage Design	Rainfall (frequency) analysis and runoff analysis (Rational Method) workshop	DRBFC Meeting Room	10
2017-08-29	Construction Supervision of 7 Package Repair Work	OJT for safety and quality control	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	2
2017-08-30	Construction Supervision of 9 Package Repair Work	OJT for quality control of drainage	Betano-Dotic site on A14 road (No.4 of 9 Packages)	2
2017-09-12	Construction Management of Ex-Japan Road Improvement Works	Progress management course: Ex-Japan Road improvement work and Ainaru emergency repair work	Ex-Japan Road	16
2017-09-13	Construction Supervision of 9 Package Repair Work	OJT for site inspection and quality control of drainage and road base construction	Betano-Dotic site on A14 road (No.4 of 9 Packages)	2

Date	Activity	Details	Location	Participants
2017-09-13	Construction Supervision of 7 Package Repair Work	Site inspection and confirmation of progress	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	2
2017-09-14	Slope Protection	How to Use Dokenbo, How to Record the Result	DRBFC Meeting Room	17
2017-09-19	Construction Management of Ex-Japan Road Improvement Works	Safety Patrol / Safety Committee of the Construction of the Upriver Comoro Bridge	Upriver Comoro Bridge Project	15
2017-09-26	Construction Supervision of 9 Package Repair Work	OJT for regular maintenance inspections and quality control of concrete pavement construction	Iliomar and Lospalos sites on A08 road (No. 1 of 9 Packages)	2
2017-09-28	Slope Protection	Dokenbo Shear Strength Test	DRBFC Meeting Room	7
2017-11-07	Bridge Substructure Protection	Groin study using Loes River	DRBFC Meeting Room	19
2017-11-09	Drainage Design	Calculation of drainage structure capacity (open-channel hydraulics) seminar	DRBFC Meeting Room	8
2017-11-10	Drainage Design	Calculation of drainage structure capacity (open-channel hydraulics) workshop	DRBFC Meeting Room	6
2017-11-14	Drainage Design	Calculation of drainage structure capacity (open-channel hydraulics) workshop	CDRS Office	13
2017-11-16	Slope Protection	How to use the Total Station	DRBFC Meeting Room	12
2017-11-21	Construction Supervision of 9 Package Repair Work	Site inspection	Casa-Same site on A13 road (No. 5 of 9 Packages)	2
2017-11-21	Slope Protection	Slope Stability Calculation	DRBFC Meeting Room	12
2017-11-22	Construction Supervision of 7 Package Repair Work	Site inspection and confirmation of progress	Ainaru-Hatudo site on A02 road and C23a road (No. 5 of 7 Packages)	2
2017-11-24	Construction Management of Ex-Japan Road Improvement Works	Safety management course (2): DRBFC role and proposal of safety activities	DRBFC Meeting Room	22
2017-11-30	Slope Protection	Slope Collapse Countermeasure	DRBFC Meeting Room	12
2017-12-12	Construction Management of Ex-Japan Road Improvement Works	Asphalt pavement workshops 1: Material and formulation design, laboratory quality control and Marshall testing	DRBFC Meeting Room	16
2017-12-14	Slope Protection	Practical Works of Cross Section Survey and DSST	DRBFC Meeting Room	8
2017-12-15	Construction Management of Ex-	Asphalt pavement workshops 2: Material and formulation design,	DRBFC Meeting Room	10

Date	Activity	Details	Location	Participants
	Japan Road Improvement Works	laboratory quality control and Marshall testing		
2018-02-02	Construction Management of Ex-Japan Road Improvement Works	Asphalt pavement workshop 3-1: Temperature control and core sampling	DRBFC Meeting Room	8
2018-02-21	Drainage Design	Consideration of erosion protection measures	DRBFC Meeting Room	7
2018-02-28	Construction Management of Ex-Japan Road Improvement Works	Asphalt pavement workshop 3-2: Site inspection of the Construction of the Upriver Comoro Bridge using a checklist	DRBFC Meeting Room	10
2018-03-01	Drainage Design	Summary of case study of Sesurai culvert on A05 road	Dept. of Maintenance Meeting Room	2
2018-03-14	Bridge Substructure Protection	Case study for Sahen	DRBFC Meeting Room	9
2018-03-27	Landslide Investigation	Case study: Aitutu landslide investigation	DRBFC Meeting Room	4
2018-04-10	Landslide Investigation	Case study: Aitutu landslide investigation	DRBFC Meeting Room	15
2018-04-13	Landslide Investigation	Case study: Aitutu landslide investigation	DRBFC Meeting Room	15
2018-04-26	Slope Protection	Case Study; Estimation of the Collapse Conditions Evaluation Safety of the Slope	DRBFC Meeting Room	7
2018-05-03	Slope Protection	Case Study; Countermeasure Study	DRBFC Meeting Room	6
2018-05-08	Slope Protection	Guideline; Slope Stability	DRBFC Meeting Room	7
2018-06-12	Bridge Substructure Protection	Explanation of Bridge Substructure Protection Guidelines	DRBFC Meeting Room	18
2018-06-12	Drainage Design	Site investigation for case study of Sarlala culvert	Ex-Japan Road	3
2018-06-13	Bridge Substructure Protection	Groin study using Loes River	DRBFC Meeting Room	24
2018-06-14	Quality Control of Humboe-Letefoho	Site inspection of road subbase course	Humboe–Letefoho emergency repair work on A10 road	1
2018-06-21	Drainage Design	Explanation of draft guidelines for planning & design of culverts	DRBFC Meeting Room	23
2018-06-25	Quality Control of Humboe-Letefoho	Explanation of Checklists for Construction	DRBFC Meeting Room	22
2018-06-26	Safety Patrol	1st Site Safety Committee	DRBFC Meeting Room	16
2018-06-26	Safety Patrol	Safety patrol of footpath construction	Ex-Japan Road (No.9)	16
2018-06-26	Safety Patrol	Safety patrol of masonry retaining wall construction	Ex-Japan Road (No.3)	16

Date	Activity	Details	Location	Participants
2018-09-11	Slope Protection	Guideline; Retaining Wall	DRBFC Meeting Room	14
2018-09-12	Quality Control of Humboe-Letefoho	On-the-job training using checklists for road subbase, masonry side drains and crossing drainage	Humboe–Letefoho emergency repair work on A10 road	3
2018-09-14	Slope Protection	Case Study; Continuous Observation on the Collapsed Slope and Isolated Cross Section Survey	DRBFC Meeting Room	13
2018-09-18	Drainage Design	Progress of case study of Sarlala culvert on Ex-Japan Road, and presentation of key points from guidelines for planning & design of culverts	DRBFC Meeting Room	11
2018-09-19	Safety Patrol	2nd Site Safety Committee	DRBFC Meeting Room	15
2018-09-19	Safety Patrol	Safety patrol of aggregate base course construction	Ex-Japan Road (STA 17.85–18 km)	15
2018-09-19	Safety Patrol	Safety patrol of masonry retaining wall construction	Ex-Japan Road (STA 7–8 km)	15
2018-09-19	Safety Patrol	Safety patrol of laying of cross drainage	Ex-Japan Road (STA 6.270 km)	15
2018-09-20	Slope Protection	Case Study; Slope Collapse Countermeasure Study Based on Site Observation	DRBFC Meeting Room	6
2018-09-28	Drainage Design	Progress of case study of Sarlala culvert on Ex-Japan Road, and presentation of key points from guidelines for planning & design of culverts	Dept. of Projects Meeting Room	9
2018-10-03	Quality Control of Humboe-Letefoho	Workshop on inspections of Humboe–Letefoho emergency repair work and Ex-Japan Road improvement work using checklists	DRBFC Meeting Room	4
2018-10-10	Quality Control of Humboe-Letefoho	Explanation and dissemination of Checklists for Construction	DRBFC Meeting Room	7
2019-03-14	Drainage Design	Presentation of findings from the case study of Sarlala culvert on Ex-Japan Road, and presentation of key points from guidelines for planning & design of culverts	DRBFC Meeting Room	51
2019-05-10	Slope Protection	Practical Works of Disaster Investigation	DRBFC Meeting Room	7
2019-05-13	Slope Protection	Conference of Disaster Investigation	DRBFC Meeting Room	6

Source: JICA Expert Team

List of participation by external parties

Date	Activity	ADB	ADN	AdP	CADEFEST	DIT	IPG	R4D-SP	UNIPAZ	UNITAL	UNTL
2016-06-23	Meeting	✓	✓					✓			
2016-11-30	Training				✓						✓
2017-05-25	Training							✓		✓	
2017-06-01	Training							✓			
2017-06-08	Training							✓			
2017-10-26	Presentation			✓							
2018-02-21	Training							✓			
2018-02-23	Meeting							✓			
2018-03-02	JCC							✓			
2018-04-13	Training						✓	✓			
2018-06-21	Presentation							✓			
2018-09-11	Training							✓			
2018-09-14	OJT							✓			
2018-09-17	Training						✓				
2018-09-26	JCC		✓					✓			
2018-09-28	Presentation							✓			
2019-03-07	Training							✓			
2019-03-14	Presentation							✓			
2019-03-15	Presentation				✓	✓	✓	✓	✓		
2019-03-19	JCC						✓	✓			
2019-04-26	Presentation					✓					
Total		1	2	1	2	2	4	17	1	1	1

Organizations

ADB:	Asian Development Bank
ADN:	National Development Agency
AdP:	Águas de Portugal group
CADEFEST:	JICA's project for Capacity Development of the Faculty of Engineering, Science and Technology, the National University of Timor-Lorosa'e, Phase 2
DIT:	Dili Institute of Technology
IPG:	Institution of Petroleum and Geology–Public Institute
R4D-SP:	Roads for Development Support Programme (by International Labour Organisation)
UNIPAZ:	Universidade da Paz
UNITAL:	Universidade Oriental Timor Lorosa'e
UNTL:	National University of Timor Lorosa'e

Source: JICA Expert Team

List of publicity activities

Media	Record	Total
Timor Post newspaper	2018-10-29: 4th JCC (Joint Coordinating Committee) meeting	1 time
JICA ODA Visualization Site	2015-11-19: Project Evaluation Proposal Search Result List 2016-12-05: Project Introduction 2016-12-05: Cooperation area map 2016-12-05: Pictures of cooperation site	4 times
JICA Project Website	2016-04-12: Kick-off meeting 2016-06-23: 1st JCC (Joint Coordinating Committee) meeting 2016-08-24: Construction quality management workshop 2016-09-16: Survey on disaster infrastructure in Southern region 2016-10-19: Start of case study on construction supervision 2016-11-30: Seminar on slope and disaster prevention for improvement of design ability 2017-02-16: 2nd JCC (Joint Coordinating Committee) meeting 2017-02-17: Workshop on road damage countermeasures for National Route 3 2017-02-21: Seminar on bridge scouring countermeasure for improvement of design ability 2017-03-01: Seminar on road drainage measures for improvement of design capacity 2017-04-25: JICA interns accepted by the CDRS project 2017-06-22: Geographical survey by UAV 2017-12-01: Landslide survey using in-hole inclinometer 2018-03-02: Temperature and quality control for asphalt paving 2018-04-27: 3rd JCC (Joint Coordinating Committee) meeting 2018-04-27: Urgent investigation of landslide disaster site 2018-06-27: Explanatory meeting for Bridge Substructure Protection guideline 2018-07-26: Explanatory meeting for Culvert Design guideline 2018-07-30: Safety patrol by counterpart 2018-10-23: 4th JCC (Joint Coordinating Committee) meeting 2019-03-06: Implementation of OJT using Construction Checklist by counterpart 2019-04-05: Implementation of international roughness index survey on national highways 2019-04-16: Joint seminar with local road improvement project 2019-04-16: Workshop for dissemination of guidelines and checklists 2019-05-10: 5th JCC (Joint Coordinating Committee) meeting 2019-05-31: Guest lecture at Dili Institute of Technology	26 times
Facebook website for CDRS Project	2016-09-26: Field survey in Same, Manufahi 2016-09-26: Joint field survey in Fatu-ahi 2016-09-26: Joint field survey of Laklo River, Manufahi District 2016-09-26: Joint field survey in Be Mean, Covalima District 2016-09-28: 1st JCC (Joint Coordinating Committee) meeting 2016-10-03: Project monitoring at Ex-Japan Road 2016-10-04: Visit to Directorate National of Research and Development (National Laboratory) 2016-10-07: Observation of safety patrol conducted by Upriver Comoro Bridge project 2016-10-21: Ground-breaking ceremony of Comoro Bridge III 2016-10-24: Site visit to Ex-Japan Road	33 times

Media	Record	Total
	2016-12-01: Seminar about introduction of slope protection 2017-02-13: Seminar about safety management seminar for construction works on site 2017-02-14: Site inspection of National Road A03 (Balibo and Karimbala) 2017-02-20: Site inspection of National Road A01 and A08 (Lospalos - Iliomar) 2017-02-20: 2nd JCC (Joint Coordinating Committee) meeting 2017-03-16: Workshop about road damage of National Road A03 (Balibo and Karimbala) 2017-03-23: Joint site survey of National Road A05 (Same, Sesurai), and National Road A14 (Sahen) 2017-03-27: Seminar about introduction to GIS database development using QGIS 2017-04-03: Lecture about protection methods against scouring for Sahen Bridge 2017-04-04: Lecture about catchment basin for design check of road drainage 2017-04-05: Joint site inspection of National Road A06 (Baucau – Viqueque) 2017-05-18: Joint site inspection of Loes River 2017-05-23: Lecture about weather resistant big sandbag method for damage site 2017-06-12: Workshop for stability calculation of a gravity retaining walls 2017-07-18: Lecture about construction planning and management for jumbo pack construction 2017-07-24: UAV (Unmanned Aerial Vehicle) survey conducted in Loes Bridge and Aitutu 2018-10-03: Safety patrol by members of Site Safety Committee using high-visibility vests 2018-10-03: Newspaper article about 4th Joint Coordinating Committee (JCC) meeting from the Timor Post newspaper 2018-10-04: On-the-job training for inspection checklists for final payment and interim payment documents 2018-10-09: Internal training sessions for culvert planning and design 2019-04-02: On-the-job Training for Construction Supervision 2019-06-28: Workshop for Database, Checklists and Guidelines 2019-06-28: 5th JCC (Joint Coordinating Committee) meeting	
Facebook website for JICA Timor-Leste	2016-12-21: JICA training alumni utilize their knowledge in cooperation with CDRS 2017-02-20: JICA interns accepted by the CDRS project 2017-02-20: 2nd JCC (Joint Coordinating Committee) meeting 2017-03-01: Joint site observation for road damage of National Road 2 and National Road 3 2017-03-29: Presentation of introduction of geographic information systems 2017-07-04: Presentation of construction planning for demonstration of jumbo pack (big sand bag) 2017-09-12: Emergency recovery project installation with jumbo pack in Loes River 2017-09-22: Safety patrol in collaboration with Project for Construction of Upriver Comoro Bridge	23 times

Media	Record	Total
	2017-09-28: Presentation on usage of *dokenbo* tool for soil strength tests 2017-10-10: Case study of Ainaru-Same emergency road works 2017-11-06: Explanatory meeting regarding Comoro Bridge's design discharge 2017-11-29: Lecture on work safety and work safety regulations 2018-02-14: Presentation session about asphalt pavement 2018-03-05: 3rd JCC (Joint Coordinating Committee) meeting 2018-03-21: Temperature and quality control for asphalt paving (shared CDRS Project News article, 2018-03-02) 2018-06-20: Explanatory meeting for Bridge Substructure Protection guideline 2018-07-05: Establishment and coordination meeting for Site Safety Committee 2018-09-27: 4th JCC (Joint Coordinating Committee) meeting 2018-10-05: Topographical survey of Loes Bridge and Aitutu by UAV (shared CDRS post, 2017-07-24) 2018-10-09: Safety patrol by members of Site Safety Committee using high-visibility vests (shared CDRS post, 2018-10-03) 2018-10-12: On-the-job training using emergency works in Humboe, Letefoho 2019-03-10: Knowledge sharing session about road maintenance 2019-05-22: 5th JCC (Joint Coordinating Committee) meeting	
Facebook website for DRBFC	2019-04-06: DRBFC continue collecting landslide data in Aitutu 2019-04-30: Inclinometer monitoring in Aitutu with CDRS and IPG	2 times
	Total number of publicity items	89 times

Source: JICA Expert Team

Annex 2: Products of the Project (Separate volume)

Deliverable	#	Title	Language	Page
Checklists for construction supervision, quality control and safety control	1	Checklist for Construction	English	A 2 - 3
Technical guidelines for bridge substructure protection measures	2	Bridge Substructure Protection Guideline	English	A 2 - 91
	3	Mata Dalan Substrutura Ponte	Tetun	A 2 - 153
Technical guidelines for drainage planning and design	4	Road Guidelines – Drainage – Culvert Design	English	A 2 - 215
	5	Annex	English	A 2 -261
	6	Mata Dalan Estrada – Drenajem – Dezenu Culvert	Tetun	A 2 - 341
Technical guidelines for slope protection	7	Road Guidelines – Slope Protection – Retaining Wall & Slope Collapse	English	A 2 - 387
	8	Matadalan Estrada – Protesaun rai Halis – Moru Retensaun & Colapso de Declive	Tetun	A 2 - 477
Technical guidelines for landslide investigation and observation	9	Road Guidelines – Slope Protection – Landslide Investigation	English	A 2 - 561
	10	Annex	English	A 2 - 599
	11	Matadalan Estrada – Protesaun rai Halis - Investigasaun Rai Halai	Tetun	A 2 - 663

Note: Tetun versions are for reference only

Annex 3: Project Monitoring Sheets (Project Design Matrices)

Project Design Matrix

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 Road, Bridge and Flood Control (DRBFC)

Period of Project: (Three (3) years)

Project Site: Whole Timor-Leste **Model Site:**

Version 0

Dated October 19, 2015

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 Conditions of major roads are improved. -International Roughness Index (IRI) -Travel speed	DRBFC annual report	・Budget and staff will be secured at satisfactory levels. ・Traffic volume is not increased more than expected.		
Project Purpose					
Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	PP1 Budget implementation rate (actual use/plan) increase from **% to **% PP2 Fixation degree(maintenance cycle, standard operation procedure) of road maintenance management is improved	Budget plan and report Monitoring sheet	・ Budget for road maintenance and management is ensured. ・Enough number of DRBFC staff in the HQs and regional offices is ensured as planned.		
Outputs					
Output 1: Appropriate road maintenance for major roads is realized the Dili area and introduced in other areas by improving cycle of road maintenance.	1-1 Important sections of major roads in TL are improved to better passable roads. 1-2 Updated road data is used for cycle of road maintenance.	・Project report ・Project report	・ 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.		
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 Number of case studies 2-2 Understanding level of DRBFC staff in construction management	・Case study report ・Examination sheet			
Output 3: Standard drawings of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection	3-1 Number of standard drawings prepared 3-2 Number of maintenance projects improved to be better passable in the whole country by using the standard drawings	・Standard drawings prepared ・ DRBFC annual report			

Activities	Inputs		Pre-Conditions
	The Japanese Side	The Timor-Leste Side	
1.1 To formulate annual work plan and annual budget plan concerned with road maintenance and repair/rehabilitation works 1.2 To conduct routine inspections and necessary repair works/rehabilitation of roads and bridges 1.3 To update the database in accordance with the routine inspections 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 and repair/rehabilitation works by following annual work and budget plans which reflect priorities within the limited budget allocation 1.7. Maintenance framework for major roads in region is improved with considering the head quarter's support. 2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies 2.2 To conduct plan, design, procurement, construction and supervision as well as budgeting of the case studies 2.3 To propose necessary manpower for construction management for rehabilitation in HQs and regional offices 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 reconstruction works 3.3 To prepare a book of draft standard drawings for rehabilitation 3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings 3.5 To prepare guidelines for using the standard drawings 3.6 To disseminate the book of standard drawings for each regional office	1 Dispatch of the Japanese experts Short-term experts: - Chief advisor/ road maintenance - Road construction management - Quality control - Road design/ road structure design - Project coordinator/database management - 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 countermesures>

Tentative Plan of Operation

Version 0
Dated , 2015

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

Inputs	Year	1st Year				2nd Year				3rd Year				Remarks	Monitoring: Issue	Monitoring: Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV			
Expert																
Chief advisor/ road maintenance	Plan															
	Actual															
Road construction management	Plan															
	Actual															
Quality control	Plan															
	Actual															
Road design/ road structure design	Plan															
	Actual															
Project coordinator/database management	Plan															
	Actual															
Other areas if needed	Plan															
	Actual															
Equipment																
In accordance with necessity of activities	Plan															
	Actual															
Training in Japan																
In accordance with necessity of activities	Plan															
	Actual															
In-country/Third country Training																
	Plan															
	Actual															

Activities / Sub-Activities	Year	1st Year				2nd Year				3rd Year				Responsible Organization: Japan	Responsible Organization: GOTL	Achievements	Issue & Countermeasures
		I	II	III	IV	I	II	III	IV	I	II	III	IV				
Output 1: Appropriate road maintenance for major roads is realized the Dili area and introduced in other areas by improving cycle of road maintenance.																	
1.1 To formulate annual work plan and annual budget plan concerned with road maintenance and repair/rehabilitation works	Plan													JICA	DRBFC		
	Actual																
1.2 To conduct routine inspections and necessary repair/rehabilitation works of roads and bridges	Plan													JICA	DRBFC		
	Actual																
1.3 To update the database in accordance with the routine inspections and repair/rehabilitation works of roads and bridges	Plan													JICA	DRBFC		
	Actual																
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan													JICA	DRBFC		
	Actual																
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	Plan													JICA	DRBFC		
	Actual																
1.6 To undertake appropriate road maintenance and repair/rehabilitation works by following annual work and budget plans within the limited budget allocation	Plan													JICA	DRBFC		
	Actual																
1.7 Maintenance framework for major roads in region is improved with considering the head quarter's support.	Plan													JICA	DRBFC		
	Actual																
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope protection.																	
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	Plan													JICA	DRBFC		
	Actual																
2.2 To conduct plan, design, procurement, construction and supervision as well as budgeting of the case studies	Plan													JICA	DRBFC		
	Actual																
2.3 To propose necessary manpower for construction management for rehabilitation in HQs and regional offices through case studies	Plan													JICA	DRBFC		
	Actual																
Output 3: Standard drawings of 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													JICA	DRBFC		
	Actual																
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and reconstruction works	Plan													JICA	DRBFC		
	Actual																
3.3 To prepare a book of draft standard drawings for rehabilitation	Plan													JICA	DRBFC		
	Actual																
3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings	Plan													JICA	DRBFC		
	Actual																
3.5 To prepare guidelines for using the standard drawings	Plan													JICA	DRBFC		
	Actual																
3.6 To disseminate the book of standard drawings for each regional office	Plan													JICA	DRBFC		
	Actual																
Duration / Phasing	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.1（Term: March, 2016 - March, 2019）

Name: Hisashi MUTO

Title: Team Leader/ Road Maintenance 1

Submission Date: 1st July 2016

< I. Summary (all achievements are as of 30th June, 2016) >

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
1	Hisashi MUTO	Team Leader/ Road Maintenance 1	(1st) 8th Mar - 10th Apr, 2016 (2nd)14th Jun - 25th Jun, 2016
2	Makoto MATSUURA	Deputy Team Leader/ Road Maintenance 2	(1st) 8th Mar – 15th Apr, 2016 (2nd)14th Jun - 30th Jun, 2016
3	Johji KOIZUMI	Road Construction Supervision	-
4	Sueo HIROSE	Quality Control/ Road Repair	(1st) 28th Mar - 17th Apr, 2016 (2nd)13th May - 11th Jun, 2016
5	Shutaro SAKANAKA	Disaster Restoration	(1st) 11th May - 31st May, 2016 (2nd)28th Jun - 30th Jun, 2016
6	Yoshiyuki AKAGAWA	Road Design/ Project Coordinator	(1st) 17th Mar – 15th Sep, 2016 (2nd)21st Jun - 30th Jun, 2016
7	Kenji MINEGISHI	Structure Design	(1st) 5th Apr - 24th Apr, 2016
8	Takashi SAITO	Database	-
9	Nao Tsujimura	Evaluation/Monitoring	Resident in Timor-Leste

< Equipment and materials >

NO	Items	Qty	Unit price	Unit	Total amount
	Not Applicable				

(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	Jose Gaspar R.C. Piedade	Project Director	8th Mar 2016 – at present
2	Rui Hernani F. Guterres	Project Manager	8th Mar 2016 – 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.	● To know the actual condition of road maintenance (routine/periodic maintenance) and rehabilitation, hearing to DRBFC headquarters and municipal office staff were carried out. ● To understand the present management structure of road maintenance and rehabilitation, hearing to DRBFC headquarters and municipal office staff were carried out. ● Information of 9 maintenance package projects were collected. ● Road conditions were observed on A01,A02,A05,A06,A07,A08,A13 and A14 through site survey.
1.2	To conduct periodic/routine inspection	● Periodic inspection was conducted by DRBFC in association with JICA Expert Team in May 2016. Through the inspection, JICA Expert Team has reviewed the relevant information with DRBFC staff as a) contents of the current inspection sheet, b) measurement method of the damaged on the road, pipe/box culvert and drainage.
2.1	To identify typical rehabilitation and repair works of major roads in the whole country as case studies	● Existing drawings which show the typical rehabilitation and repair works were collected. ● Criteria to select the case studies were discussed among DRBFC and JICA Expert Team.
3.1	To review existing technical documents for road maintenance and rehabilitation	● Existing drawings, technical standards, manuals and standard specifications were collected. ● JICA Expert Team is drafting the baseline examinations to DRBFC staff in order to know the present understanding level of design standard, concept and condition.
3.2	To review and identify factors of failure from past examples of damaged rehabilitation and	● Causes of failure on the damaged rehabilitation and construction works were examined through the site survey with DRBFC municipal office staff.

	construction works	

1-3 Achievement of Output

Indicators of Outputs		Achievement level
1.1	Important sections of major roads in TL are improved to better passable roads.	As the concrete indicators are under consideration based on the present condition analysis and baseline survey, the achievement levels of each indicator of outputs are not ready to be measured. Proper indicators shall be set up as soon as possible.
1.2	Updated road data is used for cycle of road maintenance.	
2.1	Number of case studies.	
2.2	Understanding level of DRBFC staff in construction management.	
3.1	Number of standard drawings prepared	
3.2	Number of maintenance projects improved to be better passable in the whole country by using the standard drawings.	

1-4 Achievement of the Project Purpose

Indicators of Project Purpose		Achievement level
1	Budget implementation rate (actual use/plan) increase from **% to **%.	As the concrete indicators are under consideration based on the present condition analysis and baseline survey, the achievement levels of each indicator of outputs are not ready to be measured. Proper indicators shall be set up as soon as possible.
2	Fixation degree (maintenance cycle, standard operation procedure) of road maintenance management is improved.	

1-5 Changes of Risks and Actions for Mitigation

- Risks are not confirmed so far, thus actions for mitigation are not taken.

1-6 Progress of Actions undertaken by JICA

- JICA Timor-Leste played a center role in organizing the 1st JCC and commented about the importance of inter-organizational coordination and budget disbursement.
- JICA Timor-Leste shared important information and documents with JICA Expert Team.

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

- Minister of Public Works, Transport and Communications attended the 1st JCC as a chairperson.
- DRBFC shared necessary information and documents with JICA Expert Team.
- Periodic road inspection was conducted.
- Some of candidate case study sites were proposed.

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)

- A woman engineer was assigned to the periodic inspection team.

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.)

- Kick-off meeting not mentioned in PDM but related to the project was held on 12th Apr 2016. JICA Expert Team explained the project scope and outline and the Maintenance Department of DRBFC had a presentation of activity plan of road maintenance.

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 version 0 was modified and version 1 was prepared based on the PDM version 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 increase 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.
- The following modifications were approved by JCC.

Items	PDM Version 0 (Same as R/D)	Type of changes	PDM Version 1 (approved in JCC)	Reasons of Modification
Output 1	Appropriate road maintenance for major roads is realized in the Dili area and introduced in other area by improving cycle of road maintenance.	Modified	Appropriate road maintenance and rehabilitation for major roads is realized in accordance with annual work plan and annual budget plan.	Modified because the maintenance system is not firstly developed in Dili and introduced to other area. It shall be developed evenly in the whole country.
Activity 1-1	To formulate annual work plan and annual	Modified	To review existing management structure	Modified that the activity shall start from the

Items	PDM Version 0 (Same as R/D)	Type of changes	PDM Version 1 (approved in JCC)	Reasons of Modification
	budget plan concerned with road maintenance and repair/rehabilitation work.		and condition of maintenance and rehabilitation for major roads.	present condition analysis since the concrete annual work and budget plan are not formulated.
Activity 1-2	To conduct routine inspections and necessary repair works/rehabilitation of roads and bridges.	Modified	To conduct periodic/routine inspections.	Modified because the inspections and repair/rehabilitation works are not conducted in parallel at present.
Activity 1-3	To update the database in accordance with the routine inspections and repair/rehabilitation works of roads and bridges.	Modified	To update the database based on the inspection result and repair/rehabilitation works of roads and bridges.	Modified because the database is updated based on not routine inspections but periodic maintenance. The database shall also include the project information.
Activity 1-7	Maintenance framework for major roads in regions is improved with considering head quarter's support.	Modified	To propose appropriate framework of road maintenance and rehabilitation for major roads.	Modified because not only the framework in regions but also the roles and relation between HQs and regions shall be proposed.
Activity 2-2	To conduct plan, design, procurement, construction and supervision as well as budgeting of the case studies.	Modified	To conduct the case studies for the planning, design check, and construction supervision of the project.	Modified considering the roles and responsibilities of DRBFC for the maintenance and rehabilitation works.
Activity 2-3	To propose necessary manpower for construction management for rehabilitation in HQs and regional offices through case studies	Modified	To propose preferable structures for construction management for repair/rehabilitation works through case studies.	Modified because not only necessary manpower but also the roles and relation between HQs and regions shall be proposed.
Inputs Japanese side (Experts)	- Chief advisor/road maintenance - Road construction management - Quality control - Road design / road structure design - Project coordinator/ database management - Other areas if needed	Added and Modified	- 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	Added and modified as per the Consultant's proposal

Attachment: Minutes of JCC

Project Monitoring Sheet I （Revision of Project Design Matrix）

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

Version 1

Implementing Agency: Ministry of Public Works, Transport and Communications

Dated 1,July,2016

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 Conditions of major roads are improved. - International Roughness Index (IRI) - Travel speed	DRBFC annual report	Budget and staff will be secured at satisfactory levels. Traffic volume is not increased more than expected.	To be monitored after the concrete indicator is set up	
Project Purpose Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	PP1 Budget implementation rate (actual use/plan) increase from **% to **%. PP2 Fixation degree (maintenance cycle, standard operation procedure) of road maintenance management is improved.	Budget plan and report Monitoring sheet	Budget for road maintenance and management is ensured. Enough number of DRBFC staff in the HQs and regional offices is ensured as planned.	To be monitored after the concrete indicator is set up	
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: Standard drawing of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	1-1 Important sections of major roads in TL are improved to better passable roads. 1-2 Updated road data is used for cycle of road maintenance. 2-1 Number of case studies. 2-2 Understanding level of DRBFC staff in construction management. 3-1 Number of standard drawings prepared 3-2 Number of maintenance projects improved to be better passable in the whole country by using the standard drawings.	Project report Project report Case study report Examination sheet Standard drawings prepared DRBFC annual report	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.	To be monitored after the concrete indicator is set up	

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 check, and construction supervision of the project. 2.3 To propose preferable structures for construction management for repair/rehabilitation 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 prepare a book of draft standard drawings for rehabilitation. 3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings. 3.5 To prepare guidelines for using the standard drawings. 3.6 To disseminate the book of standard drawings for each regional office.	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>

PM Form3-3 Monitoring Sheet II

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 1
Dated 1,July,2016

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

Inputs	Plan / Actual	2016 Ⅰ	2016 Ⅱ	2016 Ⅲ	2016 Ⅳ	2017 Ⅰ	2017 Ⅱ	2017 Ⅲ	2017 Ⅳ	2018 Ⅰ	2018 Ⅱ	2018 Ⅲ	2018 Ⅳ	2019 Ⅰ	2019 Ⅱ	2019 Ⅲ	2019 Ⅳ	2020 Ⅰ	2020 Ⅱ	2020 Ⅲ	2020 Ⅳ	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																								
Team Leader/Road Maintenance 1	Plan	■	■	■		■	■	■	■	■	■	■	■	■									-	-
	Actual	■	■																					
Deputy Team Leader/Road Maintenance 2	Plan	■	■	■	■	■	■	■		■	■	■	■	■									-	-
	Actual	■	■																					
Road Construction Supervision	Plan			■	■	■	■	■	■	■	■	■	■										-	-
	Actual																							
Quality Control/Road Repair	Plan		■	■		■	■	■		■		■											-	-
	Actual		■																					
Disaster Restoration	Plan		■	■		■		■	■		■	■	■										-	-
	Actual		■																					
Road Design/Project Coordinator	Plan	■	■		■	■	■		■	■		■		■									-	-
	Actual	■	■																					
Structure Design	Plan		■	■	■		■	■	■			■	■										-	-
	Actual		■																					
Database	Plan			■		■	■	■			■	■	■										-	-
	Actual																							
Evaluation/Monitoring	Plan	■		■		■		■		■		■		■									-	-
	Actual	■																						
Equipment																								
	Plan																							
	Actual																							
	Plan																							
	Actual																							
	Plan																							
	Actual																							
	Plan																							
	Actual																							
	Plan																							
	Actual																							
Training in Japan																								
necessities are under discussion	Plan																							
	Actual																							
In-country/Third country Training																								
	Plan																							
	Actual																							

Activities / Sub-Activities	Plan / Actual	2016 Ⅰ	2016 Ⅱ	2016 Ⅲ	2016 Ⅳ	2017 Ⅰ	2017 Ⅱ	2017 Ⅲ	2017 Ⅳ	2018 Ⅰ	2018 Ⅱ	2018 Ⅲ	2018 Ⅳ	2019 Ⅰ	2019 Ⅱ	2019 Ⅲ	2019 Ⅳ	2020 Ⅰ	2020 Ⅱ	2020 Ⅲ	2020 Ⅳ	Responsible Organization: Japan	Responsible Organization: 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	■	■																					Hearing, document collection and site survey were conducted	
	Actual	■	■																						
1.2 To conduct the periodic/routine inspection	Plan		■				■				■													Periodic Inspection was conducted as scheduled	
	Actual		■																						
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	Plan			■			■	■			■	■													
	Actual																								
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan			■	■			■	■			■	■												
	Actual																								
1.5 To implement emergency inspections and repair/rehabikitation works when necessity arises	Plan				■				■				■												
	Actual																								
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																								
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		■	■		■	■	■																Drawings were collected and Criteria were discussed	
	Actual		■																						
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	Plan			■	■	■	■	■	■	■	■	■	■												
	Actual																								
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	Plan								■				■												
	Actual																								
Output 3: Standard drawings of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection																									
3.1 To review the existing technical documents for road maintenance and rehabilitation	Plan	■	■																					Related drawings were collected	
	Actual	■	■																						
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works	Plan		■	■																				Some sites were observed and examined	
	Actual		■																						
3.3 To prepare a book of draft standard drawings for rehabilitation	Plan			■	■	■	■	■																	
	Actual																								
3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings	Plan							■			■	■													
	Actual																								
3.5 To prepare guidelines for using the standard drawings	Plan				■	■			■	■		■	■												
	Actual																								
3.6 To disseminate the book of standard drawings for each regional office	Plan												■												
	Actual																								
Duration / Phasing	Plan																								
	Actual																								

Monitoring Plan	Plan / Actual	2016 Ⅰ	2016 Ⅱ	2016 Ⅲ	2016 Ⅳ	2017 Ⅰ	2017 Ⅱ	2017 Ⅲ	2017 Ⅳ	2018 Ⅰ	2018 Ⅱ	2018 Ⅲ	2018 Ⅳ	2019 Ⅰ	2019 Ⅱ	2019 Ⅲ	2019 Ⅳ	2020 Ⅰ	2020 Ⅱ	2020 Ⅲ	2020 Ⅳ	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																							
	Plan																							
	Actual																							
Reports/Documents																								
Book of Standard Drawings	Plan													■										
	Actual																							
Project Completion Report	Plan													■										
	Actual																							
Public Relations																								
	Plan																							
	Actual																							
	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.2（Term: March, 2016 - March, 2019）

Name: Hisashi MUTO

Title: Team Leader/ Road Maintenance1

Submission Date: 12th October 2016

< I. Summary (all achievements are as of 12th October, 2016) >

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	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 – 12th Oct,2016	None
3	Johji KOIZUMI	Road Construction Supervision	(1st) 19th Jul– 17th Aug, 2016 (2nd)24th Sep – 12th Oct,2016	None
4	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 – 12th Oct, 2016	None
5	Shutaro SAKANAKA	Disaster Restoration	(1st) 11th May - 31st May, 2016 (2nd)28th Jun - 21st Jul, 2016 (3rd)12th Sep – 6th Oct, 2016	None
6	Yoshiyuki AKAGAWA	Road Design/ Project Coordinator	(1st) 17th Mar – 15th Sep, 2016 (2nd)21st Jun - 13th Jul, 2016 (3rd)12th Sep – 6th Oct, 2016	None
7	Kenji MINEGISHI	Structure Design	(1st) 5th Apr - 24th Apr, 2016 (2nd) 5th Jul - 4th Aug, 2016	None

8	Takashi SAITO	Database	(1st) 19th Jul– 24th Aug, 2016 (2nd) 3rd Oct– 12th Oct, 2016	None
9	Nao TSUJIMURA	Evaluation/Monitoring	Resident in Timor-Leste	None

< Equipment and materials >

NO	Items	Qty	Unit price	Unit	Total amount
	Not Applicable				

(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	Jose Gaspar R.C. Piedade	Project Director	8th Mar 2016 – at present
2	Rui Hernani F. Guterres	Project Manager	8th Mar 2016 – 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
1.3	To update the database based on the inspection result and repair/rehabilitation works of road and bridges.	● The inspection results in 2016 have not been updated on database because the inspection form revised by the Maintenance Department does not match the database. Therefore, JICA Expert Team is currently assisting DRBFC to improve the database form.
1.4	To formulate maintenance and repair/rehabilitation plans for next cycle.	● Maintenance Department has prepared the preliminary estimate of road maintenance budget in the next year roughly. Maintenance Department has also prepared drawings of maintenance works based on the periodic/routine inspection result. Budget of rehabilitation projects are estimated by Project Department based on the detail drawing and cost estimation by the local consultants and contractors although most of the projects are continued from the previous year.
2.1	To identify typical rehabilitation and repair works of major roads in the whole country as case studies	● The baseline examinations of construction quality control to DRBFC staff have been conducted by JICA Expert Team. ● Ex. Japanese road rehabilitation project was identified as the first site of case study on construction supervision. JICA Expert Team has held the site lectures of quality control and safety activities. ● 2 case studies of design for drainage and protection against scouring were identified through the discussion with DRBFC and site observations.
3.1	To review existing technical documents for road maintenance and rehabilitation	● The baseline examinations of survey and design to DRBFC staff have been conducted by JICA Expert Team. ● Technical drawings of Approximately 100 projects were collected and reviewed. It was found that the most of the structure drawings are prepared with reference to the drawings of donor projects.
3.2	To review and identify factors	● Causes of failure on the damaged sites were examined

	of failure from past examples of damaged rehabilitation and construction works	through the site survey with DRBFC staff. It was found that major causes are the inadequate treatment of drainage and structure foundation as well as inadequate measures against souring. ● JICA Expert Team held a lecture on the hydrological analysis to calculate the discharge of the river and drainage. 9 DRBFC technical staffs of both Maintenance and Project Departments participated in the lecture.

1-3 Achievement of Output

Indicators of Outputs		Achievement level
1.1	Important sections of major roads in TL are improved to better passable roads.	As the concrete indicators are under consideration based on the present condition analysis and baseline survey, the achievement levels of each indicator of outputs are not ready to be measured. Proper indicators shall be set up and approved in the 2nd JCC.
1.2	Updated road data is used for cycle of road maintenance.	
2.1	Number of case studies.	
2.2	Understanding level of DRBFC staff in construction management.	
3.1	Number of standard drawings prepared	
3.2	Number of maintenance projects improved to be better passable in the whole country by using the standard drawings.	

1-4 Achievement of the Project Purpose

Indicators of Project Purpose		Achievement level
1	Budget implementation rate (actual use/plan) increase from **% to **%.	As the concrete indicators are under consideration based on the present condition analysis and baseline survey; the achievement levels is not ready to be measured. Proper indicator shall be set up and approved in the 2nd JCC meeting.
2	Fixation degree (maintenance cycle, standard operation procedure) of road maintenance management is improved.	

1-5 Changes of Risks and Actions for Mitigation

- Risks are not confirmed so far, thus actions for mitigation are not taken.

1-6 Progress of Actions undertaken by JICA

- JICA Timor-Leste shared important information and documents with JICA Expert Team.

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

- DRBFC shared necessary information and documents with JICA Expert Team.
- Some candidate sites of the case study were proposed.
- 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.

Attachment 1: Result of Baseline Survey
Attachment 2: Training Material on Hydrological Analysis
Attachment 3: Training Record on Quality Control
Attachment 4: Training Record on Safety
Attachment 5: Plan of 1 Case Study on Construction
Attachment 6: Plan of 2 Case Studies on Design

Project Monitoring Sheet I （Revision of Project Design Matrix）

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:**

Version 2

Dated 12 October 2016

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 Conditions of major roads are improved. - International Roughness Index (IRI) - Travel speed	DRBFC annual report	Budget and staff will be secured at satisfactory levels. Traffic volume is not increased more than expected.	To be monitored after the cocrete indicater is set up.	
Project Purpose Capacity of DRBFC for maintenance of major roads in the whole country is enhanced.	PP1 Budget implementation rate (actual use/plan) increase from **% to **%. PP2 Fixation degree (maintenance cycle, standard operation procedure) of road maintenance management is improved.	Budget plan and report Monitoring sheet	Budget for road maintenance and management is ensured. Enough number of DRBFC staff in the HQs and regional offices is ensured as planned.	To be monitored after the cocrete indicater is set up.	
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: Standard drawing of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection.	1-1 Important sections of major roads in TL are improved to be better passable roads. 1-2 Updated road data is used for cycle of road maintenance. 2-1 Number of case studies. 2-2 Understanding level of DRBFC staff in construction management. 3-1 Number of standard drawings prepared 3-2 Number of maintenance projects improved to be better passable in the whole country by using the standard drawings.	Project report Project report Case study report Examination sheet Standard drawings prepared DRBFC annual report	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.	To be monitored after the cocrete indicater is set up.	

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 check, and construction supervision of the project. 2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies. 3.1 To review existing technical documents for road maintenance and 3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works. 3.3 To prepare a book of draft standard drawings for rehabilitation. 3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings. 3.5 To prepare guidelines for using the standard drawings. 3.6 To disseminate the book of standard drawings for each regional office.	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 2

Dated 12 October 2016

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

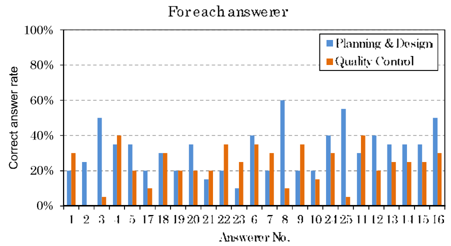
Inputs	Plan / Actual	2016 I II III IV	2017 I II III IV	2018 I II III IV	2019 I II III IV	2020 I II III IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert									
Team Leader/Road Maintenance 1 /Mr. Hisashi MUTO	Plan							-	-
	Actual								
Deputy Team Leader/Road Maintenance 2 /Mr. Makoto MATSUURA	Plan							-	-
	Actual								
Road Construction Supervision /Mr. Johji KOIZUMI	Plan							-	-
	Actual								
Quality Control/Road Repair /Mr. Sueo HIROSE	Plan							-	-
	Actual								
Disaster Restoration /Mr. Shutaro SAKANAKA	Plan							-	-
	Actual								
Road Design/Project Coordinator /Mr. Yoshiyuki AKAGAWA	Plan							-	-
	Actual								
Structure Design /Mr. Kenji MINEGISHI	Plan							-	-
	Actual								
Database /Mr. Takashi SAITO	Plan							-	-
	Actual								
Evaluation/Monitoring Ms. Nao TSUJIMURA	Plan							-	-
	Actual								
Equipment									
	Plan								
	Actual								
	Plan								
	Actual								
	Plan								
	Actual								
	Plan								
	Actual								
Training in Japan									
necessities are under discussion	Plan								
	Actual								
In-country/Third country Training									
	Plan								
	Actual								

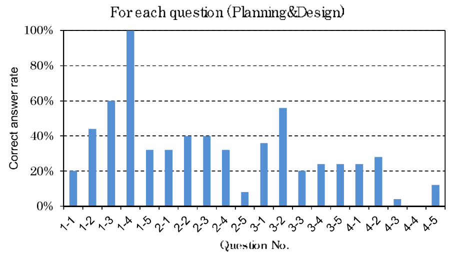
Activities / Sub-Activities	Plan / Actual	2016 I II III IV	2017 I II III IV	2018 I II III IV	2019 I II III IV	2020 I II III IV	Responsible Organization: Japan	Responsible Organization: GOTL	Achievements	Issue & Countermeasures
Output 1: Appropriate road maintenance and rehabilitation for major roads 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								Hearing, document collection and site survey were conducted	
	Actual									
1.2 To conduct the periodic/routine inspection	Plan								Periodic Inspection was conducted	
	Actual									
1.3 To update the database based on the inspection result and repair/rehabilitation works of roads and bridges	Plan								The inspection result in 2016 is not updated on database	The database has to be improved so as to match the revised inspection form
	Actual									
1.4 To formulate maintenance and repair/rehabilitation plans for next cycle	Plan								Maintenace budget has been proposed based on the road inspection and drawing	
	Actual									
1.5 To implement emergency inspections and repair/rehabilitation works when necessity arises	Plan									
	Actual									
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									
Output 2: Capacity of DRBFC construction management for maintenance and rehabilitation is improved through case studies in the whole country including slope										
2.1 To identify typical rehabilitation and repair works of major roads in the whole country as case studies	Plan								1 case study on construction and 2 case studies on design are identified	
	Actual									
2.2 To conduct the case studies for the planning, design check, and construction supervision of the project	Plan								Site lectures on quality control and safety were conducted.	
	Actual									
2.3 To propose preferable structures for construction management for repair/rehabilitation works through case studies	Plan									
	Actual									
Output 3: Standard drawings of maintenance and rehabilitation are provided as a tool for more appropriate design including slope protection										
3.1 To review the existing technical documents for road maintenance and rehabilitation	Plan								About 100 technical drawings were collected and reviewed	
	Actual									
3.2 To review and identify factors of failure from past examples of damaged rehabilitation and construction works	Plan								Some sites of damaged roads/bridges and slopes were observed and examined	
	Actual									
3.3 To prepare a book of draft standard drawings for rehabilitation	Plan								Not yet started preparing standard drawings	Drawings on donor's projects are frequently used like standard drawings
	Actual									
3.4 To reflect the case studies in Activity 2-3 to the book of draft standard drawings	Plan									
	Actual									
3.5 To prepare guidelines for using the standard drawings	Plan									
	Actual									
3.6 To disseminate the book of standard drawings for each regional office	Plan									
	Actual									
Duration / Phasing	Plan									
	Actual									

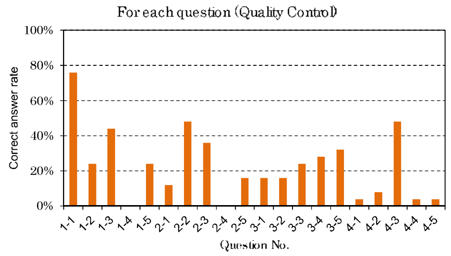
Monitoring Plan	Plan / Actual	2016 I II III IV	2017 I II III IV	2018 I II III IV	2019 I II III IV	2020 I II III IV	Remarks	Monitoring: Issue	Monitoring: Solution
Monitoring									
Joint Coordination Committee	Plan							-	-
	Actual								
Set-up the Detailed Plan of Operation	Plan							-	-
	Actual								
Submission of Monitoring Sheet	Plan							-	-
	Actual								
Joint Monitoring	Plan							-	-
	Actual								
Post Monitoring	Plan								
	Actual								
	Plan								
	Actual								
Reports/Documents									
Book of Standard Drawings	Plan								
	Actual								
Project Completion Report	Plan								
	Actual								
Public Relations									
	Plan								
	Actual								
	Plan								
	Actual								

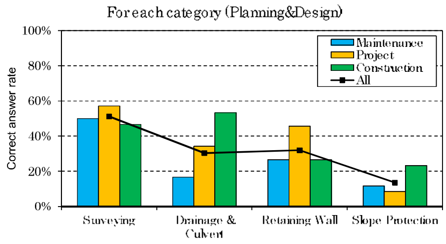
Attachment 1　Result of Baseline Survey

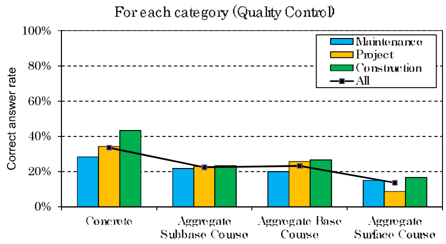
Result Summary of Baseline Survey

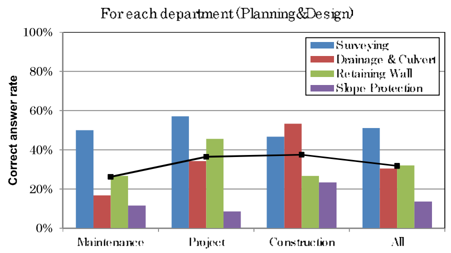


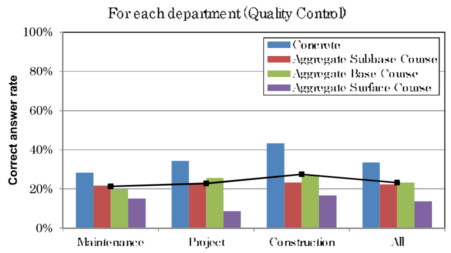












Summary Table of Baseline Test

[illegible]

Examination Sheet of Baseline Survey

1 Concrete

Questions	Answer: Choose the one of them as the most appropriated answer.				
1- 1 How much is the Slump for Class A of concrete in accordance with the SPC (ITEM 506) ?	0 – 50mm	50 – 100mm	100 – 200mm	more than 100mm	Sorry I don't know
1- 2 How much is the Minimum Cement Content for Class A of concrete in accordance with the SPC (ITEM 506) ?	360 kg	320 kg	380 kg	440 kg	Sorry I don't know
1- 3 How much is the Maximum Water/ Cement Ratio for Class A of concrete in accordance with the SPC (ITEM 506) ?	0,49	0,53	0,55	0,58	Sorry I don't know
1- 4 When do you check the Compressive Strength Test for specimen of concrete in accordance with the SPC (ITEM 506) ?	at 4 days and 28 days after casting of concrete	at 5 days and 28 days after casting of concrete	at 7 days and 28 days after casting of concrete	at 10 days and 28 days after casting of concrete	Sorry I don't know
1- 5 What do you use the Classe of Concrete for retaining wall in accordance with SPC (ITEM 506) ?	Class A	Class B	Class C	Class P	Sorry I don't know

SPC=MPWTC Standard Specifictions – November 2014 Edition

2 Aggregate Subbase Course

Questions	Answer: Choose the one of them as the most appropriated answer.				
2- 1 Material Test How much is the Liquid Limit (LL) for Aggregate Subbase Course in accordance with the SPC (ITEM 301) ?	Max. 20%	Max. 30%	Max. 35%	Max. 40%	Sorry I don't know
2- 2 Material Test How much is the Plasticity Index (PI) for Aggregate Subbase Course in accordance with the SPC (ITEM 301) ?	Max. 10	Max. 12	Max. 14	Max. 16	Sorry I don't know
2- 3 Material Test How much is the Abrasion of the Coarse Aggregate for Aggregate Subbase Course in accordance with the SPC (ITEM301) ?	Max. 40%	Max.45%	Max. 50%	Max. 60%	Sorry I don't know
2- 4 Tolerance How much is the Permitted Variation from design Level of Surface for Subbase Course in accordance with the SPC (ITEM 301) ?	±0mm	±10mm	±20mm	+10mm -20mm	+20mm -30mm
2- 5 Tolerance How much is the Permitted Variation from design Thickness of Layer for Subbase Course in accordance with the SPC (ITEM 301) ?	±0mm	±5mm	±10mm	±15mm	±20mm

SPC=MPWTC Standard Specifictions – November 2014 Edition

3 Aggregate Base Course

Questions	Answer: Choose the one of them as the most appropriated answer.				
3- 1 Material Test How much is the Liquid Limit (LL) for Aggregate Base Course Class A in accordance with the SPC (ITEM 303) ?	0 – 10%	0 – 15%	0 – 20%	0 – 25%	Sorry I don't know
3- 2 Material Test How much is the Plasticity Index (PI) for Aggregate Base Course Class A in accordance with the SPC (ITEM 303) ?	Max. 10	Max. 15	Max. 20	Max. 25	Sorry I don't know
3- 3 Material Test How much is the Abrasion of the Coarse Aggregate for Aggregate Base Course Class A in accordance with the SPC (ITEM 303) ?	0 – 30%	0 – 35%	0 – 40%	0 – 45%	Sorry I don't know
3- 4 Tolerance How much is the Permitted Variation from design Level of Surface for Base Course in accordance with the SPC (ITEM 303) ?	±0mm	±5mm	±10mm	+5mm -10mm	+10mm -20mm
3- 5 Tolerance How much is the Permitted Variation from design Thickness of Layer for Base Course in accordance with the SPC (ITEM 303) ?	±0mm	±5mm	±10mm	±15mm	±20mm

SPC=MPWTC Standard Specifictions – November 2014 Edition

4 Aggregate Surface Course

Questions	Answer: Choose the one of them as the most appropriated answer.				
4- 1 Material Test How much is the Liquid Limit (LL) for Aggregate Surface Course in accordance with the SPC (ITEM 401) ?	Max. 20%	Max. 25%	Max. 30%	Max. 35%	Sorry I don't know
4- 2 Material Test How much is the Plasticity Index (PI) for Aggregate Sirface Course in accordance with the SPC (ITEM 401) ?	Max. 8	Max. 10	Min. 4 Max. 9	Min. 6 Max. 12	Sorry I don't know
4- 3 Material Test How much is the Abrasion of the Coarse Aggregate for Aggregate Surface Course in accordance with the SPC (ITEM 401) ?	Max. 30%	Max. 35%	Max. 45%	Max. 50%	Sorry I don't know
4- 4 Tolerance How much is the Permitted Variation from design Level of Surface for Surface Course in accordance with the SPC (ITEM 401) ?	±0mm	±5mm	±10mm	+5mm -10mm	+15mm -5mm
4- 5 Tolerance How much is the Permitted Variation from design Thickness of Layer for Surface Course in accordance with the SPC (ITEM 401) ?	±0mm	±5mm	±10mm	+5mm -10mm	+15mm -5mm

SPC=MPWTC Standard Specifictions – November 2014 Edition

5 Remarks

Please let me know your remarks about today's baseline test and your request to the CDRS Project freely.

Department : _____

Your name : _____

1 Surveying

Questions	Answer:: Choose the one of them as the most appropriated answer.				
1-1 If the result of measured coordinates of national bench mark on project is different to the coordination which you were officially informed before the measurement, what will you do ?	To check the coordination of the BM	To order re-survey	To change the measured coordination based on the BM's coordination	To check the survey instrument	To re-training surveyor team
1-2 How do you protect the coordination of control points physically and formally ?	To cover with a little soil	To cover with a much soil	To install peg and instruct the resident to protect	To set up by reference points for restoration	To train the surveyor to remember the correct position
1-3 How do you check the topograpic data on the drawing at the site on the project ?	To check the direction of compass	To check the planned center line	To check the existing center line	To check the location of existing houses	To check the location of existing utilities
1-4 When you check road design drawing, which subject you are concerned ?	To check with the standard drawing	Strength of the road bed	Boundary on the road reserve	Direction of compass	Direction of destination of drainage system
1-5 Regarding mobile GPS operation, which subject you shall give the attention when you survey x, y, z coordinates ?	Accuracy	Coordination z (i.e. elevation)	Speed of the surveying	Continuous of the surveying	Battery charger

2 Drainage and Culvert

Questions	Answer:: Choose the one of them as the most appropriated answer.				
2-1 When you will conduct a field survey for planning and design of road drainage facilities, which point of view is not appropriate ?	To check a flow direction of surface water	To check a traffic volume and origin and destination of traffic	To check a surrounding condition of outlet point	To check a location and volume of spring water and seepage water from natural ground	Sorry I don't know
2-2 Which data you do not need when you estimate the quantity of water due to rainfall i.e. runoff ?	Catchment area	Rainfall data	Return period	Traffic speed	Sorry I don't know
2-3 Which data you do not need when you estimate the flow capacity passed under the road embankment ?	Dimension of the crossing	Water quality	Velocity of flow	Slope of crossing	Sorry I don't know
2-4 What is the minimum earth covering thickness you will apply for culvert structure ?	15cm	30cm	50cm	100cm	Sorry I don't know
2-5 Which discription is not appropriate for hydraulic study on bridge project, comply with the draft Bridge Design Manual in TL ?	In preliminary survey, waterway openings should be able to pass 500-year flood without causing structural failure	In the hydraulic analysis the design discharge is 50-years discharge	Minimum vertical clearance between the highest flood level and the lowest point of the girder should be more than 150mm	Maximum discharge can be estimated by using a Rational method	The velocity obtaining in the stream under the flood condition is calculated using Lacey's formula

3 Retaining Wall

Questions	Answer:: Choose the one of them as the most appropriated answer.				
3-1 Which factor is not appropriate for damage and collapse of retaining wall ?	Recovery of vegetation and animal	Increase in earth pressure and hydraulic pressure	Settlement of ground	Riverbed erosion	Sorry I don't know
3-2 Which sbuject is not appropriate for stability analysis of retaining wall ?	Safety for sliding	Safety for overturning	Environmental and social consideration	Bearing capacity of ground	Sorry I don't know
3-3 Which item is not appropriate as primary load for design of retaining wall ?	Self weight of retaining wall	Earth load	Hydraulic pressure	Loaded weight	Sorry I don't know
3-4 Which item is not appropriate for design condition of retaining wall ?	Angle of share resistance (ϕ) of sandy soil, which is assumed according to soil clasification, is 35 degree	Unit weight of sandy soil used as backfilling material is 19 kN/m3	Friction coefficient (μ) between a concrete and gravel ground is 0.6	Allowable bearing capacity (qa) of gravel ground is 600 kN/m2	Sorry I don't know
3-5 Which description is not appropriate for design of masonry retaining wall ?	Masonry without back fill concrete is used only for a river revetment	It is not necessary to install a drain pipe for retaining wall on land (non-river)	Masonry wall is often used at the site of small earth load	High permeable material such as crashed stone should be used as a back fil material	Sorry I don't know

4 Slope Protection

Questions	Answer: : Choose the one of them as the most appropriated answer.				
4－1 Which item is not appropriate reason for set up a terrace on slope surfece	Ensure a stability	Drainage on the surface	Cost saving	Maintenance and operation	Sorry I don't know
4－2 Which subject you will consider in case of the determination for cut slope?	Height of cutting	Drainage system	Type of the soil	Availability of equipment	Sorry I don't know
4－3 What is the minimum slope gradient you will apply for cutting slope on hard rock ground ?	Vertical cut	1 : 0,3	1 : 0,5	1 : 1,0	Sorry I don't know
4－4 What is the standard slope gradient you will apply for embankment slope with normal material ?	1 : 1.0	1 : 1.5	1 : 1.8	1 : 2.0	Sorry I don't know
4－5 Which description is not appropriate for bio－engineering work ?	The first purpose of the work is to protect a slope from rain erosion and prevent from surface failure	The work can not expect the effect which prevents deep slope failure	Selection of the work depend on the vegetable seed, soil type, slope gradient and meteorological condition	The work is also applicable in steep slope	Sorry I don't know

5 Remarks

Please let me know your remarks about today's baseline test and your request to the CDRS Project freely.

Department : _____

Your name : _____

Attachment 2　Training Material on Hydrological Analysis

Runoff Coefficient is 0.9

Runoff coefficient of Comoro River basin is determined to be 0.9 based on standard values in "Manual for River Works in Japan, Technical Criteria for River Works"

Steep mountainous region	0.75~0.90
Mountains of Tertiary strata	0.70~0.80
Rugged land and forests	0.50~0.75
Flat arable land	0.45~0.60
Irrigated paddy fields	0.70~0.80
Rivers in mountainous regions	0.75~0.85
Small rivers in level land	0.45~0.75
Large rivers in flat land	0.50~0.75

Source: Manual for River Works in Japan, Technical Criteria for River Works

Ⅱ. Rainfall Intensity

What is Rainfall intensity ?

Rainfall intensity means momentary rainfall is converted one hour amount of rainfall.

Question

In the case rainfall is 2.5mm/one minute.
Which value is rainfall intensity ○ mm/hour ?

Answer

2.5mm/one minute × 60 minutes=150mm/hour

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

Training No.1 Rational Formula

July 2016

JICA Expert Teams

Self - introduction

Name ; Shutaro SAKANAKA

Specialized field ; River Plan and River Design
Harbor Design
Disaster Management
Disaster Restoration

E-mail ; shutaro.sakanaka@ingerosec.com

Today Training

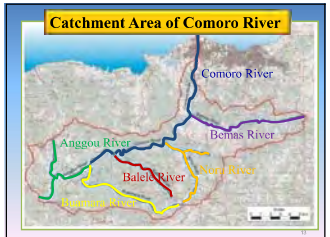
Calculation example of Comoro River Discharge

How to set up Comoro River Discharge ?

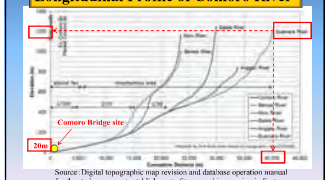
↓

Rational Formula Method

Catchment Area of Comoro River

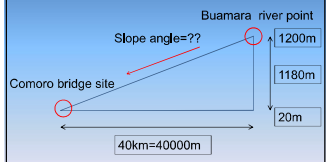


Longitudinal Profile of Comoro River



Source: Digital topographic map revision and database operation manual for the study on urgent establishment of topographic mapping in East Timor (2000), JICA

How to set up of Slope Angle?



Slope angle=1180/40000≒1/33

T: Flood Concentration Time

Flood concentration time is expressed using Kraven's Formula as follows.
T = L/W
Where, T is flood concentration time (hour),
L is watercourse length⇒ 40,000(m),
W is flood flow velocity (m/s) shown in below.

I : Watercourse slope	over 1/100	1/100~1/200	below 1/200
W : Flood runoff velocity	3.5 m/s	3.0 m/s	2.1 m/s

Watercourse slope is 1/33, and so flood runoff velocity is 3.5m/s.
Flood concentration time is calculated using these values as follows.

T = L/W = 40,000 (m) / 3.5 (m/s) = 3.1 (hour)

Rational Formula Method

Runoff is estimated using the Rational Formula method. The Rational Formula is expressed in the following formula. coverage of this method is approximately basin area 200km² or less.

$$Q=\frac{1}{3.6}fRA$$

Input data
- f: run-off coefficient
- R; rainfall intensity within the time of flood concentration (mm/hour)
- A; Catchment Area (km²)

Output Q is Discharge volume (m³/s)

We have to prepare the input data at first !

Set up below input data

I. f; run-off coefficient
II. R; rainfall intensity within the time of flood concentration (mm/hour)
III. A; basin area (km²)

I. Run-off coefficient

What is Runoff Coefficient ?

Runoff coefficients depend on the land use, Land condition of river basin. Runoff coefficients are needed to calculate rain water runoff using the Rational Method.

R:Rainfall Intensity

Rainfall intensity is calculated by the following Mononobe's Formula based on daily rainfall shown in below.

$$I = \frac{R_{24}}{24}\left(\frac{24}{T}\right)^{2/3}$$

Where, R is rainfall intensity within flood concentration time (mm/hr), R24 is 24-hour rainfall (mm), and T is flood concentration time. Rainfall intensity for each return period calculated using above formula is shown below table .

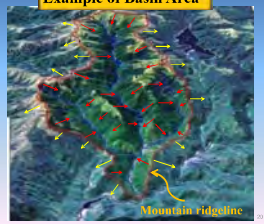
Return Period	R24=Daily Rainfall (mm)	R=Rainfall Intensity (mm/hr)
2-year	144.2	20.5
5-year	193.8	27.6
10-year	226.6	32.2
30-year	276.3	39.3
50-year	298.9	42.5
100-year	329.5	46.9

Ⅲ. Basin Area

What is Basin Area ?

Basin Area is an extent or an area of land where all surface water from rain, melting snow, or ice converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another body of water, such as a river, lake, reservoir, estuary, sea, or ocean.

Example of Basin Area



A-19

Comoro River Basin

Source : Report on the Basic Design Study on the Project for the Implement of Roads and Bridges in the Democratic Republic of Timor-Leste, JICA

Run-off

Input data

- f ; runoff coefficient ⇒ 0.9
- R ; rainfall intensity within the time of flood concentration (mm/hr) ⇒ Each values
- A ; basin area (km2) ⇒207.1km2

$$Q = \frac{1}{3.6} fRA$$

Result of Run-off

Runoff is calculated based on the values mentioned using Rational Formula. Calculated each retune period discharge are shown below Table.

Return Period	Discharge (m^3/s)
2-year	1,100 (1,062)
5-year	1,500 (1,427)
10-year	1,700 (1,669)
30-year	2,100 (2,035)
50-year	2,200 (2,201)
100-year	2,500 (2,427)

Design Flood Discharge of Comoro River : **2,200m3/s** (50-year return period)

A-20

Attachment 3　Training Record on Quality Control

A3-32

Report of Observation for Quality Control Workshop at upriver Comoro Bridge
Activity 2-1 : Case Study for Construction

Participants
DRBFC:Construction Department, Ms. Pricilia
External Cooperation Department, Mr.Angelo, Ms Inacia
JICA Expert Team:Hirose、Zelia
Organizer:DRBFC working group and JICA Expert Team
Date:2016.08.24
Location:Directorate National of Research and Development (National Laboratory) and Laboratory of upriver Comoro Bridge

This is report of the observation of quality control conducted on upriver Comoro Bridge project shown on below, as a practice of quality control for above captioned Case Study.
In the workshop was described purpose of test, test procedure and criteria according to Technical Specification of upriver Comoro Bridge.
The contents of each test are shown below:

Item	Description	Test Contents
Material Test	Subgrade(by Borrow pit)	➢ Gradation ➢ Specific Gravity ➢ Liquid Limit ➢ Plasticity Index
Concrete Job Mix	Class C (Compressive Strength 30Mpa)	➢ Job Mix ➢ Slump ➢ Air Content ➢ Temperature ➢ Chloride Content
Concrete Compressive Strength Test	Class D (Compressive Strength 24Mpa)	➢ 7 days

Photos

Photo-1、at National Labo
Test for Subgrede material

Photo-2、at National Labo
Test for Subgrede material

Photo-3、at Comoro Bridge Labo
Concrete Job Mix

Photo-4、コモロ新橋工事試験場にて
Concrete Job Mix, Slump Test

Photo-5、at Comoro Bridge Labo
Concrete Compressive Strength Test

Photo-6、at Comoro Bridge Labo
Concrete Compressive Strength Test

Attachment 4　Training Record on Safety

06 October, 2016

Report of Observation for Safety Patrol at upriver Comoro Bridge

Activity 2-1 : Case Study for Construction, EX Japan Road (STA.8+000～19+750)

DRBFC working group and JICA Expert Team

This is report of the observation of safety activity, Safety Patrol conducted on upriver Comoro Bridge project shown on below, as a practice of Safety Control for above captioned Case Study.

1. Description of Safety Patrol

1) Time and Date : 9:30 – 10:40, Thursday 06 October, 2016
2) Site and name of the project : The site of the Project for Construction of Upriver Comoro Bridge
3) Outline of the project : Bridge: 6 Span Continuous PC Box Girder Bridge. Length= 250m, Span=33.7m + 4@45m + 33.7, Width=11.55m
Access Road: Total length 3.2 km, 2 lanes, Asphalt Concrete
4) Agenda of Patrol : Joint Site Inspection at various points of the site and discussion at the Office of the project

2. Participant of the observation from working group of Case Study

From Construction Department of DRBFC : Eng. Jose Augusto I.S. Freitas
Eng. Pricilla I.D. R. Comes
Technical staff. Gervasio M. da Silva

From JICA Expert Team : Johji KOIZUMI (Road Construction Supervisor)
Nao TSUJIMURA (Evaluation/Monitoring)
Letichia S.A. Barreto (Assistant Engineer)

3. Learnings and understanding

There are many rooms for improvement for safety on this site, even the project is initial stage. For example, it requires more precaution sign board near heavy machinery prevents resident people, especially children living nearby, from coming close to the machinery for their interests and becoming injury by such machinery.

It will be expected another month participation of Safety Patrol giving another site conditions and finding other safety measures needed.

Attachment 1. Photos for Inspection and discussion

Photos of Inspection and discussion attachment #1.

Photo-1 Client, JICA, Consultant and Contractor jointly inspect the site

Photo-2 At the edge of embankment, it is danger for Bulldozer park

Photo-3 Point out the construction machine keep safe for moving after working hour

Photo-4 At the border of downstream edge of Comoro river regarding protection fence

Photo-5 Safety Signboard at the entrance of the Site Office yard

Photo-6 Discussing the preventive measures for site safety

Attachment 5 Plan of 1 Case Study on Construction

September. 2016

Plan of Training for Construction management

Activity 2-2 : Case Study. EX Japan Road (STA.8+000～19+750)

JICA Expert Team and DRBFC

This is reported the Plan for Training for Construction management on Case Study. EX Japan Road (STA.8+000～19+750). based on the Plan for Activity 2-2 Case Study.

1. Baseline Study

At the beginning of case-study. baseline survey is to be conducted against the DRBFC personnel subjected to Case-Study. It will be used for evaluation of DRBFC staff capability for construction management. It may include staffs of DRBFC regional office that are in charge of construction supervising.

It will be a paper test for knowledges in respect of supervising the construction as same the test conducted in June 2016. It is no need to take test for the person who had already taken it at June.

2. Plans of Training on the Case-Study as an activity 2-2

2-1 Safety Control

A. Lecture

1) Introduction of accidents at the construction site
2) Awaring the importance of Safety and explaining safety measures and introduction of general theory
3) Obligation for Safety based on Labor law and other regulations

B. Practices

1) Observation of safety activities. such as morning meeting and safety gathering. on the other project financed by Donor.
2) Planning and conducting Safety Patrol and evaluation meeting

2-2 Progress Control

A Lecture

1) Introduction various progress management method. such as bar-chart and net-work method.
2) Drafting and practicing a progress charts for one of Contract of Ex Japan Road and for total contracts including future pavement contract.

3) JICA Expert's attendance for Monthly Progress Meeting between CDRBF and contractors and giving some advices.

2-3 Quality Control (QC)

A Lecture

1) Based Specification. drafting and understanding "Table for required QC items and tests for the Works"
2) Introduction typical QC method and tests results
3) Checking the results of QC (tests) conducted by contractors

B Practices

1) Training session for Quality Control of construction regarding proposed material using the project of Comoro New Bridge held on 24 August. 2016 and other opportunity
2) Practice and observation QC test on site by DRBFC staff in charge the Works
3) Practice and observation QC test at laboratory by DRBFC staff in charge the Works

Attachments :

1. Draft of Schedule for the Case-Study Ex Japan Road_as of 27 September 2016
2. Location Map for Ex. Japan Road (STA. 8+000 – 19+750)
3. Organization chart of Construction Department. DRBFC as of 25 July. 2016

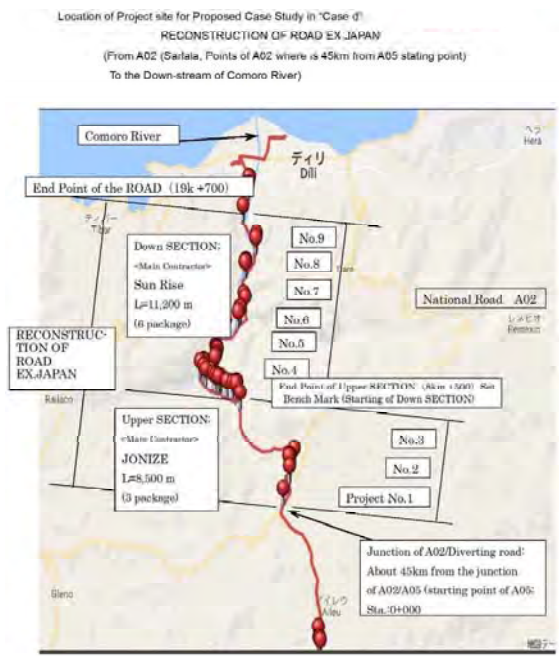
Draft of Scdedule for Case Study; on Reconstruction Road of Ex Japan (Ex Japan Road)

[From STA.8+000 to STA.19+750; The Section of Down stream of Comoro River. under management by "Sun Rise" construction]

Updated on 27 September 2016

Year													2016										2017													Remarks
Month													June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	August	Sept.	Oct.								
Proposed schedule for the project of "Reconstruction Road Ex. Japan" (Dil-Beduco-Safala-Meu Road)																																				
No.	Name of Contractor	Length (Km)	Start/End Location	Start=12/11/2015 End= 12/11/2016 Contract No.4 & 7 & 8: Start=29/07/2016 End= 29/07/2017 Contract No.5 & No.6:																																
No.1	Sun Rise	11.2	Dili																																	
No.2	NTN	3.20	Bemasiana																																	
No.3	Soares Bastos	1.34	Comoro Bridge																																	
No.4	Mota Loes	1.79	Safala																																	
No.5	Sun Rise	1.20	Safala																																	
Activity 2-1: Selection of Case Study Type "Case D" for construction management, such as supervising the existing on-going project																																				
from Type(Case) B: Items to package for maintenance activities				Start of Case Study" & Works supervising to start																																
Plan for Activity 2-2 of Case Study; Ex Japan Road																																				
No.	Activity	Description																																		
1	Base Line Survey	Checking the room for improvement; Knowledge test for SV for construction		Testing to whom is in charge																																
2	Safety Control	A. Lecture 1) Introduction accidents 2) Awaring the importance of Safety and others 3) Obligation for Safety based on law and other obligation B. OJT Practice 1) Observation Morning Meeting & Safety gathering othe site 2) Safety patrol and discussion on the issues															Observation Morning Meeting at Comoro Bridge site								Demonstration of safety measures, such as Safety patrol								
2-1	Progress Control	A. Lecture 1) Introduction various progress management 2)Practicing progress chart for one/total contract * Attending Progress Meeting (JET) and giving advices																							basic trains for making/drafting									
2-2	Quality Control	A. Lecture 1) Making the required Table for QC as specification 2) Understanding the QC test items and meanings B. OJT Practice 1)Attended labo test of material fro Comoro Bridge. 2) & 3) Practicing QC test on the site & at the laboratory																	Check Spec. & Table for demanded																
Expert in charge for Construction Supervising Management													JICA Expert Team																							
Counterpart													Nicolau																							
Supervisor													João K.																							
Other Activities of CDRS																																				
Activity 1	Appropriate road maintenance and rehabilitation with annual work/budget plan																																			
Activity 2	Selection of othe Case Study																																			
Activity 3	Standard drawing of maintenance and rehabilitation																																			

Attachment #2



Attachment 6 Plan of 2 Case Studies on Design

28th Sep. 2016

Plan of Case Study

for

Design

September 2016

JICA Expert Team

DRBFC

This is reported the Draft of the Plan of Case Study Activity for Output 3. JICA Expert Team finally selected the sites as a result of evaluation.

I. Reasons of Selection for Case Study

Reasons of selection for the case study for design check are as follows;

1) Generality of work item

The work items of the case study are protection work for bridge, drainage culvert and stone masonry retaining wall. Once the plan of this case study is successfully completed, the knowledge obtained by the case study will be developed to all the area of Timor-Leste.

2) Accessibility

The site is located near the major district town and it takes within 60 minutes drive from the municipal office of DRBFC and the general security is also good.

3) Urgency and Importance

The road is considered the essential road and it is urgently required.

II. Protection Works against Scouring of Bridges

1. Location of Case Study

The target site is located on the right side bank at Sahen River.

Figure2.1 Location of Case study at Sahen Bridge Abatement

2. Current Situation

Following picture is shown scoring situation at right bank side abutment and right side pier. There is no protection work in front of the abutment and pier, therefore it is necessary to rehabilitate based on technical analysis.

Photo2.1 Situation of Damaged Abutment and Pier

3. Contents of Activity for Design Check

The activities of JICA expert team are shown in below table.

Table2.1 Activities for Case Study

Activities	Detailed Activities
A. Geotechnical survey	a) To make a plan geotechnical survey
	b) To make Terms of Reference(ToR) for geotechnical survey
	c) To analyze for result of geotechnical survey
B. Topographic survey	a) To make a plan topographic survey
	b) To make Terms of Reference(ToR) for topographic survey
C. Lecture	a) Protection method for scoring
	b) Analysis of result of geotechnical survey
	c) Runoff for river analysis
	d) Design method for protection work
	e) Explain of guideline
D. Protection Basic Design	a) Technical advice for basic design
E. Guideline	a) Preparation for guideline

4. Personnel Subject to the Case Study (Member of Working Group)

Table2.2 Member of Working Group

Department	Name
Maintenance Dept. (Region 3)	: Cristovao da Costa Monteiro
Maintenance Dept. (Region 3)	: Celestino Evangelino Ximenes
Dept. Municipal Same	: Arnecto Aquino Andrade

5. Schedule of Case Study

Schedule of the case study is shown as below table.

Table2.3 Schedule of Case Study for Sahen Bridge Rehabilitation

Work Items		2016	2017	2018	2019
1.Geotechnical Survey	1.1Boring				
	1.2 Laboratry test				
2. Topographic survey	2.1 Cross section				
	2.2.Plan survey				
3. River survey	3.1 River analysis				
4. Lecture	4.1 Protection works for scoring	▲			
	4.2 Analys for geotechnical survey		▲		
	4.3 Runoff for river analys			▲	
	4.4 Design method for protection work				▲
	4.5 Explain of guideline				▲
5. Protection Basic Design	5.1 Technical advice for basic design				
6. Guideline	6.1 Preparation for guideline				

6. Quantities for Geotechnical and Topographic Survey for the Case Study

Bill of Quantity for Geotechnical Investigation and Topographic Survey (Sahon Bridge)

Currency Unit: US$

Item No.	Work items	Unit	Unit Price (US$)	Qty	Amount (US$)	Remark
	Part I. Geotechnical Investigation					
I-1.	Boring and Soil Sampling					
I-1-1	Mobilization	Ls		1		
I-1-2	Machine boring	m		40		
I-1-5	Standard Penetration Test	point		40		
I-1-1	Soil Sampling					
	a) Undisturbed sample	sample		30		
	b) Disturbed sample	sample		10		
	Sub-total of item1					
I-2	Laboratory Soil Test					
	a) Grain size analysis	No.		40		
	b) Liquid limit and plastic limit test	No.		40		
	d) Density analysis of soil particles	No.		40		
	e) Density analysis by sand	No.		40		
	f) Water content test	No.		40		
	g) Triaxial compression test	No.		30		
	j) Unconfined compression test	No.		10		
	Sub-total of item2					
I-3.	Riverbed material survey					
	a) Grain size analysis	No.		2		1.6m×1.6m×2point
	Sub-total of item3					
I-4.	Report	Ls		1		
	Sub-Total of Part I. for Geotechnical Investigation					
	Part II. Topographic Survey					
II-1.	Mobilization and Demobilization	Ls		1		
II-2.	Control Survey	sets		1		
II-3.	Topographic Feature Survey	km2		0.25		L500m x W500m
II-4.	Cross section Survey	section		7		L 500m 50m pitch
II-5.	River Profile Survey of Right bank side	km		1		L500m x 2 Lines
II-6.	Drawing and Reporting	Ls		1		scale 1/1000
	Sub-Total of Part II. for Topographic Survey					
	Total Amount					
	VAT					
	Total Amount including VAT					

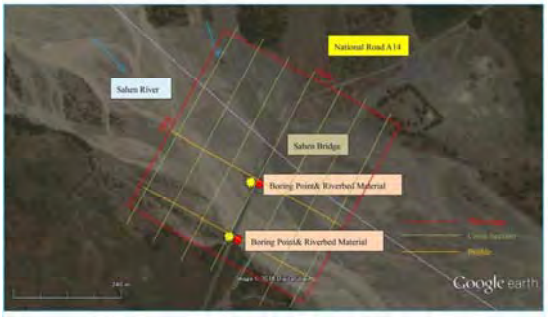


Figure2.2 Location of Geotechnical and Topographic Survey

III. Road Drainage Structure

1. Location of Case Study

The target site is located at between Same town and Sesurai town along national road A05.

Figure3.1 Satellite image of damaged site

2. Corrent Situation

Corrent situation of the site is shown as following pictures. Width of the road is about 2.5m and passage vehicle has to reduce its speed with careful attention.

Photo1 Full view

Photo2 Condition of traffic

Photo3 Damaged culvert

Photo4 Upstream side

Photo5 Upstream side

Photo6 Downstream side

Date : 16/9/2016

3. Contents of Activity for Design Check

The activities of JICA expert team are shown in below table.

Table3.1 Activities for Case Study

Activities	Detailed Activities
Review of existing condition	Joint field survey
	Review of existing drawings
Hydrological study	Confirmation of catchment basin
	Data collection
	Estimation of discharge volume
Technical assistance to basic design	Preparation for field survey
	Field survey (Topographic survey, Geotechnical investigation)
	Confirmation of flow capacity
	Basic design
Preparation of design guideline	Classroom lecture
	Preparation of draft guideline
	Lecture for other staff

4. Personnel Subject to the Case Study (Member of Working Group)

The personnel subjected to the case study are as follows.

Table3.2 Member of Working Group

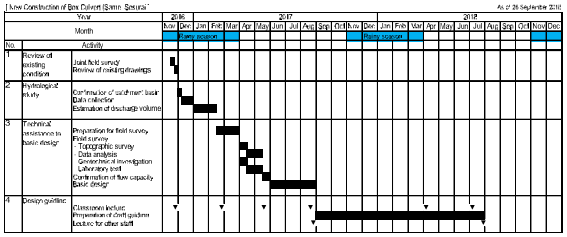
Department	Name
Maintenance Dept. (Region 3)	: Cristovao da Costa Monteiro
Maintenance Dept. (Region 3)	: Celestino Evangelino Ximenes
Dept. Municipal Same	: Aniceto Aquino Andrade

5. Schedule of Case Study

Draft of schedule for case study is shown as below table.

Training Period : From November 2016 to July 2018

Table3.3 Schedule of Case Study for Road Drainage Structure



6. Quantities for Geotechnical and Topographic Survey for the Case Study

Bill of Quantity for Geotechnical Investigation and Topographic Survey (Sesurai Culvert)

Currency Unit: US$

Item No.	Work items	Unit	Unit Price (US$)	Q'ty	Amount (US$)	Remark
	Part I. Geotechnical Investigation					
G-1.	Boring and Soil Sampling					
G-1-1	Mobilization	Ls		1		
G-1-2	Machine boring	m		10		
G-1-5	Standerd Penetration Test	point		10		
G-1-4	Soil Sampling					
	a) Undisturbed sample	sample		7		
	b) Disturbed sample	sample		3		
	Sub-total of item1					
G-2.	Laboratory Soil Test					
	a) Grain size analysis	No.		10		
	b) Liquid limit and plastic limit test	No.		10		
	d) Density analysis of soil particles	No.		10		
	e) Density analysis(dry, wet)	No.		10		
	f) Water content test	No.		10		
	g) Triaxial compression test	No.		7		
	j) Unconfined compression test	No.		3		
	Sub-total of item2					
G-3.	Report	Ls		1		
	Sub-Total of Part I. for Geotechnical Investigation					
	Part II. Topographic Survey					
T-1.	Mobilization and Demobilization	Ls		1		
T-2.	Control Survey	site		1		
T-3.	Topographic Feature Survey	m2		400		L:20m x W:20m
T-4.	Road Cross-section Survey	section		1		L=20m
T-5.	Drawing and Reporting	Ls		1		Scale 1:200
	Sub-Total of Part II. for Topographic Survey					
	Total Amount					
	VAT					
	Total Amount (including VAT)					

Figure3.2 Location of Geotechnical and Topographic Survey

Appendix-1 List of Candidate Site for Case Study

List of Candidate Case Study for Output 3

No.	Project Name	Location	Present stage and progress	Variety of works	Geographical Characteristic	Technical difficulty	Urgency	Budget	Accessibility	Evaluation as Case Study Project
No.1	Landslide near Aileu Junction	Aileu A-02	Not planned yet	○	Mountain	difficult	○	Not yet	○	pending
No.2	Slope Collapse at Bee-metan	Bemian A-12	Designed by local contractor and under verification by ADN	○	Mountain	difficult	☒	Not yet	. .	. .
No3	Erosion of dessert/manmide culvert at Funsabi	A-02	Not planned yet	△	Mountain	normal	△	Not yet		-
No.4	Damaged abutment at Saben bridge	A-14	Designed by DRRFC and Under verification by ADN	○	Plain	difficult	☒	Not yet		~
No.5	Same-Sesa-Rai damaged culvert	A-05	Ongoing Design.	○	Plain	difficult	☒	Not yet		~
No.6	Bipency embankment for Road protection at Biddo river	A-14	Bipency work is progressing	△	Plain	normal	○	distributed	○	△
No.7	Ypackage 1	Lautem-Com(A01) and Los-palos-Hornarii(A08)	Under verification by ADN	△	Coastal & Mountain	Normal	○	distributed	A1-△ A08-△	△
No.8	Ypackage 2	Viqueque-Dilor(A07) and Ai-Lacluta-Laclota(C9)	Under verification by ADN	△	Plain	Easy	○	distributed	A07-△	△
No.9	Ypackage 3	Luak-Betano(A05/6/8) and Betano-Dilor(A14/1-7)	Under verification by ADN	○	Coastal, Plain and Mountain	Normal	○	distributed	A05/○ A14/○	○
No.10	Ypackage 4	Aisaun-Boander Suai(A02/22-25) and Cassa-Hatudo(A013/0)	Under verification by ADN	△	Coastal, Plain and Mountain	Normal	○	distributed	A02/○ A13/○	△
No.11	Ypackage 5	Bessarasse-Remunda Hera and Aera Bassca-Remunda Hera(A-01,A-02)	Under verification by ADN	○	Coastal & Mountain	Normal	○	distributed	A01/○ A02/○	○
No.12	Ypackage 6	Urban Road Dili Town	Under verification by ADN	△	Urban	Easy	○	distributed	☒	△
No.13	Ypackage 7	Liquic-Maubara, Cairnbolo-Loes and Aipelo-Bazartete(A-01,C-16)	Under verification by ADN	△	Coastal	Normal	○	distributed	○	△
No.14	Ypackage 8	Gleno-Ermera(A04) and Umboe-Laiculu(A04, A10)	Under verification by ADN	○	Mountain	Normal	○	distributed	A04/○ A10/○	○
No.15	Ypackage 9	Loes-Atabae and Batugade-Bobonaro(A-01)	Under verification by ADN	△	Coastal&Mountain	Normal	○	distributed	A01/○	△