Arab Republic of Egypt

General Authority for Roads, Bridges and Land Transport

(GARBLT)

Arab Republic of Egypt

The Project for Improvement of the Bridge Management Capacity

Project Completion Report

July 2015

Japan International Cooperation Agency

Nippon Engineering Consultants Co., Ltd.
Chodai Co., Ltd.

EI
JR
15-134

Project Area

Abbreviation chart

Abbreviation	English
ASTM	American Society for Testing and Materials
AASHTO	American Association of State Highway and Transport Officials
BMS	Bridge Management System
BIV	Bridge Inspection Vehicle
C/P	Counterpart
CSV	Comma-Separated Values
DO	District Office
DSL	Domain-Specific Language
GARBLT	General Authority for Roads, Bridges and Land Transport
GM	General Manager
HCD	Head of Central Department
HTB	High Tension Bolt
JCC	Joint Coordination Comittee
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
M/M	Minutes of Meeting
MOT	Ministry of Transport
NDT	Non-Destructive Test
ODA	Official Development Assistance
OS	Operating System
OST	On-site Training
PC	Prestressed Concrete
PDM	Project Design Matrix
pH	Potential Hydrogen
PM	Project Manager
PMS	Photo Management System
PO	Plan of Operation
RC	Reinforced Concrete
Rebar	Reinforcing Steel Bar
R/D	Record of Discussion
TWG	Technical Working Group
WG	Working Group

Table of Contents

Appendices

Figures

1 Outline of the Project

2 Details of Activities

Tables

1 Outline of the Project

2 Details of Activities

1 Outline of the Project

1.1 Background

Egypt has currently a road network of more than 64,000 km across the country, on which more than 3,000 bridges are in service. Statistics shows that 98 % of its domestic cargo depends on this road network so that no doubt the road network plays a significant role to the national economy and people's daily activities.

However, it is said that roads and bridges have not been properly maintained to accelerate degradation and deterioration, causing adverse influence to not only domestic but also international transport system.

As these issues need to be solved for the further economical development of Egypt, the General Authority for Roads, Bridges, and Land Transport (hereinafter referred as GARBLT), which controls road construction and maintenance in the country, started a program to undertake the maintenance and repair of the bridges. However, there are a shortage of skilled and well-trained human resources, and necessary equipment for proper inspections and assessments in the country, which require further improvement. In addition, GARBLT refrained recruitment of younger generations to fill the retirees' positions under the government's policy to suppress labor costs, which resulted in a shortage of manpower, and outsourcing of builders and consultants. It is an urgent matter for GARBLT to improve the level of the skills of engineers.

"The Project for Improvement of the Bridge Management Capacity in Egypt" (hereinafter referred as the Project), is conducted in Egypt where human resources development for bridge maintenance and repair is of high priority, based on the request from Egyptian Government. This technical cooperation project was implemented for approximately 3 years and 3 months, from March 2012 to June 2015, to support planning for proper maintenance and improvement in daily maintenance skills.

1.2 The Aim of the Project

For the aforementioned reasons, this Project was conducted as requested by the Egyptian government for technical cooperation, and aimed for improvement of bridge maintenance skills of the GARBLT headquarters and the District Offices (hereinafter referred as DO), therefore, contributing to the enhancement of proper bridge maintenance capacity in Egypt by "Establishing continuous maintenance cycle", "Improving technological cpacity necessary for the maintenance, especially inspection and repair skills", "Building and operating bridge maintenance system (BMS) which enables the execution of the designed maintenance" on the engineers of the GARBLET headquarters and DO.

1.3 Outline of the Project

1.3.1 Overall Goal and Project Purpose

Table 1-1 Overall Goal and Project Purpose

Overall Goal	Bridges in Egypt are maintained properly.
Project Purpose	Capacity of GARBLT on bridge maintenance management is improved.

1.3.2 Expected Outputs

《Expected Outputs》

Output-1: Bridge maintenance/ management cycle in GARBLT is enhanced.

Output-2: Capacity of GARBLT's engineers on bridge inspection is enhanced.

Output-3: Capacity of GARBLT's engineers on bridge repair is enhanced.

Output-4: Bridge Management System (BMS) is prepared.

1.3.3 Activities

Activities for each output specified in PDM are as shown below. Activity for output-3 in PDM was amended at Mid-term evaluation as follows.

1) Indicator for Output-3

The main objects were limited to be concrete bridge.

2) Activity for Output-3

Scope of repair technology is limited to be minor repair works. Capacity for construction method selection and supervision is intended to be improved. For the above reasons, Output 3-2 was amended and Output 3-3 was added.

【Activity for Output-1】

1-1. To review current bridge maintenance management cycle and to identify issues necessary to be improved

1-2. To propose measures to improve maintenance management cycle

1-3. To take trial actions on the proposed measures

1-4. To conduct seminars on bridge maintenance management cycle

【Activity for Output-2】

2-1. To develop Bridge Inspection Manual

2-2. To implement trainings on bridge inspection (inventory survey, routine inspection,

periodic inspection, detail inspection) utilizing Bridge Inspection Manual

2-3. To develop Bridge Inspection Manual for Aswan Bridge

2-4. To implement trainings on inspection (inventory survey, routine inspection, periodic inspection) of Aswan Bridge utilizing Inspection Manual for Aswan Bridge

【Activity for Output-3】

3-1. To develop Bridge Repair Manual/Guideline

3-2. To implement trainings through the pilot works for bridge repair (minor repair only)

【Activity for Output-4】

4-1. To develop BMS (inventory and inspection record function) (STEP1)

4-2. To input data (inventory, routine, periodic, detail inspection) to BMS

4-3. To implement trainings utilizing BMS

4-4. To upgrade BMS to deal with damage evaluation and cost estimation (STEP2)

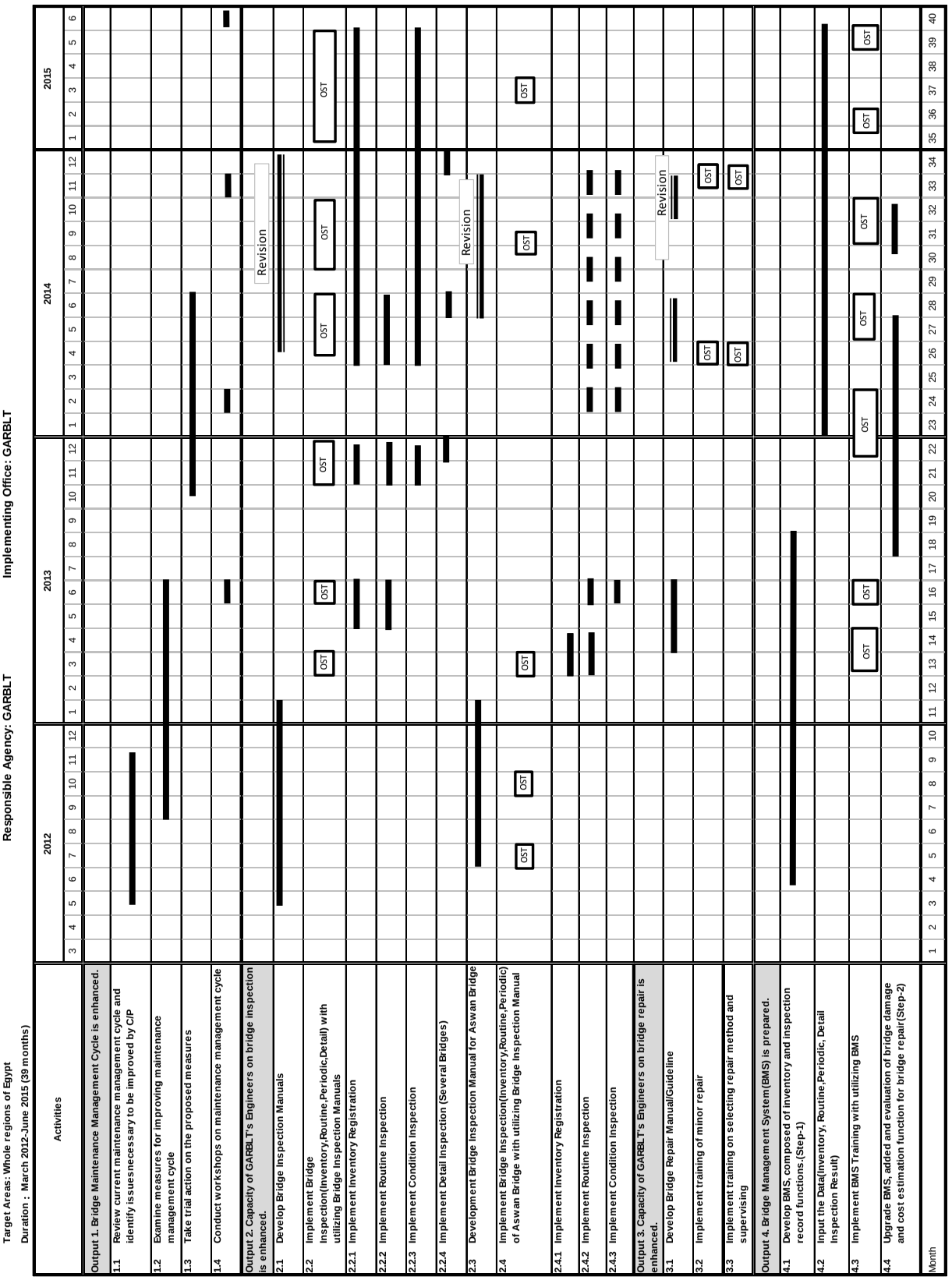


Figure 1-1 Record of Activities

1.3.4 The Implementation Period of the Project

Implementation period February 20th, 2012 ～ July 15th, 2015 (42 months)

On-site activities The end of March, 2012 ～ The end of June, 2015 (39 months)

After the commencement of this Project, the on-site activities were halted from July to the middle of October in 2013 due to worsening security in Egypt. We were forced to halt the procurement process of a bridge inspection vehicle during this period, and due to the delay in the arrival of the bridge inspection vehicle, there was no time for bridge inspection training sessions using the vehicle. Therefore, the construction period was extended by three months for the interrupted on-site activities.

1.3.5 Targeted Area

The Project targets the entire nation and bases in Cairo, however, training sessions of bridge inspection and repair were implemented on the selected pilot bridges, which included coastal area of the Mediterranean Sea and inland Aswan.

1.3.6 Organization of Egypt Side

The implementing organization in Egypt is GARBLT : General Authority for Roads, Bridges and Land Transport. The organizations in charge of the bridge maintenance are the bridge sector headquarters and 14 District Offices, which manage major roads throughout the nation.

Main office organization and an example of a District Office organization are shown as below.

Picture 1-1 GARBLT Headquarters

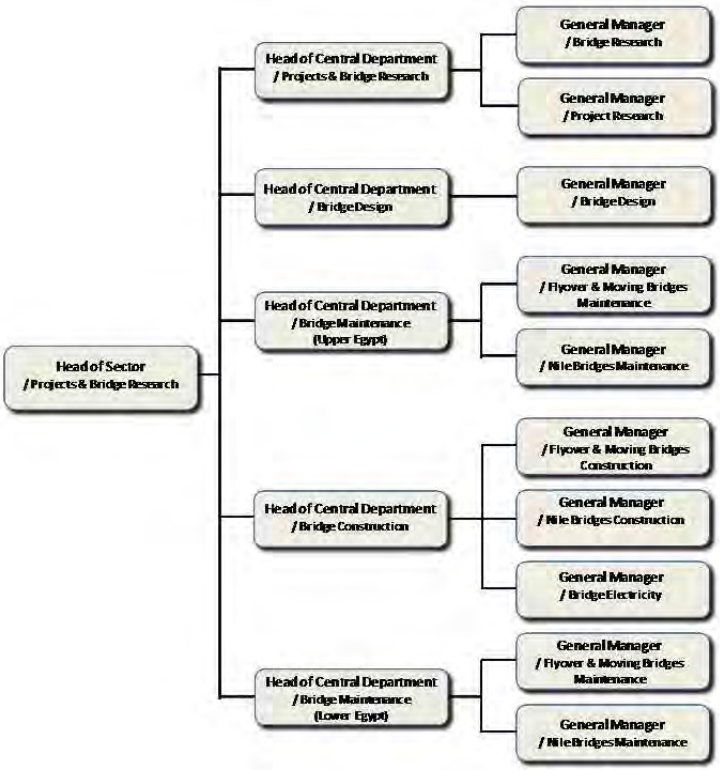


Figure 1-2 Organization Structure of Bridge Sections of Main Office

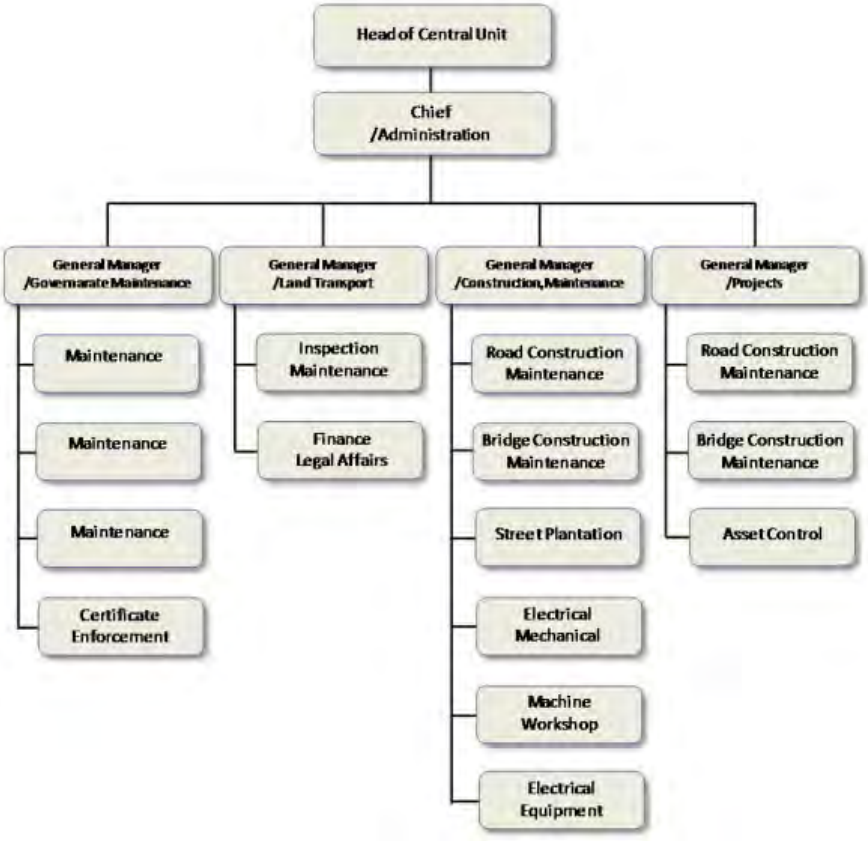


Figure 1-3 Organization Structure of District Office

1.3.7 Experts Dispatch

The following Japanese experts were sent to implement this Project. The period of the dispatch was 98.78MM total. A Chief Advisor, who is responsible for bridge maintenance cycle, was dispatched for 36 months.

Table 1-2 A list of Japanese experts

Name	Assignment
Nobuhiko TAKAGI	Team Leader/Bridge maintenance/Bridge inspection -2
Hideo NAGAO	Deputy Team Leader/Bridge inspection - 1
Osamu TSUKAHARA (Takehumi YAMAZAKI)	Management of Cable-stayed bridge
Takashi MATSUO	Bridge repair
Teruyuki MIYAKAWA	BMS development
Nagisa OKADA (Jun NAKAMURA)	Coordinator
Kokichi TERAI	Bridge inspection -3
Hiroyuki TAKENOUHI	Steel bridge fatigue
Hirofumi KAMIMURA	Bridge inspection -4

Table 1-3 Number of months of short-term experts

	1st year	2nd year	3rd year	4th year	Total
Number of days	902	576	727	297	2,502
Number of months	30.07	19.20	24.23	9.90	83.40

Table 1-4 Number of months of long-term experts

	1st year	2nd year	3rd year	4th year	Total
Number of months	12.00	12.00	12.00	-	36.00

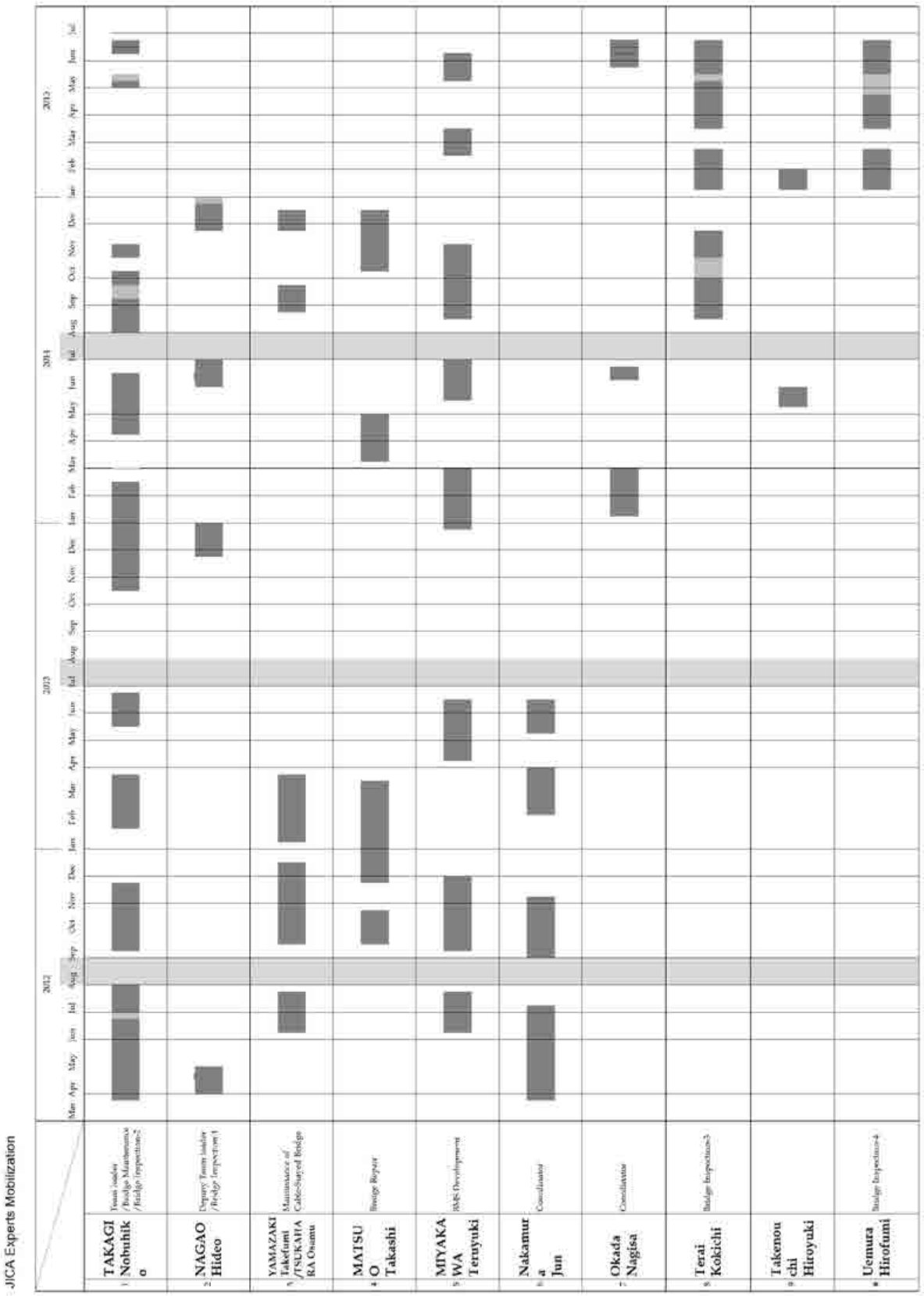


Figure 1-4 Performance of Expert Input

1.3.8 Training in Japan

Three training sessions were conducted in Japan during the Project.

Table 1-5 Training in Japan

	Training session period	Attendee	Main session location
1st year	November 25th, 2012 ～ December 9th 2012 (Technical training period) November 27th, 2012 ～ December 8th 2012	5	-Nippon Engineering Consultants Co., Ltd. -Ministry of Land, Infrastructure, Transport and Tourism, Chiba National Highway Office -Honshu-Shikoku Bridge Expressway Company Limited, the headquarters, Kobe Operation Center, Sakaide Operation Center
2nd year	August 24th, 2013 ～ September 6th 2013 (Technical training period) August 26th, 2013 ～ September 5th 2013	5	-Nippon Engineering Consultants Co., Ltd. -National Institute for Land and Infrastructure Management -Public Works Research Institute -Ministry of Land, Infrastructure, Transport and Tourism, Kofu River and National Highway Office. -Honshu-Shikoku Bridge Expressway Company Limited, Onomichi Operation Center, Kobe Operation Center, the headquarters.
3rd year	November 8th, 2014 ～ November 22nd, 2014 (Technical training period) November 10th, 2014 ～ November 21st, 2014	5	-Public Works Research Institute -Ministry of Land, Infrastructure, Transport and Tourism, Chiba National Highway Office - Japan Construction Method and Machinery Research Institute -Kawada Industries, Inc., Shikoku factory -Honshu-Shikoku Bridge Expressway Company Limited, Sakaide Operation Center, Naruto Operation Center, Kobe Operation Center

1.3.9 Provided Equipment and Equipment Accompanied by Dispatched Experts

Table 1-6 Equipment List

Provided equipment	Equipment accompanied by expert dispatch
Concrete rebound hammer	Projector
Testing anvil for concrete rebound hammer	Video camera
Ultrasonic tester for concrete crack	Voice recorder
Carbonation test (Phenolphthalein)	Copy machine
Half cell (Chloride ion penetration tester)	Digital camera
Paint thickness meter	Laptop computers
Reinforced concrete detector (Magnetic type)	Helmets
Ultrasonic metal thickness gauge	Rubber traffic cones
Portable Water Pressure washer	Safety belts
Generator	Safety vests
Shotcrete material	GPS
Anti-Corrosion Paint	Distance meter
Micro core drill	
Reinforced concrete detector (Rader type)	
BMS server	
Photo re-size engine	

The Project for Improvement of the Bridge Management Capacity in Egypt

CERTIFICATE OF HANDOVER

ATTENTION : Nobuhiko TAKAGI (Team Leader)

Team Leader, JICA Expert Team

PROJECT TITLE : "The Project for Improvement of the Bridge Management Capacity in Egypt"

This is to certify that the equipment in the attached list have been handed over properly as of 15 May, 2013 to General Authority for Roads, Bridges and Land Transport.

- GARBLT will take responsibility for management.
- The equipment will be used for the purpose of the Project during the Project period.

(NAME) Ramzy Mahmound Lashine

(TITLE) Chairman

(ORGANIZATION) General Authority for Roads, Bridges and Land Transport

(DATE) 15 May, 2013

The Project for Improvement of the Bridge Management Capacity in Egypt

EQUIPMENT LIST

No.	Item	Model	Qty.
1	Concrete Rebound Hammer	Proceq Original Schmidt Type N	2
2	Testing Anvil for Concrete Rebound Hammer	Proceq Testing anvil Type N	2
3	Ultrasonic Tester for Concrete Crack	Proceq Pundit Lab	1
4	Carbonation Test (Phenolphthalein)	ELE 433-096	20
5	Half Cell (Chloride ion Penetration Tester)	Controls 58-E0065/A	1
6	Paint Thickness Meter	PosiTector 6000-FS3 Memory	1
7	Reinforced Concrete Detector for Substructure	Proceq Profometer 5 Model S	1
8	Ultrasonic Metal Thickness Gauge	CheckLine TI-007	1
9	Portable Water Pressure Washer	Pump washing factories and workshops DLQ5/ GX160	5

The Project for Improvement
of the Bridge Management Capacity in Egypt

CERTIFICATE OF HANDOVER

ATTENTION : Nobuhiko TAKAGI (Team Leader)

Team Leader, JICA Expert Team

PROJECT TITLE : "The Project for Improvement of the Bridge Management Capacity in Egypt"

This is to certify that the equipment in the attached list have been handed over properly as of 23rd June, 2015 to General Authority for Roads, Bridges and Land Transport.

- GARBLT will take responsibility for management.

(DATE) 23rd June, 2015

(NAME) Eng. Adel Salah Tork

(TITLE) Chairman

(ORGANIZATION) General Authority for Roads, Bridges and Land Transport (GARBLT)

Attachment: List of Equipment

The Project for Improvement
of the Bridge Management Capacity in Egypt

List of Equipment for Bridge Inspection and Bridge Repair

Agreed to Be Provided to GARBLT in Record of Discussion

No.	Item	Model	Qty.
1	GENERATOR	Air-cooled Gasoline Generator LT 15000 CLT 5.5KW	1
2	SHOTCRETE MATERIALS	BASF Rheomix 140 BASF Shotpatch 10 BASF Mastercure 102	-*
3	ANTI-CORROSION PAINT	Zinc Rich 2 Comp –local (A+B) SIKA Ferrogard 903 jerkin 20 SIKA Grout 214	-*
4	MICRO CORE APPRERATUS	WEKA DK17	1
5	REINFORCED CONCRETE DETECTOR RADAR FOR SUBSTRUCRURE WITH PRINTER (RADAR TYPE)	JRC NJJ-105 Handy Search	1
6	BMS SERVER	DELL PE T110 II Monitor 19 LED Windows Server Standard 2012 Symantec Endpoint Protection	1
		Oracle Database Standard Edition 1 CD-Pack	1
7	PHOTO RESIZE ENGINE	NX Power Lite 5 File Server Edition	1

*already consumed in OST

The Project for Improvement
of the Bridge Management Capacity in Egypt

List of Other Equipment to be Handed Over

No.	Item	Model	Qty.
1	PROJECTOR	EPSON EB-925	1
2	VIDEO RECORDER	SONY HANDYCAM HDR-XR260	1
3	VOICE RECORDER	OLYMPUS VN-8100	1
4	COPY MACHINE	TOSHIBA e-STUDIO 225	1
5	DIGITAL CAMERA	Panasonic LUMIX DMC-FH2R	3
		Panasonic LUMIX DMC-FT4	2
6	LAPTOP COMPUTER	DELL Latitude E6420 Windows Professional 7 SP1 Antivirus (1 year) Portable HHD 500GB	3
		DELL Latitude E6420 KASPERSKY Internet Security 2013 Windows Office pro 2013 Adobe Acrobat XI Pro ME WD-HD 2TB	2
7	HELMET	MSA V Guard	27*
8	ROAD CONE	Cone 100cm	30
9	SAFETY BELT	FAT	60
10	SAFETY VEST	Phosphoric vest	18**
11	GPS	GARMIN Etrex 30	4
12	DISTANCE METER	HILTI PD 5	4

*The other 33 had been discarded due to damage in OST.
**The other 42 had been discarded due to damage in OST.

1.3.10 Bridge Inspection Vehicle

A bridge inspection vehicle for bridge inspection was provided to GARBLT. Though close visual inspection is basis for bridge inspection, bridge inspection vehicle is utilized for bridges with difficulty to be approached.

The bridge inspection training sessions were conducted using the vehicle. Upon the introduction of the vehicle, the operation training was conducted for the GARBLT operators with a presence of experts of regular inspection training.

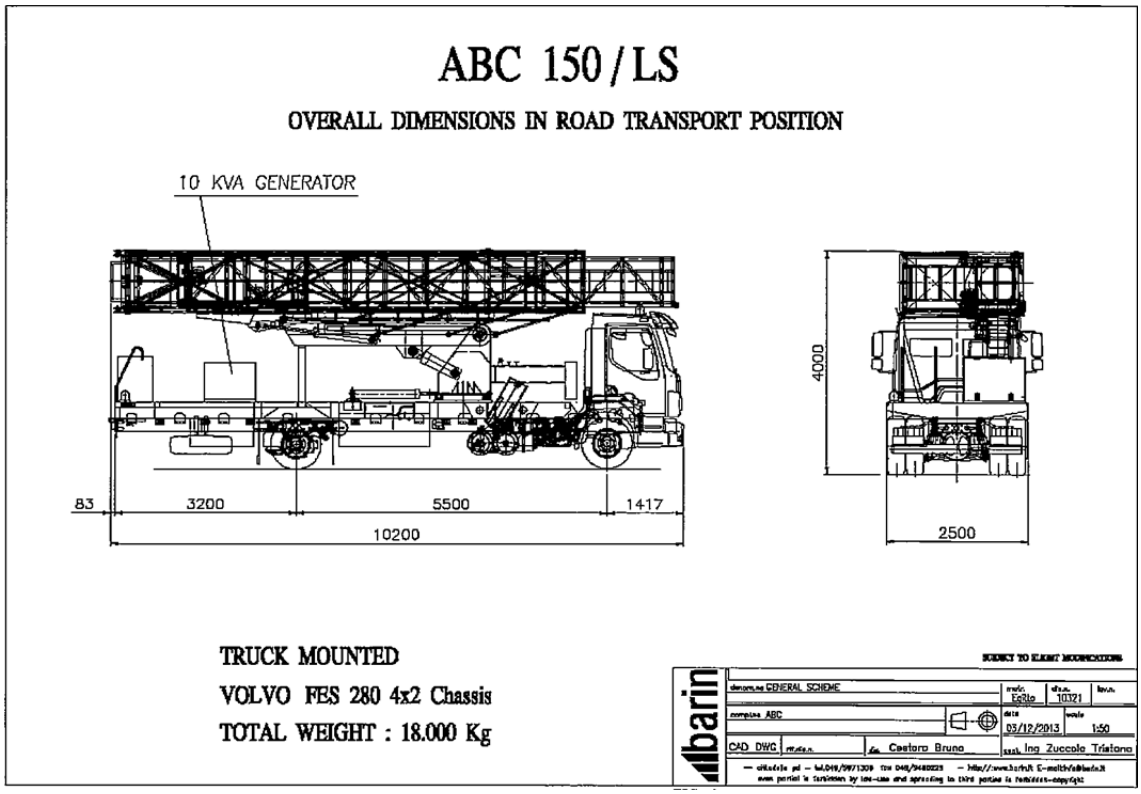
Date of introduction: November 8th, 2014

Main specifications of a bridge inspection vehicle:

Table 1-7 Specification of Bridge Inspection Vehicle

Item	Specifications
Dimension	10.2 m x 2.5 m x 4.0 m (L x W x H)
Weight	18,000 kg
Floor live loads	450 kg (4 persons＋130 kg)
Floor dimension: width	1.10 m
Floor dimension: length	Max 15.0 m

Picture 1-2 Bridge Inspection Vehicle



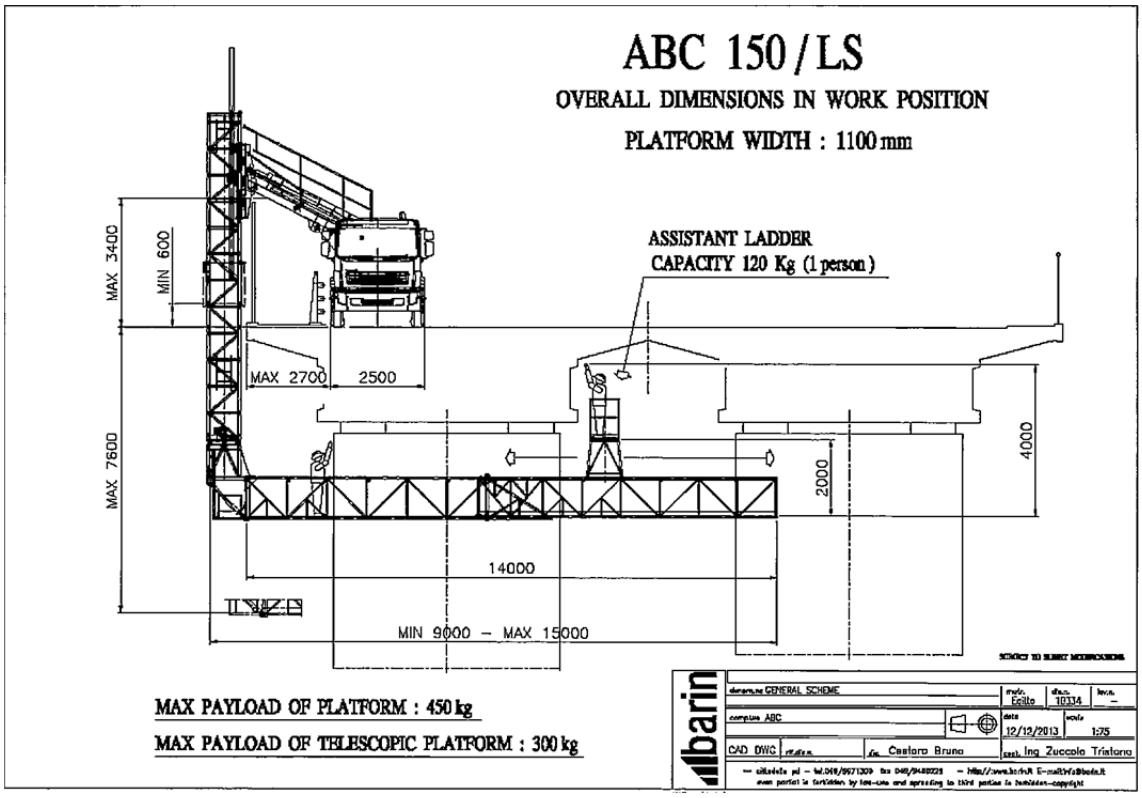


Figure 1-5 Bridge Inspection Vehicle

1.3.11 Manuals

Manuals for bridge maintenance management had not been developed before the Project. The following manuals were prepared for this Project and used for GARBLT's bridge management.

- Bridge Inspection Manual
- Detail Inspection Manual
- Aswan Bridge Inspection Manual
- Bridge Repair Manual
- Bridge Management System Manual
- Photo Management System on BMS Manual

Bridge Inspection Manual
Detail Inspection Manual
Aswan Bridge Inspection manual

Bridge Repair Manual
Bridge Management System Manual

Bridge Inspection Manual (Arabic)
Detail Inspection Manual(Arabic)
Aswan Bridge Inspection manual(Arabic)

Bridge Repair Manual(Arabic)
Bridge Management System Manual (Arabic)

Picture 1-3 Prepared Manuals

2 Details of activities

2.1 Output – 1 Maintenance Management Cycle Enhancement Activity

2.1.1 Bridge Maintenance Management by GARBLT

(1) Background

As the external organization for Ministry of Transport, GARBLT (General Authority for Roads, Bridges & Land Transport) is primarily responsible for the development of inter-city highways nationwide. On the other hand, various kinds of other roads also exist, such as the toll roads established by military-related corporations, the roads established by the Ministry of Housing, Utilities and Urban Communities, and the roads established by the Ministry of Water Resources & Irrigation. Moreover, the inner Ring Road within the Cairo metropolitan area (where population is most densely concentrated) falls under the jurisdiction of three metropolitan Governorates, including the Cairo Governorate. While the Ministry of Housing, Utilities and Urban Communities was responsible for the construction of the Cairo Ring Road, responsibility for its management shifted to GARBLT after its completion.

The total length of the inter-city roads managed by GARBLT is about 25,000 kilometers. In order to manage these, 14 District Offices have been established throughout the country. Each District Office is responsible for the maintenance and management of roads, but bridge engineers and specialized departments in charge of bridges are not assigned to these offices. Bridge engineers in charge of all construction and maintenance of bridges nationwide have not been assigned to GARBLT HQ, and with the whole country divided into several areas, engineers are only responsible for the bridges in their own areas.

At the start of the project, of all the personnel working in the bridge maintenance department of the GARBLT headquarters organization, there were only about six engineers capable of performing bridge inspections. Given such a small number of technical personnel, planned bridge maintenance management could only be performed for a limited number of bridges.

Moreover, since basic documentation on bridges and maintenance had not been developed, objective management of maintenance proved difficult.

Table 2-1 Length of roads managed by GARBLT

District	Road length (km)
Sinai Peninsula	10,149
Upper Egypt	3,790
Lower Egypt	9,680
Total	23,619

This breaks down to 15,303 km of single-lane roads, and 4,158 km of double-lane roads, for a total of 19,461 km.

Table 2-2 GARBLT District Offices

Office No.	Office Designation	Area of Jurisdiction
1	Central	Cairo, Giza, Qalubia, 6th October, Helwan
2	Canal and Sinai	Port Said, Ismailia, North Sinai
3	East Delta	Dakahlia, Sharqia, Damiatta
4	Middle Delta	Kafr El Sheikh, Gharbia, Minufia
5	West Delta	Alexandria, Matrouh
6	Beni Suif	Beni Suif, Fayoum
7	Asyout	El Menya, Asyout
8	Qena	Luxor, Qena, Sohag
9	Red Sea	Red Sea
10	Aswan	Aswan,
11	South Sinai	Suez, South Sinai
12	New Valley	New Valley
13	Behira	Behira
14	Ring Road	Cairo Ring Road

(2) Current bridge situation

According to data provided by GARBLT, bridges were rarely built before the Egyptian revolution of 1952, except for approximately 40 bridges constructed during the period of British rule around 1940. From 1952 until the 1960s, bridge construction was actively carried out. Bridges built during this period represent about half of all currently usable bridges. In other words, around half of Egypt's bridges are more than 50 years old.

Starting from the 1970s, on average about 15 bridges were built each year. However, this varied widely from year to year—in two instances, more than 100 bridges were constructed in a single year, but in some years almost no bridges at all were constructed. Many culverts were built in the 1980s, which is believed due to the history of road development. The average age of the bridges currently managed by GARBLT is about 40 years.

With regard to bridge types in Egypt, reinforced concrete bridges account for about 90%, with steel bridges accounting for less than 10%. In addition to being used for old bridges crossing the Nile, many steel bridges are swing bridges built over waterways. Egypt's prevalent form of bridge, the reinforced concrete bridge, is in many cases constructed of steel only for sections that cross railway lines. Long concrete bridges (more often constructed in recent years) are usually made of pre-stressed concrete. Girder bridges are overwhelmingly common, and there are two cable-stayed bridges: the Aswan Bridge and the Suez Canal Bridge.

Aside from bridges crossing the Nile, the overwhelming majority of bridges are small-scale concrete

bridges. Generally, clearance between bridge girders and water surface is narrow, due to substantial changes in the Nile's water level caused by the flood control function of the dams built upstream on the Nile. Except for coastal areas, environmental corrosion of steel is not severe due to Egypt's desert or semi-desert climate, and steel rebar embedded in concrete is rarely subject to severe corrosion. Thus, despite generally poor maintenance of bridges after construction, corrosion of reinforcing steel is only minor.

Picture 2-1 Low clearance

Picture 2-2 Worn-out paving of steel deck

Picture 2-3 Insufficient cleanup at time of construction

Picture 2-4 Picture Construction method to be improved

Picture 2-5 Old steel bridge in good condition

Picture 2-6 Construction method to be improved

Bridge damage in Egypt tends to be centered on expansion joints, railings, bearings, and so on. Spaces under girders and near bridge abutments are not only used to dump garbage, but in some cases to incinerate it. Aside from honeycomb defects occurring during construction and left unrepaired, concrete shrinkage cracks (also occurring during construction) can often be found. Below, some examples of bridge conditions can be found.

Current status of Cairo area

The viaducts that cross the Ring Road are mostly made of concrete. Piles of garbage under these elevated viaducts often obstruct passage of traffic. Shops and the like occupy the areas under viaducts, so that bearings near abutments often cannot be inspected. Viaduct girders suffer damage from collisions with large vehicles. Steel rebar is often exposed due to poor quality construction, and shrinkage cracks are quite common.

There is extensive damage to expansion joints and pavement. On some construction sites, emergency repairs are made to expansion joints using buried-type joints. Viaducts in the Cairo metropolitan area cause chronic congestion due to the intense traffic volume, and it is not uncommon for three or four rows of cars to be travelling each way along a viaduct with only a two-lane road. Expansion joints often suffer significant damage, and in many cases fractured steel comb and missing metal pieces are left unrepaired.

(3) The reality of maintenance management

In order to carry out maintenance of the road network under its jurisdiction, GARBLT is organized into District Offices in 14 locations across the country. These District Offices are responsible for managing road-related maintenance and repair (such as pavement surfaces), but this excludes bridges—no organization or personnel responsible for bridges are assigned to District Offices. Although bridge personnel were assigned to the office in charge of managing the Suez Canal Bridge (a cable-stayed bridge), the Suez Canal Bridge management office has since been closed.

The GARBLT HQ organization in Cairo is the only maintenance department that handles bridges, and since the number of its engineers responsible for bridges is remarkably inadequate, it is impossible for the HQ organization to maintain a constant grasp of the bridge situation nationwide. Therefore, if any District Office discovers some bridge abnormality while conducting road patrols, it is supposed to convey this abnormality in document form to the bridge maintenance department at GARBLT HQ.

This document allows GARBLT HQ to know that a bridge abnormality has occurred, and to take the necessary steps. To enable this, the entire country is divided into five areas, with GARBLT and the contractors responsible for bridge repair and maintenance work entering into formal contracts. These contractors then employ consultants to create the necessary inspections and repair plans.

The number of bridges in the road networks managed by the 14 District Offices nationwide varies widely by office. The five District Offices in the Delta region are responsible for over 100 bridges, while

five other District Offices manage around 50 bridges. The number of bridges in the road network managed by the Aswan District Office is less than 10.

3rd District Office (East Delta)

The third District Office has jurisdiction over three governorates (Al Sharqia Governorate, Dakahlia Governorate, and Damiatta Governorate), comprising a total of about 300 bridges. This District Office is exceptional in that it has one bridge unit, responsible for keeping track of the condition of bridges. This unit exists because of the large number of bridges present in the road network this District Office manages. There are no professional bridge engineers in the bridge unit, but they take great interest in the condition of bridges.

The condition of all bridges is checked every month through routine bridge inspections, after which reports are submitted to headquarters. Submitted reports are accompanied by photographs of damage, enabling GARBLT to confirm that inspection is carried out reliably. The bridge inspection form was designed and created independently by the engineers responsible, but the same inspection form is not used uniformly across all of GARBLT.

It should be noted that these offices are responsible for routine maintenance only. When large-scale maintenance (repairs etc.) is required, this is carried out on a non-regular basis by engineers employed by private construction companies under contract from GARBLT HQ.

4th District Office (Middle Delta)

The Fourth District Offices performs only routine visual inspection of bridges, and does not have a fixed reporting format for inspection results or reports sent to GARBLT HQ. When abnormalities are found during inspection, letters are sent to the GARBLT HQ calling for more detailed examination. This Office has created a summary table of road lengths and number of bridges under its jurisdiction.

This District Office does perform direct repairs of pavement, but GARBLT HQ is responsible for bridge repairs. Although it does conduct routine inspections of bridges, since it does not organize its report using a fixed format, it is not possible to accumulate inspection data on bridges in an organized fashion. This Office has a maintenance management method for abnormalities discovered during inspection, and it carries out complete corrective maintenance.

10th District Office (Aswan)

The Tenth District Office does not perform either periodic inspection or detailed inspection of bridges. In charge of the vast Upper Egypt region are only the five bridge engineers stationed at GARBLT HQ, who are responsible for both bridge construction and maintenance. Since only road engineers are stationed at the Tenth District Office, maintenance of the Aswan Bridge falls to the GARBLT HQ bridge engineer in charge of the entire Upper Egypt area—effectively, one person. If any abnormalities are found in daily inspection, these are reported back to Cairo. Any bridge repairs are

handled by GARBLT HQ without direct involvement by the Aswan District Office.

2.1.2 Improving the bridge maintenance management cycle

(1) The concept of the bridge maintenance management cycle

Maintenance management of bridges is carried out during the period after construction (when the bridge starts being used for traffic) until the end of its use. This activity is carried out for the purpose of maintaining the expected function of bridges. In general, the sequence of maintenance activities is considered as a bridge maintenance cycle, which is repeated periodically. Appropriate bridge maintenance involves a clearly established sequence of activities, which cycles continuously.

Broadly speaking, there are two concepts on maintenance. The first is "corrective maintenance," while the other is "preventive maintenance."

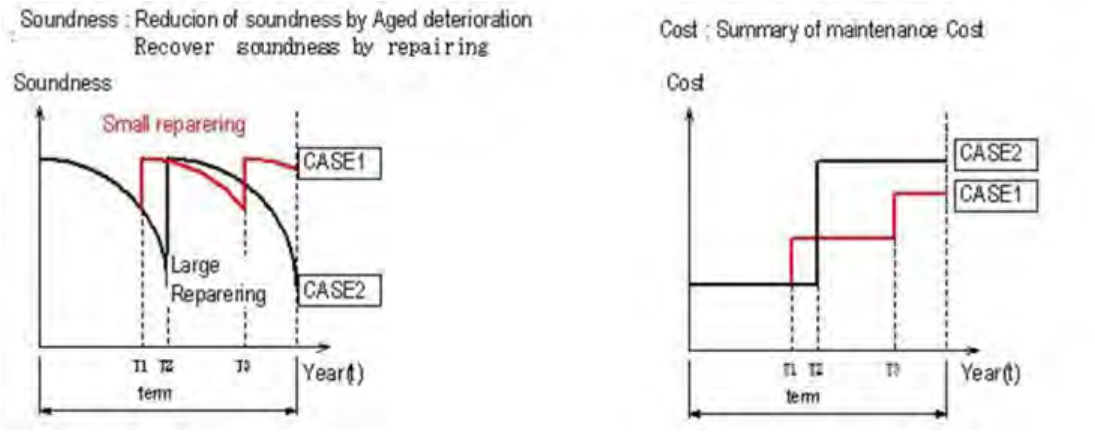


Figure 2-1 Minimization of Life-cycle Cost

In WG and OST, differences of these two maintenances and importance of “preventive maintenance” was explained.

After initial construction, bridges tend to lose proper function through age-based deterioration or damage from accidents. The idea of corrective maintenance is to carry out appropriate repairs or other measures for any problems that manifest when bridge function falls below a certain level. The concept of preventive maintenance involves measures carried out to restore bridge function in smaller steps than in corrective maintenance. These measure also tend to be carried out earlier than in corrective maintenance. For this reason, day-to-day maintenance activities are an important element of preventive maintenance.

The maintenance cycle for this project is laid out in the conceptual diagram below. Activities are conducted in sequence—**inspection**, **planning**, **repair**, **evaluation**—and each activity is associated with a database. Databases are handled by BMS.

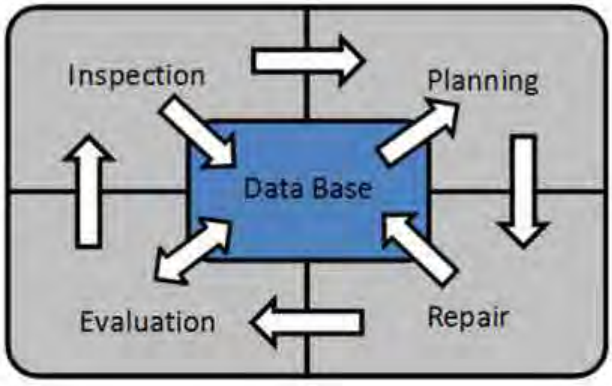


Figure 2-2 Bridge Maintenance Management Cycle

(2) Activities policy

- Transition to preventive maintenance

There are significant advantages in moving to the preventive maintenance method over the corrective maintenance method. GARBLT's bridge maintenance currently involves corrective maintenance, but an activities policy aimed at introducing preventive maintenance has been decided upon.

To this end, in addition to developing the necessary manual and documentation, GARBLT had to introduce a bridge maintenance management cycle to facilitate bridge inspection and evaluation, the storage and updating of bridge data, and selection of repair methods. So that GARBLT engineers were able to grasp the concept of the bridge maintenance management cycle, explanatory sessions about the effectiveness of the bridge maintenance management cycle and the challenges and improvements to GARBLT's bridge maintenance were repeated in every WG and OST.

Since the District Offices are required to play a role in bridge maintenance (for example, through activities such as daily inspections), the concept of the bridge maintenance management cycle had to be explained not only to HQ bridge engineers, but also to District Office engineers.

Also, because GARBLT engineers are required to have an interest in bridge maintenance, various studies and other information relating to bridge maintenance were also presented, such as the condition of Egypt's bridges, the maintenance management system, bridge inspection methods, the use of bridge inspection vehicles, and similar.

In addition, there were also opportunities for training in Japan. These covered Japan's bridge maintenance management method, which is based on the concept of preventive maintenance. Training participants were able to understand the benefits of preventive maintenance.

- Consideration of maintenance management standards

We have established that the maintenance management standards are set for the evaluation values (health index), which are calculated based on changes in the condition, and that they are explained/considered with the focus on the following items in order to set the management targets that are in line with the current situation in Egypt.

1) Run test calculations for the annual budget in multiple patterns by using the deterioration prediction calculation function of BMS
2) Focus on the deterioration level of the average health index and other aspects based on the above test calculation result and consider the optimal management standards
3) Use different colors for different levels of the health index and compare with the target management standards in the short-term repair planning training, which requires more detailed operations

At GARBLT, we explained the importance of the stance to go through the shifts of the health index in all bridges under the management of GARBLT every time repair plans are formulated and to consider the target average health index when maintaining the management standards. The below table shows the conceptual relationships between health index, condition of member, and the maintenance management standards. We provided the explanations by using this table based on the assumption that at least 60 in the average health index is targeted as preventive maintenance.

Table 2-3 Examination on Management Standard

	Health Index	Condition of Member	Category of Maintenance
Main Girder (Steel)	80≦HI≦100	Almost new bridge No specific problem by continuous inspection	
	60≦HI≦80	Repair or continuous inspection is desirable though no problem with operation	Target management level (Preventive Maintenance)
	40≦HI＜60	Repair is required though no problem with temporary operation	(Corrective Maintenance)
	20≦HI＜40	Urgent Repair is required	
	0≦HI＜20	Large-scale repair/ renewal is urgently required	Limit management level

(3) Results

Working groups involved in improving the bridge maintenance management cycle met 22 times. In addition to these groups, the concept of the bridge maintenance management cycle and the effectiveness of preventive maintenance were explained at nearly all District Offices.

Through these activities, not only core personnel at GARBLT HQ but also District Office personnel were able to grasp the importance of bridge maintenance management and the concept of the bridge

maintenance management cycle. This laid the ground for GARBLT's future introduction of the bridge maintenance management cycle.

Moreover, in order to connect the project's activities cross-sectionally, a flow chart showing bridge maintenance operations was also created. As a result, the positioning of the manual created by this project became clearer.

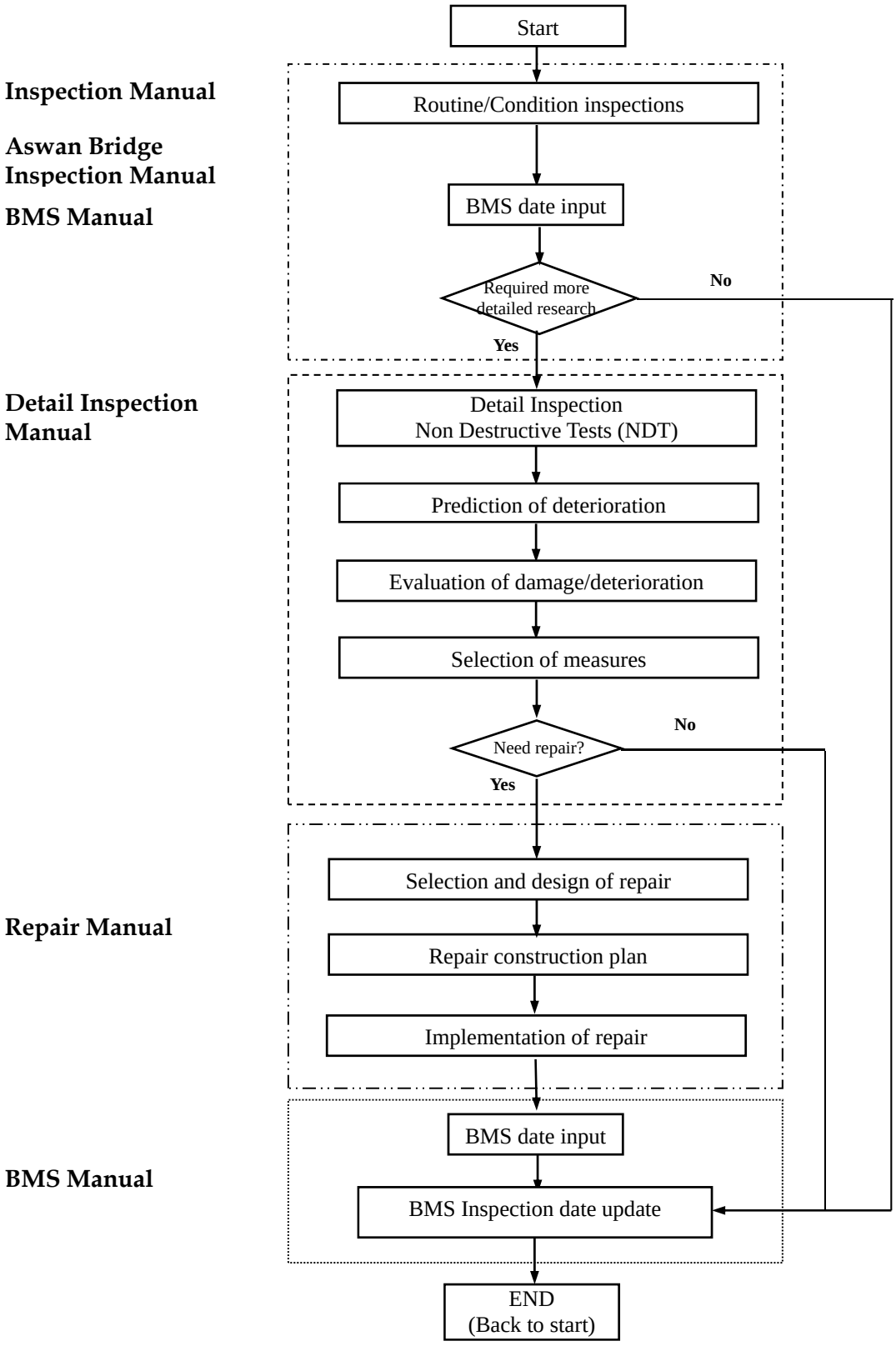


Figure 2-3 Flow chart of bridge maintenance management operations

2.1.3 Improving the maintenance management organization

(1) The need for a maintenance management organization

The Head of Bridge Sector has ultimate responsibility for GARBLT's bridges, and oversees both the construction and maintenance of bridges. For this reason, in Egypt (where construction of roads and bridges is urgently underway nationwide), priority is given to construction works, which have a higher profile. There tends to be lower interest in maintenance works.

In order to properly implement maintenance by introducing a bridge maintenance management cycle, it is advisable to establish a dedicated department in charge of maintaining the nation's bridges. At the 4th JCC meeting, the results of the final evaluation study were approved and the establishment of an organization at HQ responsible for bridge maintenance management was proposed.

Figure 2-4 Proposed bridge maintenance management organization

(2) Established management structure

However, since the lack of staff could not be remedied in timely fashion, a dedicated department was not established by the end of this project. It is advisable for GARBLT to establish a maintenance management organization at HQ as soon as possible, and to allocate personnel accordingly.

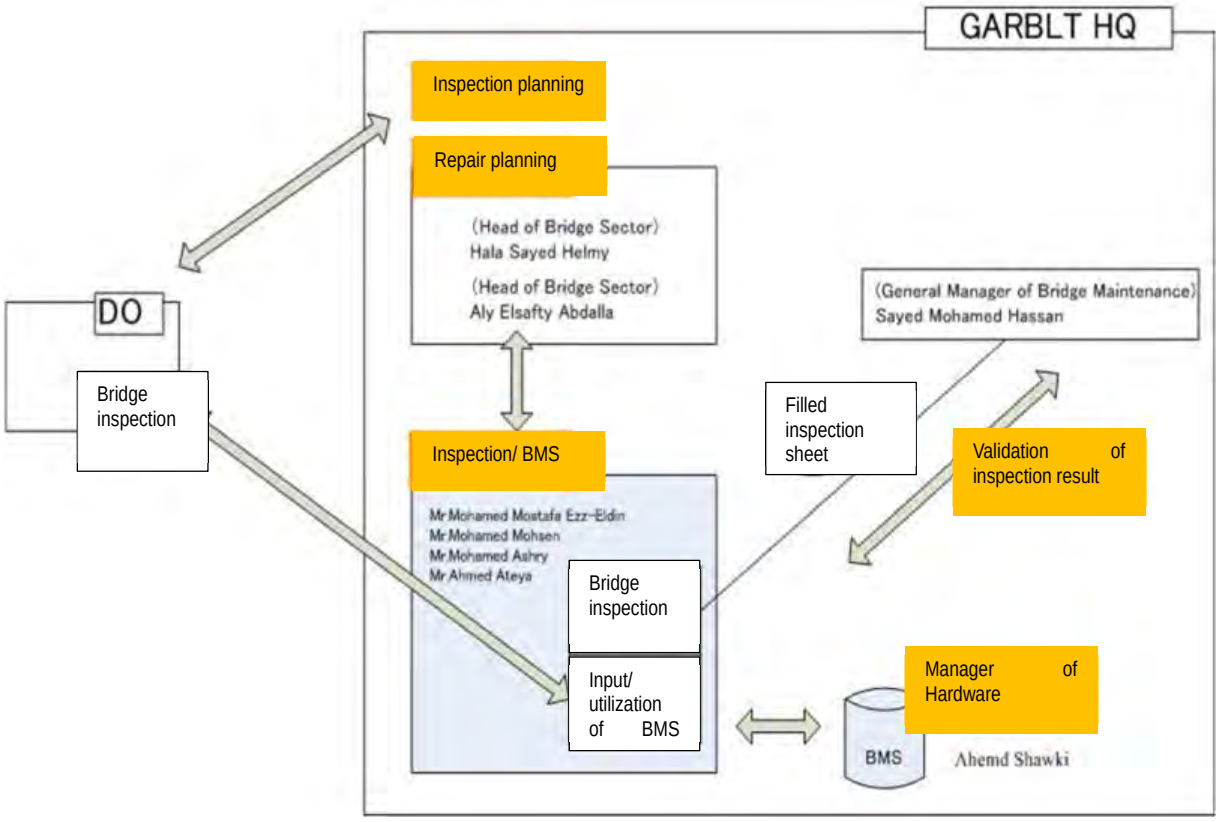


Figure 2-5 Proposed bridge maintenance management organization

(3) Management of design documents

Design documents created at time of construction represent some of the most important documents for the maintenance stage. GARBLT does store a lot of design documents, but design documents associated with bridges that are transferred from other agencies after being built (such as the Cairo Ring Road) are not kept.

The importance of storing and using design documents for project activities has come to be understood. It can be expected that efforts will be made to collect and properly store these documents in future.

2.1.4 Accomplishment of PDM Indicator

The item of indicator on PDM of this Project has been achieved as shown below.

Table 2-4 Accomplishment of PDM Indicator

Item	Activity	Indicator	Means of Verification	Result
1-1	Review current maintenance management cycle and identify issues necessary to be improved	Model action plans for improving maintenance management cycle, such as keeping/sharing drawings and technical documents, are implemented.	Model action plans.	Completion (*1)
1-2	Propose measures to improve maintenance management cycle			
1-3	Take trial actions on the proposed measures	More than 70% of bridge maintenance engineers of GARBLT pass achievement tests about bridge maintenance management cycle.	Monitoring reports on model action plan, interviews with engineers.	Completion (*2)
1-4	Conduct seminars on bridge maintenance management cycle			

(*1)

In terms of design drawings and technical materials, we established the flow of application/reception to freely browse the existing documents at the time of inspection preparation. They have been effectively sharing information, as seen in the example of GARBLT's inspection engineers preparing drawings, which are required for inspections, by using drawings from completed constructions.

As a result of multiple demonstrations for the bridge maintenance management cycle, "short-term repair plans" by the units of 5 to 10 years was confirmed to be more effective for GARBLT than long-term repair plans as long as 50 years, etc.

Therefore, multiple "short-term repair plans" were prepared by GARBLT engineers as part of the improvement actions for the bridge maintenance management cycle.

Furthermore, GARBLT independently conducted investigations regarding the checking task of the actual repair cost and the provisional repair cost, which is calculated by BMS, based on the result materials. The difference was within the expected range, and the effectiveness to use provisional repair costs for maintenance management planning was confirmed.

(*2)

Completion test for GARBLT bridge maintenance management engineers was conducted, and everyone cleared the passing score.

2.2 Output 2: Improvement of Inspection Technology

2.2.1 Background

1) Background

GARBLT currently manages more than 1700 bridges and continues to build new ones every year. Consequently, the amount of bridge stock to be managed will continue to steadily increase. Roughly 50% of all bridges in the country were constructed about 50 years ago. It is feared that overloaded vehicles traveling over these bridges, the outbreak of fires on bridge girders, and other such factors are damaging and contributing to the deterioration of these bridges. Despite concerns following the construction of these bridges that GARBLT was not properly managing them, the agency does recognize the importance of bridge management.

Properly inspecting the nation's numerous bridges with a limited number of bridge engineers will require a unified bridge inspection manual in order to--as much as possible--eliminate subjective decision-making by inspectors and achieve quality inspection results.

This project has overseen the creation of three manuals: the Bridge Inspection Manual, which is for bridges of a general construction; the Aswan Bridge Inspection Manual, which is for the Aswan Bridge, a cable-state bridge; and the Detailed Inspection Manual, which describes the use of nondestructive testing equipment. Bridge inspection manuals provide for the fundamentals of such things as inspection methods, evaluation criteria, record-keeping methods, and are also used when contracting inspection work to outside consultants.

As inspections require that inspection manuals be used correctly, on-site inspection training has been conducted and GARBLT engineers have repeatedly taken part in training to prepare them for conducting proper inspections. Almost all regional offices in the country have conducted routine inspections, condition inspections, and detailed inspections. As Aswan Bridge inspections are only done for Aswan Bridge, the Aswan District Office has conducted its own on-site inspection training.

2.2.2 Feature of the Inspection

In this inspection, we promoted general routine inspections, condition inspections, and detail inspections as preventive inspections. There were 2 characteristics, which are listed below.

1) Utilization of a handbook

Although they understood the necessity and importance of maintenance management through the bridge maintenance management cycle activities, which were promoted in Result-1, the following hesitation was observed when conducting the inspections.

- Inspection method　What to inspect, how to inspect
- Determination method　How to determine the damage in the inspection result

In terms of the demonstration method, we can expect to improve the level of understanding by continuously hosting OST. However, damage determination standards are up to the decision of individuals who conduct inspections, so we need means to unify the standards.
Therefore, we have prepared a handbook including damage example photos to be used as part of the materials to help them decide the determination standards. The handbook was structured as follows.

- Includes damage examples for each structure: floor board, girder, bearing, abutment, and peripheral facilities
- Includes different damage photos for each structure along with the damage level of Bad, Poor, or Fair for each photo.
- In B5 size, which is easy to handle on site

Trainees always carried this with them in OST. Trainees gave positive comments, such as those below. Handbook utilization was effective.

- Photos in the handbook also include damage levels, so they are easy to understand.
- It is easier to determine the damage level by comparing the actual bridge and handbook photos.
- It is now easier to identify sections that are prone to damage after seeing many examples of damage.

In addition, it was pointed out that damage locations in the photos were too small and difficult to see in B5 size in the course of the training. Therefore, the handbook was changed to A4 size in the middle of the training.
Below are excerpts from the handbook.

Damage degree with the pictures

Girder

Rebar Exposure (Poor)

Minor corrosion.

Girder

Efflorescence/Free Lime (Poor)

Girder

Rebar Corrosion (Bad)

Severe corrosion.

Girder

Rebar Exposure (Bad)

Severe exposure.

2) Introduction of bridge inspection vehicles

Since these bridge inspection vehicles are introduced to Egypt for the first time, we had to resolve a number of issues, such as operation methods and inspection methods. Below are the issues and solutions implemented in this project.

	Issues	Solutions	Remarks
Issues involving vehicle operation	Operation method of bridge inspection vehicles	Supplier held a seminar/demonstrations (P2-16 Material A)	Seminar: Half day Demonstration: 2 days
	Time required to expand and fold the inspection platform	Operator conducted training twice a week	Although it required 30 minutes at first, it was reduced to 12 minutes as a result of the training
Issues involving inspection operation	Lane regulations at the time of inspections	Prepared the regulation procedures in PPT. Explained them in WG. (P2-17 Material B)	Understand the necessity of regulations. Procedure diagrams were included in the manual as reference materials
	Inspection method in case of light poles	Explained in WG that the platform must be extended and folded between each light pole. (2-18 Material C)	Understand the importance of preparations before starting inspections
	If a road is under girders, approval from the road authority is required	Explained the necessity to obtain approvals in WG	Understand the necessity of approvals

Material A


①
Extension of stabilizer
Stabilizing


②
Tower-up


③
Tower Rotation

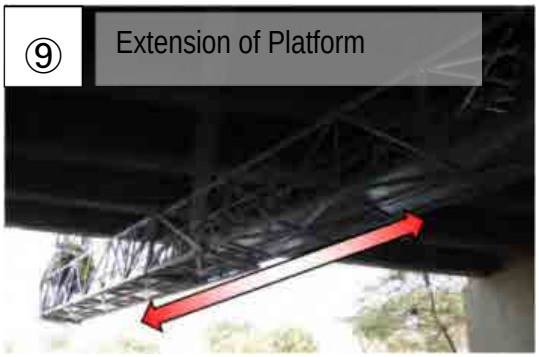

④
Stand-up of Tower

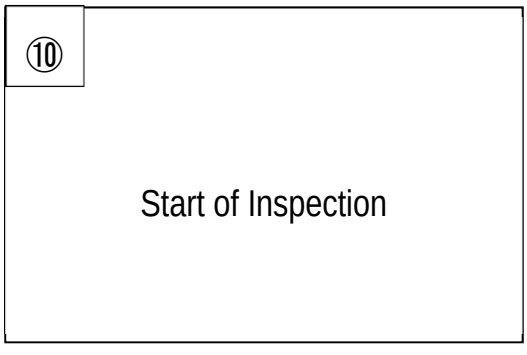

⑤
Unfolding of platform


⑥
Inspector getting-in

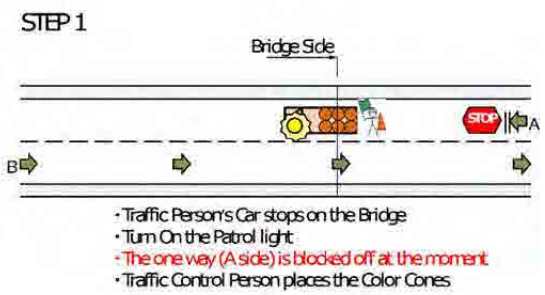

⑦
Lift-down of Platform

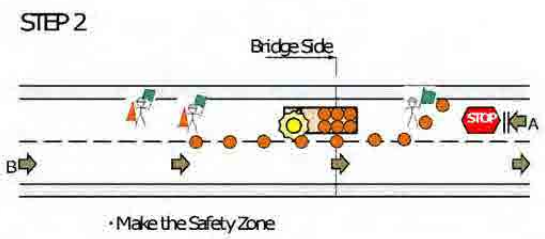

⑧
Rotation of Platform

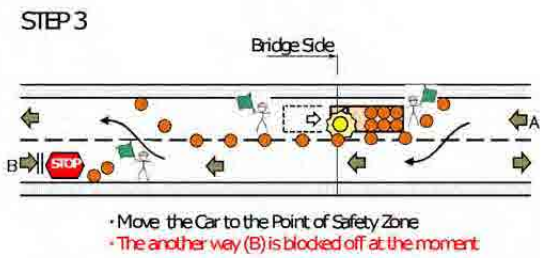

⑨
Extension of Platform

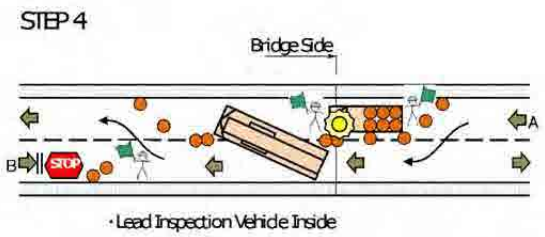

⑩
Start of Inspection

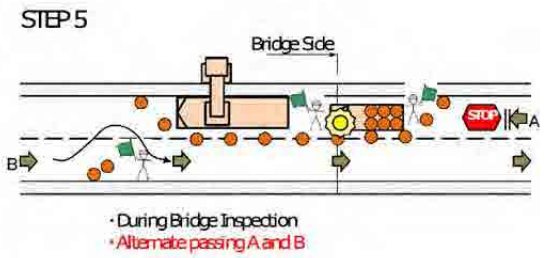
Material B

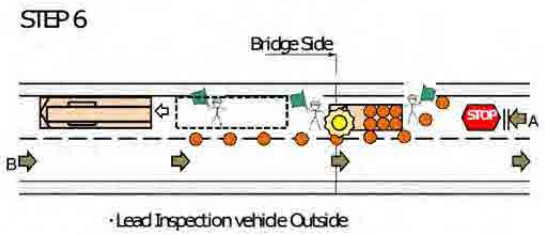

STEP 1
Bridge Side
STOP
A
B
・Traffic Person's Car stops on the Bridge
・Turn On the Patrol light
・The one way (A side) is blocked off at the moment
・Traffic Control Person places the Color Cones

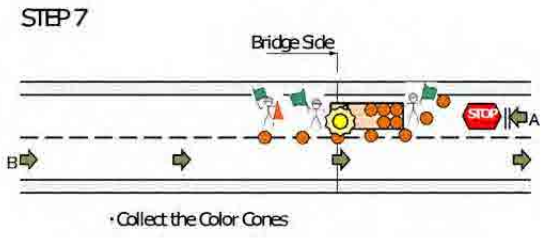

STEP 2
Bridge Side
STOP
A
B
・Make the Safety Zone

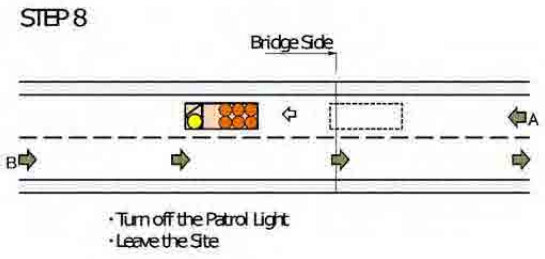

STEP 3
Bridge Side
STOP
A
B
・Move the Car to the Point of Safety Zone
・The another way (B) is blocked off at the moment


STEP 4
Bridge Side
STOP
A
B
・Lead Inspection Vehicle Inside

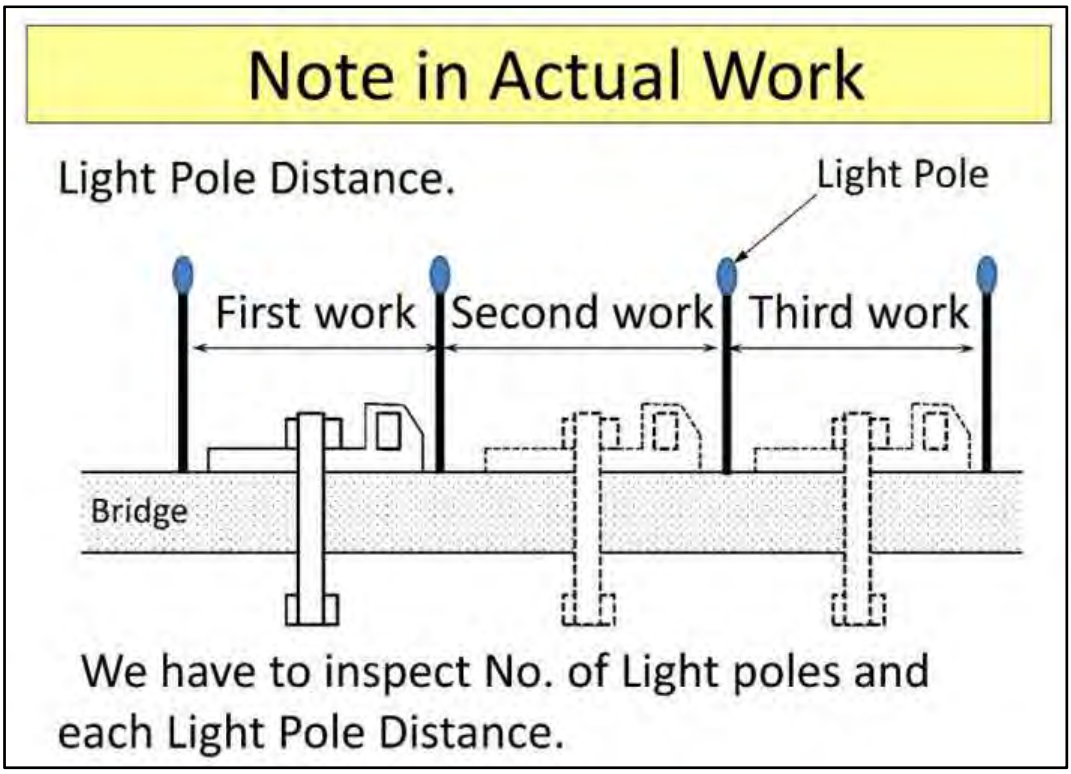

STEP 5
Bridge Side
STOP
A
B
・During Bridge Inspection
・Alternate passing A and B


STEP 6
Bridge Side
STOP
A
B
・Lead Inspection vehicle Outside


STEP 7
Bridge Side
STOP
A
B
・Collect the Color Cones


STEP 8
Bridge Side
A
B
・Turn off the Patrol Light
・Leave the Site

Material C


Note in Actual Work
Light Pole Distance.
Light Pole
First work
Second work
Third work
Bridge
We have to inspect No. of Light poles and each Light Pole Distance.

2.2.3 Bridge Inspection Manual Development

1) Basic policy

Inspections are the most important activity in the bridge management cycle. Inspections clarify a bridge's condition and allow repairs or other necessary action to be taken. By storing the results of these inspections in the BMS, this information becomes a critical part of bridge management--including making future predictions.

Bridge inspection manuals are created on the assumption that they will be used by GARBLT engineers. There is also the assumption that routine inspections will be conducted by district offices based on previously-existing GARBLT management methods. Consequently, to allow non-bridge engineers to understand the content of these manuals, the manuals include a basic grounding in the subject of bridges. They use many diagrams to make it easier to understand things such as bridge types and the names of the elements that compose bridges. The manuals seek to give clear definitions for bridge-related jargon used in inspections. To achieve one of the goals of these manuals--eliminating subjective decision-making by inspectors and achieving quality inspection results--the manuals include standard photographs depicting the degree of damage.

With the intention that basic inspection results will be stored in the BMS, inspection record sheets for entering results into the BMS have been created.

2) Types of inspection

Bridge management agencies in most countries use four types of inspections: routine inspections, condition inspections, detailed inspections, and emergency inspections. Routine inspections are done most frequently and aim to find major changes to a bridge's condition as quickly as possible. Conducted regularly, condition inspections entail bridge engineers with expert knowledge of bridges looking into whether there are problems with a bridge in terms of its overall structure and are used to evaluate a bridge's integrity. Detailed inspections involve the use of Non-Destructive Testing equipment. In general, the results of a condition or routine inspection will dictate the necessity of conducting a detailed inspection. Emergency inspections are conducted as needed in response to a natural disaster or other accident that has occurred. Inventory inspections are conducted in order to record a bridge's basic specifications.

The frequencies, goals, methods, and inspectors involved in each type of inspection are shown in the table below. Although condition inspections are normally conducted every four years, they can be conducted every two years as, ideally, data on the condition of Bridges nationwide should be collected in a shorter timeframe, with results entered into the BMS.

Routine and condition inspections involve visual inspection by engineers and do not use special measuring instruments. Basic tools such as test hammers, crack gauges, digital cameras, and binoculars are, however, used. Information about frequencies, goals, inspection methods, and inspectors for each type of inspection are shown in the table below.

Table 2-5 Types of inspection

Name		Frequency	Main Goal	Method	Inspector
Scheduled inspection	Routine inspections	Monthly	Find road safety problems and promptly detect major structural problems.	Visually inspect superstructures, substructures, and road surfaces.	Road inspectors from District Offices. Bridge inspectors.
	Condition inspections	Biennial (or every 4 years)	Regularly check structural integrity. Results are entered into the BMS.	Conduct visual inspections. Measurement using basic equipment.	Bridge inspectors with inspection education and training
Non-scheduled inspections	Detail inspections	As required	Inspect details based on the results of a routine or condition inspection. Detailed inspection using equipment. Done to examine necessary measures.	Visual inspection and measurement using measuring instruments	Bridge engineers with knowledge of bridge design and maintenance
	Emergency inspections	As required	Find problems affecting road safety. Done to determine necessity of emergency countermeasures.	Visually inspect superstructures, substructures, and road surfaces.	Bridge inspectors with inspection education and training Bridge engineers with knowledge of bridge design and maintenance
	Inventory inspections (inspection at time of data entry)	As required	Done to collect and organize specifications data. Results are entered into the BMS and processed.		Bridge engineers with knowledge of bridge design and maintenance

3) Structural elements of bridges

Bridges comprise many elements such as deck slabs and girders. Bridge inspection manuals specify two main kinds of structural elements: elements with a short service life that will be replaced and those with a long service life that are generally not replaced.

Elements with a short service life do not impact overall bridge strength but do impact the safety of

vehicles and pedestrians traveling over it. Routine inspections, which are conducted frequently, place an emphasis on finding problems concerning elements with short service lives, while condition inspections target elements related to the bridge's overall structure.

Table 2-6 Structural components of bridges

Component (A) with short durable years, some of which usually affect traffic safety : Component excluding main structure	Component (B) with long durable years, which affect stability, strength and durability of the bridge structures : Main structure
pavement	deck (main structure)
expansion joint	main structure (main structure)
railing/ parapet	major member excluding deck (main structure)
lighting / traffic sign	Minor member excluding deck (main structure)
noise barrier	Substructure
curb	Foundation
drainage	Bearing
inspection way	bearing seat
utilities	Connection
approach	wing wall

4) Evaluation criteria

The goal of inspections is to identify and take a record of damage, deterioration, and other such problems and condition changes. Standards are established for evaluating the degree of each instance of damage. As routine inspections involve evaluating whether or not there are major problems, two ratings are used: Good and Bad. As condition inspections involve looking at the overall state of a bridge's condition, four ratings are used: Good, Fair, Poor, and Bad.

The number of ratings has been simplified in view of the fact that those conducting inspections will not always be engineers with expertise in bridges. Condition inspections look at more detailed areas than do routine inspections because it will generally be bridge engineers conducting the inspections. However, as more inspection areas results in greater variation in readings received, four ratings are used.

The following provides examples of routine inspection ratings and condition inspection ratings.

Table 2-7 Routine inspection ratings (concrete main girder)

Defect		Rate	Explanation
Rebar exposure	7	Good	Except following
		Fair	
		Poor	
		Bad	Rebar exposure of longer than 0.3 m.
Defect		Rate	Explanation
Rebar corrosion	8	Good	Except following
		Fair	
		Poor	
		Bad	Corroded rebars
Defect		Rate	Explanation
Abnormal deflection	17	Good	Except following
		Fair	
		Poor	
		Bad	Visible deflection at girder

Table 2-8 Condition inspection ratings

Defect		Rate	Explanation
Crack	6	Good	None
		Fair	Fine cracks of max. 0.1 mm spacing at 0.5 m or wider in one direction.
		Poor	Moderate cracks of max. 0.2 mm spacing at about 0.5 m in one direction with fine cracks in right angle direction.
		Bad	Large cracks exceeding 0.2 mm forming grids.
Defect		Rate	Explanation
Rebar exposure	7	Good	None
		Fair	
		Poor	Rebar exposure of max. 0.3 m.
		Bad	Rebar exposure of longer than 0.3 m.
Defect		Rate	Explanation
Rebar corrosion	8	Good	None
		Fair	Rusted rebars
		Poor	
		Bad	Corroded rebars
Defect		Rate	Explanation
Leakage /free lime	9	Good	None
		Fair	
		Poor	
		Bad	Leakage/free lime
Defect		Rate	Explanation
Delamination /spalling	12	Good	None
		Fair	
		Poor	
		Bad	Delamination/Spalling
Defect		Rate	Explanation
Abnormal deflection	17	Good	None
		Fair	
		Poor	
		Bad	Visible deflection at girder

Concrete Superstructure/Main Structure	Rating
   Reinforcement bars are partially exposed.	Fair
   The condition may cause danger to people and vehicles travelling underside.	Poor
 Very severe crack on the girder. Reinforcement bars are badly corroded.	Bad
   Severe corrosion of reinforcement bars, severe exposure of reinforcement bars, and severe shear cracks of girders indicate loss of strength.	Bad

Figure 2-6 Damage ratings

5) Inspection planning

Routine and condition inspections are conducted with regular frequency. As condition inspections involve bridge engineers inspecting a bridge's overall structure, gathering and comparing a number of high-quality inspection results allows for ascertaining the speed at which deterioration or damage is progressing.

Creating inspection plans in advance is important for regularly inspecting the many bridges throughout the country. It is important that District Offices create inspection plans for routine inspections while bridge engineers from GARBLT headquarters create plans for condition inspections.

6) Evaluating bridges' structural soundness

Although inspections involve identifying problems and damage in elements that compose bridges and evaluating the degree of damage for each instance, the results of such inspections do not directly indicate the soundness of a bridge's overall structure. The overall structural soundness of a bridge must be determined in consideration of the impact that the bridge's components have on the bridge overall. Even if a bridge's paving is in serious disrepair, for example, its strength is not necessarily compromised. If, however, its concrete deck slab is severely damaged, an inspection of this slab would have to find that there is a major impact on the bridge's overall functionality and strength.

Furthermore, for multi-span bridges, inspections of all spans will not turn up the exact same results for each. However, because the lowest-rated span holds control over the overall bridge, it is best to--in the case of multi-span bridges--use the lowest-rated span to evaluate the overall structural soundness of a bridge. The following describes the basic policy concerning the use of inspection results to evaluate a bridge's overall soundness.

① Compare inspection results (bridge inspection recording) for each element
② Identify the lowest-rated element from among inspection results that account for each element's degree of impact
③ Evaluate spans by looking at the element with the lowest rating
④ Evaluate a bridge's overall integrity by looking at the lowest-rated span among all of the bridge's spans

The following table shows components' degree of impact (weight) and standards for expressing the evaluation of a component's degree of damage as numerical values expressing structural soundness and damage level.

Table 2-9 Quantifying damage ratings

Rating	Soundness	Damage level
Good	1.00	0
Fair	0.67	33
Poor	0.34	66
Bad	0.0	100

Table 2-10 Examples of weight given to components

Member	Impact level	Details
Floor board	1.00	This damage directly impacts bridge function.
Main girder	1.00	
Other superstructure	0.20	The impact of this damage to bridge function is not great.
Abutment	0.67	Compared to main girders, the impact of this damage to bridge function is not great as the size of the structure is large.
Pier	0.67	
Foundation	0.67	
Bearing	0.33	The impact of this damage to bridge function is not great.
Bearing base	0.1	The impact of this damage to bridge function is not great.
Protective fence	0.1	

7) Usage of GPS and digital cameras

It has become a simple matter to make use of GPS coordinates. Egypt has no accurate roadmaps or official system for displaying addresses, and lacks distance markers in many areas. For such reasons as these, GPS coordinates can be used to locate bridges. Although how to display coordinates can be chosen, coordinates are required to be given in degrees in order to facilitate their entry into the BMS. The use of GPS coordinates has made it possible to easily check the accuracy of position data using mapping software, and has also enabled people to reliably identify bridges to be inspected.

Digital cameras must be carried at all times during inspections. Even in situations where inspectors cannot approach certain parts of a bridge, photographs taken with a digital camera from a position some distance away can be used to record small cracks. Due to their inclusion of GPS functions in recent years, digital cameras are a piece of equipment consistently used during inspections. To facilitate data entry into the BMS, inspection manuals establish standards for the sizes of photographs taken by digital cameras.

Table 2-11 Digital camera photograph sizes

Category	Size	Resolution	Aspect ratio	Remarks
	0.3M	640x480	4:3	VGA
Standard size	3M	2048x1536	4:3	QXGA
Specific case	5M	2560x1920	4:3	
	10M	3648x2736	4:3	
	14M	4320x3240	4:3	

2.2.4 Aswan Bridge Inspection Manual

The Aswan Bridge is a cable-stayed bridge, which has a more complicated structure than ordinary bridges owing to the use of stay cables and towers. While inspections of the Bridge are basically conducted in accordance with the Bridge Inspection Manual, the frequency of inspections is higher owing to the bridge's special structure.

1) Types of Inspections

The table below gives the purposes, methods, and implementers of routine and condition inspections. Routine inspections are to be carried out weekly, while condition inspections are required once a year, in consideration of the Bridge's importance and special structure. The Aswan District Office is designated as the organization responsible for the inspections, as the Aswan Bridge is an important cable-stayed bridge in the Aswan District.

Table 2-12 Types of Inspections

Name		Frequency	Purpose	Method	Inspector	BMS Input
Scheduled Inspection	Routine Inspection	Weekly	To find defects which can affect road safety To find significant defects of bridge structure at early stage	To visually inspect overall superstructure, substructure, road surface by using patrol car or foot patrol as necessary	・Patrol staff of District No. 10 Aswan District Office	Required
	Condition Inspection	Annually	To regularly check structural soundness.	Visual inspection using simple measuring equipment by foot patrol and boat	・Patrol staff of District No. 10 Aswan District Office ・Bridge Engineer of GARBLT	Required
	Inventory Inspection	As required	To collect specification. The result will be input into BMS	To visually inspect overall superstructure, substructure, road surface	・Patrol staff of District No. 10 Aswan District Office ・Bridge Engineer of GARBLT	Required

2) Identification of Structural Members

The Aswan Bridge has a long span and thus requires many structural members. Accordingly, a numbering code is used to identify the locations of individual members. For example, the numerous stay cables are numbered in such a way that each is clearly identifiable. In the same way, there is a method for identifying the location of towers and deck plates.

The following is an example of the numbering code used to identify deck plates located between piers P5 and P6:

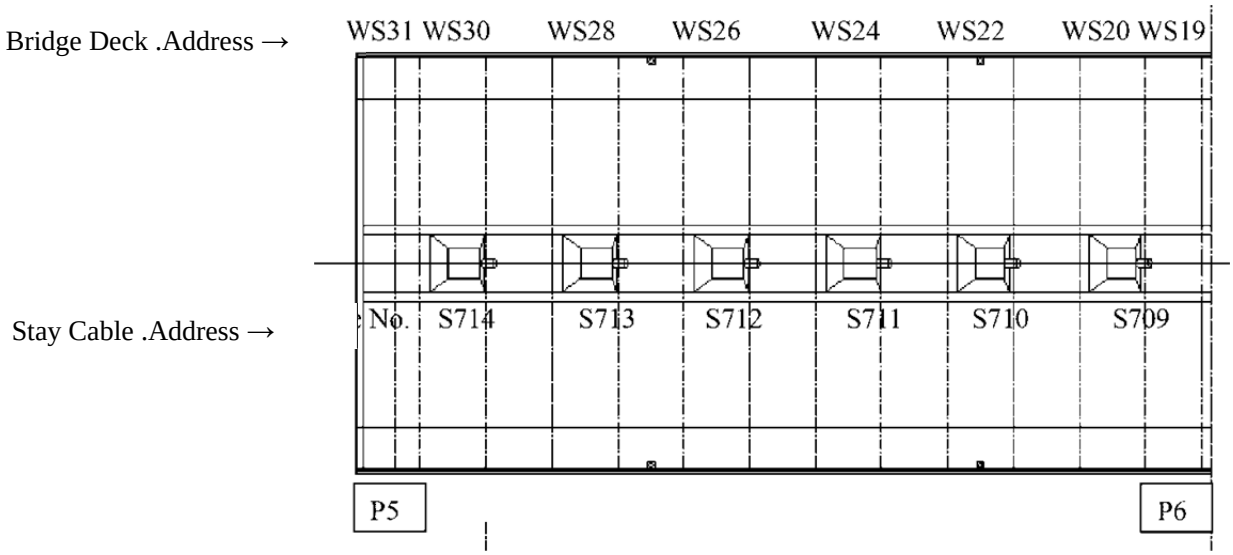


Figure 2-7 Numbering Code Used to Identify Member Location

3) Checkpoints

Checkpoints for Aswan Bridge inspections have been established, in view of the Bridge's special structure. In addition, inspection procedures have been set down so that inspections can be carried out accurately. The table below shows the checkpoints for condition inspections and their order of execution. In the case of stay cables, inspectors should check for any abnormal vibration, sound or sag, among other conditions.

Table 2-13 Checkpoints for Condition Inspections of Aswan Bridge

Checkpoint	defect
road pavement	upheaval or ratting, crack (pothole, accumulation of sand, falling object)
sidewalk	abnormality pavement (accumulation of sand, falling object)
curb	(failure, deformation)
catch basin	(clogging)
bridge railing	loosing bolt at the base, missing parts, corrosion, rust (failure, deformation)
expansion joint	missing parts (bump, abnormal sound)
road lighting pole	loosing bolt at the base, missing parts, corrosion, rust (failure, deformation)
safety barrier	(failure, slippage)
central reserve	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime) (accumulation of sand, falling object)
landscape lighting	(failure)
electrical facility	damage of electrical cable duct, missing of electrical cable
stay cable	abnormal vibration, abnormal sound, abnormal cable sag, damage on the cable protection pipe, chalking sealant
steel member at the stay cable anchorage on the deck	failure, deformation, missing or loosing bolt at the base, corrosion, rust
concrete block at the stay cable anchorage on the deck	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime)
pylon over the deck	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime) Failure, deformation
steel member at the stay cable on the pylon	failure, definition, missing or loosing of bolt at the base, corrosion , rust
inside wall of the pylon concrete block at the	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime)

stay cable in the pylon	
steel member at the stay cable anchorage in the pylon platform, ladder	failure, deformation, corrosion, rust, wax leaking on the socket
bridge deck	(failure, deformation)
concrete structures inside of girder	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime)
external tendon	abnormal tendon force, damage on the tendon protection pipe
concrete structures underside of girder	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime)
bearing	Failure, deformation, abnormality of transition
pier	abnormality of concrete (crack, spalling, re-bar exposure, re-bar rust, free lime) (failure, deformation)
riverfront	(scouring)

2.2.5 Detailed Inspection Manual

1) The purpose of detailed inspections

Routine and condition inspections are based entirely on visual observation, with the exception of the use of simple tools such as hammers. However, detailed inspections, which are to be implemented as necessary, include the use of nondestructive testing equipment.

The purpose of detailed inspections is to

- confirm the results of condition inspections
- obtain detailed information needed to carry out repairs,
- investigate the causes of damage or deterioration
- collect additional data for evaluating bridge condition.

2) Flow of the detailed inspection

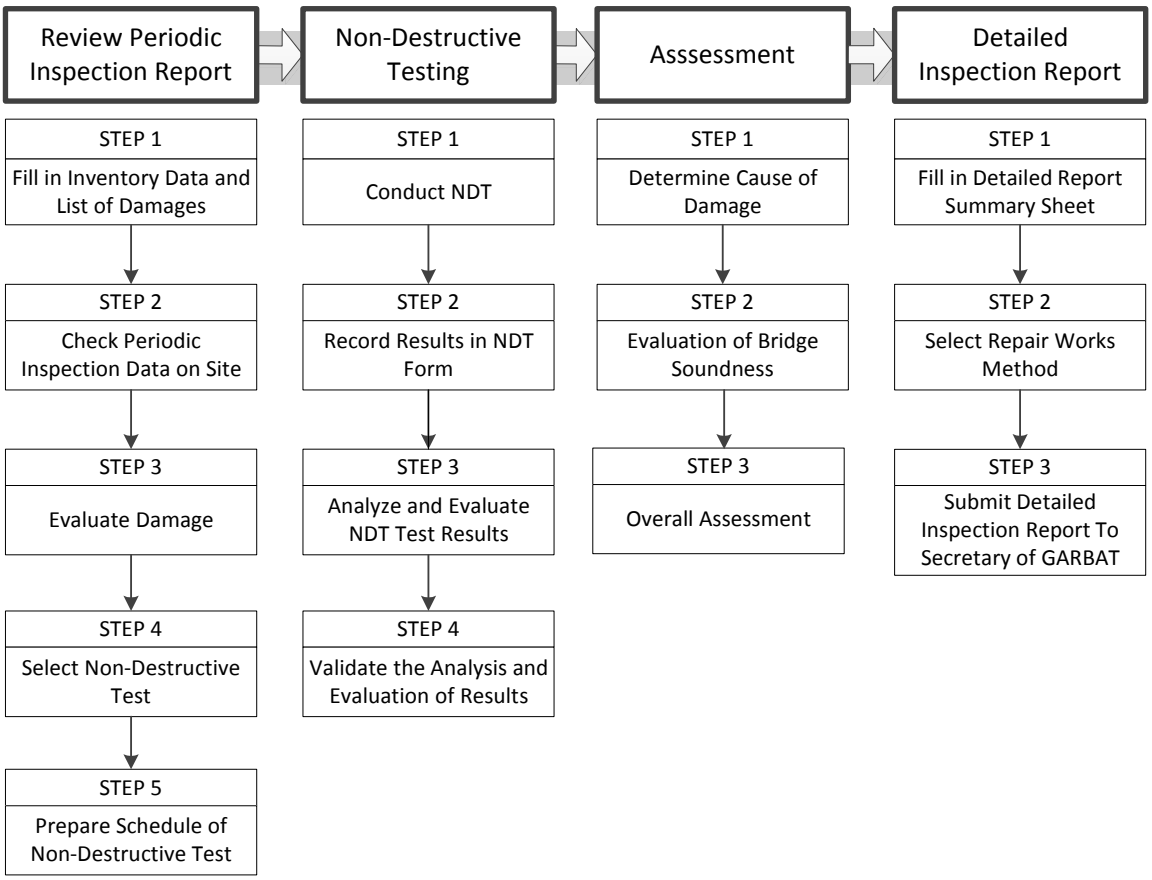


Figure 2-8 Overall Flow

3) Scope of the inspection

- Validation of the result of preparatory inspection (Routine inspection, Condition Inspeciotn)
- Selection of appropriate equipment
- Non-destructive test supplement to visual inspection and simplified measure
- Identification of damage cause

4) Process of the Inspection

Operation procedures of detail inspections are as follows.

i. Selection of investigation members

Select investigation members who are familiar with the use of non-destructive tests when conducting detail inspections.

ii. Preparation prior to detail inspections

・Collect plans, drawings, reports, etc. for the target bridge prior to the investigation.

・Make a request to the local office regarding factors that may pose obstacles for the investigation and remove them.

(Traffic situation, concentrated housing)

・Check that equipment, vehicles, etc., which are required for the investigation, are functioning.

・Confirm the equipment and materials required for the inspection

・Prepare the inspection form

iii. Checking of routine inspection results

Check to determine whether or not appropriate evaluation has been given according to the evaluation standards based on the damage in photos, etc.

Damage caused by structural damage Determine based on cracks, rebar exposure, corrosion, deformation, buckling, etc.

Damage caused by peripheral environment, such as salt damage Distance from the ocean, delamination status, etc.

Damage caused by age of material Corrosion, deformation, buckling

iv. Selection of non-destructive test equipment

Equipment suitable for the damage is selected by using the below table for reference.

Table 2-14 NDT Methods

NDT methods	A	B	C
I. NDT Methods			
A. For Concrete Attributes			
N01 Rebound Hammer Test	**	**	**
N02 Carbonation Depth Measurement Test	**	**	**
N03 Ultrasonic Pulse Velocity Test	**	*	**
N04 Half-Cell Electrical Potential Test	*	**	*
N05-01 Rebar Detection Test for Superstructure (Magnetic Type) N05-02 Rebar Detection Test for Substructure (Radar Type)	**	**	**
B. For Steel Attributes			
N06 Paint Thickness Test		*	
N07 Metal Thickness Test	**	*	

**: Required,

*: Depending on the recommendation of Head of Central Department

v. Implementation of Non-Destructive Test

vi. Evaluation

The result will be evaluated based on chapter 3 of Detailed Inspection Manual.

vii. Report

Report of survey and evaluation need to be submitted at the earliest moment.

2.2.6 On-Site Training

(1) Types of Inspection in OST

On-site inspection training was provided to selected GARBLT engineers so that they can understand and correctly implement the inspections described in the Bridge Inspection Manual. Inventory inspections, routine inspections, and condition inspections were carried out at nearly all District Offices. Types of bridges covered by the training sessions were the reinforced-concrete girder bridge, pre-stressed concrete girder bridge, steel plate girder bridge (including swing bridge), and steel truss bridge. Training at the Aswan Bridge consisted of inventory, routine, and condition inspections, all carried out in accordance with the Aswan Bridge Inspection Manual.

Detailed inspection training included demonstrations of nondestructive tests at nearly all District Offices nationwide. On-site training (OST) was attended by engineers from District Offices in addition to bridge engineers from GARBLT. Nondestructive tests covered by the OST included the rebound hammer test, carbonation depth test, ultrasonic pulse velocity test, half-cell electrical potential test, rebar detection test, paint thickness test, and metal thickness test. In addition, measurements of concrete cracks using crack gauges and tests using inspection hammers were carried out.

Inspection training at the 20 bridges specified in the PDM was completed by March 2015. Training in condition inspections using bridge inspection vehicles was carried out from February 2015, when GARBLT adopted the use of such vehicles. Training sessions using bridge inspection vehicles were conducted by two Japanese experts in order to ensure safety. The sessions took place over a period of four months, from February through May 2015.

(2) Routine Inspection OST

1) Training period: November 10 – 14, 2013
2) Training contents: Prior to training, we explained the summary of the project, significance of inspections, and inspection method. Then, we held the training for inspection work using actual bridges. Due to the fact that most of the engineers in local offices had never been close to actual bridges, we explained points to note in inspections, general damage examples and evaluation methods, simple inspection equipment usage, and how to fill out the inspection form. The office manager of each local office also participated in the seminar.
3) Participants: Engineers belonging to local Aswan, Qena, Sohag offices
4) Inspection result evaluation:

We inspected 20 bridges with counterparts during the period and entered the inspection results in BMS. Since there are 3 bridges on the Nile between Aswan and Sohag among the 20 bridges, the inspection was conducted after the OST for routine inspections. Since all of the 3 bridges are big with a lot of traffic, the inspection was only done on part of the span within the limited time. The structure itself of the steel bridges, including the old truss bridge that was built as a railroad bridge but has recently been used as a road bridge and the old swing bridge, is sound. However, deterioration of floor boards was visible. Although we did not find damage that would immediately affect traffic, there was a great amount of sand accumulation and other materials around the bearing in many places. It was assumed that no inspection had been conducted since the construction.

Office managers also participated in the training, and we observed their motivation and willingness. Due to the fact that most of the employees had never had inspection experiences, we think that explaining the summary of inspection methods prior to the inspection was useful in improving their understanding level.

5) Routine Inspection OST

Explanation of inspection purpose, methods and paparwork.(Aswan Office)

OST of damage type, rating, use of equipment andinspection mehotd.

Confirming a faulty expansion device discovered during inspection

Explanation of routine inspection method and equipment from C/P to engineer in DO. (Tanta Office)

Confirming a bearing that is nearly entirely buried in sand

Learing how to fill inspection form

(3) Condition Inspection OST

1) Training period: May 25, 2015

2) Participants: (Consultants) Uemura, Terai, Saleh Basheer, Ahmed Fahim
(GARBLT HQ) Eng. Mohamed Emad, Eng. Mohamed Ezz El-din,
Eng. Mohamed El-Ashry, Eng. Ahmed Atteya

3) Training contents: Kafr El-Zayat bridge: This is a bridge that mainly consists of the 4-span continuous PC box girder bridge that crosses a tributary of the Nile in the northern Delta region. It possesses attached bridges (continuous PC box girder bridges) on both ends. While the inspection was conducted in a high temperature, it went smoothly in terms of both preparation work and inspection work. We confirmed that their level of expertise has improved and that they are conducting the inspection with a sense of relaxation.

4) Inspection result evaluation:

Installation at the time of the upper section construction was slightly defected (defect in concrete casting/compaction) in this bridge, and honeycomb and exposure of rebar are seen in areas. We confirmed that iron corrosion is more severe in this area compared to the southern area, due to the air from the ocean. Therefore, we explained the necessity of repairing the cross-section at an early stage. Furthermore, there was missing steel bridge railing (due to theft, we were told) in Span-X3. Since this is an extremely dangerous situation for pedestrians, we explained that it is necessary to swiftly repair/add this and that it is desirable to swiftly remove/clean the accumulated soil (sand) and trash that were observed almost throughout the sidewalk.

5) Condition Inspection OST


Kafr El-Zayat Bridge


Inspection using BIV

Inspection using BIV（Kafr El-Zayat Bridge）

Inspection using BIV（Kafr El-Zayat Bridge）

(4) Aswan Bridge Inspection OST

1) Period: June 4 (Tue), 2013

2) Participants: [JICA specialist team] Tsukahara, Matsuo, Eng. Saleh El-Basheer,
[GARBLT] AboNoser Ahmed Aly

3) Training contents:

- Explanation of routine inspection/detail inspection contents
- Routine inspection
- Detail inspection for floor board
- Detail inspection inside of girder
- Detail inspection under girder using boat

Time and date	Contents
6/4 10:30	Arrived at GARBLT No.10 Aswan District Office. Held a pre-inspection meeting
11:10	Condition inspection (entire bridge)
11:40	Condition inspection over the bridge (P10 -> center of girder)
12:20	Condition inspection inside of girder (center of girder -> P5)
13:55	Condition inspection under girder and pier by using a boat (entire bridge)
14:30	Inspection completion

4) Training result

Although people in general seemed to be hesitant during the inspections requiring a boat, etc., which they had not experienced before, they seemed to have understood the importance of inspections. Opinions were actively exchanged. Below is the current situation of routine and condition inspections.

・ Routine inspection result

Accumulation of sand on the sidewalk, clogging in the catch basin, and rust in the bridge railing, which were pointed out in the previous routine inspection (conducted on March 4), had been improved through cleaning and painting of zinc-rich paint.

However, repair is required for bridge railing, from which vertical lattice has been removed, landscape lighting, and the covering panel for the railing on the middle wall of the expansion joint. We recommended that they also improve other minor items.

・Condition inspection results

In addition to those pointed out in the previous routine inspection, rust and bird dropping in the cable socket were observed near the side span opening. We proposed that repair was required due to the fact that neglecting the condition may lead to further rusting and that they place lighting for inspection within girder. We also recommended improvement of other minor items.

5) Aswan Inspection OST

1) Routine Inspection

2) Condition Inspection on bridge surface

3) Condition Inspection inside girder

4) Condition Inspection under girder and piers

(5) Detailed Inspection OST

1) On-Site-Training (On-Site- Training on Detail Inspection Manual, Non Destructive Test)

2) Training period: 2 days (1 day for lecture and 1 day on site)

3) Training contents: Chief Advisor Okawa: Project summary, introduction of examples (preventive maintenance in Japan)

Nagao: Introduction of bridge detail inspections (non-destructive test), non-destructive equipment demonstration, practical training for non-destructive test on an existing bridge.

In Ring Road Office and Behira Office, core inspection teams also participated in the preparation and training, etc.

4) Detailed Inspection OST

Presentation on Preventive Maintenance by Mr..Okawa, JICA Chief Advisor

Lecture on NDT by Mr.Nagao, Bridge Expert

Participants

Field Training of Rebar detector (Magnetic type)

5) Bridge maintenance management technical instructions to 4 new engineers (in charge of BMS)

We gave equipment training and instructions on evaluation analysis methods and report preparation to the 4 engineers (in charge of BMS), who newly joined. The 4 engineers also proactively participated in OST and also conducted evaluation analyses based on the results of NDT tests, which were conducted in OST, and prepared reports. We also conducted individual instructions regarding equipment operation.

As a result, the 4 engineers started actively giving part of the lectures in OST in Asyut and Aswan. They also started being able to voluntarily instruct participants in local equipment training. They also understood equipment usage and evaluation analysis and explained the report of the NDT test result, which was conducted on site, to WG members in the third WG meeting. It is not determined in what positions the GARBLT side will continue to employ new engineers, but they have become effective members, who could also become part of the force not only for BMS but also in the core inspection team, as mentioned above.

Since detail inspections must be conducted by trained bridge engineers, we aimed to have the counterparts learn the usage of non-destructive test equipment. In addition, in order to have engineers in local offices be interested in bridge maintenance management, we accepted as many engineers from local offices as possible in the training. 4 young counterpart engineers became fully familiar with the use of non-destructive test equipment through repeated OST.

2.2.7 Achievements and Issues

The four young counterparts have gained adequate understanding of the Bridge Inspection Manual and the Detailed Inspection Manual, after having participated in a continuous series of bridge inspection OST. They are now capable of carrying out inspections properly. They have entered inspection results in the BMS and are able to play a central role in GARBLT's inspection activities. They have also learned how to operate nondestructive testing equipment. Once the four counterparts start giving seminars for district office engineers, GARBLT's bridge inspection capacity is likely to improve.

GARBLT has numerous bridge drawings on file, but there are still many bridges without drawings. Without a drawing, GARBLT will have to implement on-site surveys to obtain the necessary inventory data. Accordingly, best efforts should be made to obtain the missing drawings.

It is important for GARBLT and its district offices to cooperate on entering inspection results in the BMS as much as possible.

Detailed inspections can be outsourced to universities and other organizations. This option should be considered in cases where GARBLT itself is unable to implement detailed inspections.

The items of indicators on the PDM of this Project have been achieved as follows.

Items	Activities	Indicators	Means of Verification	Result
2-1	Develop Bridge Inspection Manual	Bridge inspection manual is developed.	Manual developed in the Project.	Completed(*1)
2-2	Implement trainings on bridge inspection (Inventory, Routine, Periodic, Detail) with utilizing Bridge Inspection Manual	Bridge inspections are carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts.	Reports of training implementation.	Completed(*2)
2-3	Develop Bridge Inspection Manual for Aswan Bridge	The quality of the inspection by GARBLT engineers on the target bridges is assured by Japanese Experts.	Inspection Reports by GARBLT engineers.	
2-4	Implement trainings on inspection (Inventory, Routine, Periodic) of Aswan bridge with utilizing the Inspection Manual for Aswan Bridge			

(*1)

3 manuals, including the Inspection Manual, Aswan Bridge Inspection Manual, and Detail Inspection Manual, were prepared as the inspection manuals.

(*2)

Monthly reports of the time and date, place, participants, contents, etc. are recorded as the results of each inspection. In addition, the record also contains the attitude of trainees toward inspections and evaluations by Japanese engineers. Although trainees seemed not to be used to inspections at first, inspections were ultimately conducted by trainees alone. The validity of the contents of the prepared inspection materials were also confirmed by Japanese engineers.

Inspection data was entered in BMS by trainees themselves. The input results are also stored as files and approved by superiors.

2.3 Output 3: Improvement of Bridge Repair Capacity

2.3.1 Basic Policy

The activities of the Project were to 1) create bridge repair manuals and 2) demonstrate simple repairs (method selection and work management) of concrete bridges with the participation of Japanese experts. A WG in charge of bridge repair technology was designated, and reviews of draft manuals, provision of repair information, introduction of repair materials, and demonstrations were carried out for a successful technical transfer.

Bridge repairs are carried out on bridges with defects. Such defects are usually caused by a complicated mix of factors, including the natural environment, construction and architectural factors and traffic conditions. For this reason, there are no two repairs that are exactly alike. The degree of degradation can vary widely, from extremely slight to very large-scale (such as requiring the exchange of concrete slabs). Since the bridges to be repaired are already in service, temporary structures, safety measures and other aspects can also vary from case to case, in addition to the actual repair work. Furthermore, the effects of repairs can vary hugely depending on how they are carried out. GARBLT engineers should be made aware of these aspects.

Activities to increase bridge repair capabilities consisted of the preparation of repair manuals and the provision of training in light repairs. The manuals provided guidelines for selecting appropriate methods for repairing small defects generally seen in Egypt. The training included demonstrations of light repair work and was designed to teach how to select the appropriate repair method and manage repair work.

2.3.2 Survey of Current Conditions

(1) Survey Objective

Since repairs are conducted by local construction companies using locally available labor and materials, knowledge of current conditions in Egypt concerning matters pertaining to construction (repair methods, skills level, customary practices, supplies availability, etc.) is necessary for manual development and all other activities of the Project. Knowledge of typical damages in Egypt is also necessary for the selection of bridges for inspection. Accordingly, surveys for obtaining such information were conducted.

Damages generally seen in Egypt include the following:

- Concrete salt damage
- Defects caused by insufficient rebar cover

- Faulty concrete, such as cold joints and rock pockets
- Faulty treatment of seams between old and new concrete
- Defects in steel girder fabrication
- Degraded paint of steel members
- Faulty welding
- Faulty bolt connections
- Damage to expansion devices
- Insufficient cleaning and anti-corrosion protection around bearings
- Damage to light pole and handrail foundations (concrete)
- Subsidence of abutment embankment

(2) Companies Surveyed

Interview surveys of leading construction firms and an engineering consultant in Egypt were carried out to ascertain their business fields and expertise. The companies surveyed employ numerous engineers, and it was ascertained that their technical levels are high.

Table 2-15 Construction Companies Surveyed

Name	Features	Date
The Arab Contractors	General contractor affiliated with the Ministry of Housing and Urban Development (MOH). Undertakes bridge maintenance work for MOH. Was in charge of the 6 October Bridge Repair Project (MOH contract) in Cairo.	March 7, 2013
SAMCO	A-class general contractor (private sector). Undertakes maintenance work and bridge construction projects for GARBLT. Has an experience of about 20 years and is also involved in repair and construction of housing and other structures.	March 10, 2013
Arab Steel Fabricator	One of Egypt's top four fabrication companies. Primarily focused on fabrication of steel structures.	March 11, 2013

The following information was obtained from an interview with a consultant company (Nile Engineering Consultant):

- Inspections for prevention and conservation are not conducted in Egypt.
- Inspections conducted by the consultant are either contracted directly with GARBLT or subcontracted with a general contractor. Depending on the contract terms, there are cases where they survey damage conditions and investigate causes and cases where they also recommend

repair plans.

- Inspections are mainly based on visual observations and non-destructive tests (rebound hammer, rebar depth investigation)
- GARBLT generally supervises repair work themselves. However, depending on the director's policy, emphasis can be placed on outsourcing to consultants.
- There were no quality control considerations during the 1970s construction boom. Steel and concrete materials were used without confirming their quality. It was not until about 1990 that the industry started to recognize the importance of quality control.

(3) Survey of Repairs Implemented

GARBLT routinely carries out repairs of asphalt pavement, expansion devices and guardrails. In coastal areas, where salt damage is severe, repairs of concrete and steel materials are implemented.

Table 2-16 Examples of Repair Work

Target	Repair Method	Notes	Survey Date
Asphalt pavement	Injection method	Repairs based on injections of melted binder into asphalt pavement cracks were observed	Sep. 19, 2012
Expansion device	Replacement	Replacement with embedment-type devices was observed	Sep. 21, 2012
Concrete salt damage	Shotcrete method	Re-occurrence of salt damage in some repaired areas was observed. Initial concrete defects from the time of construction were observed.	Dec. 3, 2012
Guardrail & cable	Repair of damage to cable covering	Repair of damage caused by vehicle collision (method undecided)	Feb. 4, 2013

(4) Construction Conditions

Methods used in Egypt for repair and strengthening work are shown below. It was confirmed that the shotcrete method was generally used for repairs of concrete structures. A method sometimes used to repair reinforced concrete girders is to use a jacket surrounding the part to be repaired and pouring in a highly fluid concrete mixture from the top.

- Repair of salt-damaged reinforced concrete (shotcrete method, jacket method)
- Repair of salt-damaged reinforced concrete deck slab (recasting)

- Repair of salt-damaged steel plate girder (rust removal, anti-rust treatment)
- Repair of fallen deck slab (partial recasting)
- Corrosion of exposed rebar (anti-rust treatment, shotcrete method)
- Strengthening of steel plate girder damaged by overweight vehicles (thickening of flanges, addition of stiffening plate)
- Embedment of steel expansion device (joint embedment with binder and crushed stones)
- Railing replacement and coating
- Re-erection of deformed superstructure (re-positioning using jacks)
- Adding a second bridge deck

(5) Information Available at GARBLT

GARBLT has been conducting bridge repairs for many years based on its bridge maintenance and management activities and has accumulated considerable experience in repairs owing to the prevalence of defects and damages in the country's bridges. Nevertheless, the Project Team found that GARBLT has not required engineers to keep records of their repairs in a way that can be shared with others. Since the information is retained as a personal asset of the engineer, other engineers cannot access the information in a timely manner. Moreover, valuable expertise is being lost due to the high turnover of GARBLT engineers.

2.3.3 Repair manual

1) Fundamental policies

Many repair manuals tend to be available in Japan. These manuals may slightly vary in detail but tend to be quite similar with regard to repair methods and the criteria for selecting particular methods. The repair manual for this project accounts for the specifics of construction projects in Egypt, including technology levels, conventions, and procurement.

Ideally, a repair manual should provide a wide range of repair methods to allow for sustainable development after project completion. For real-world purposes, this means providing as many repair methods as possible while prioritizing repair methods for the types of damage typically encountered in Egypt.

2) Scope of repair work

Ideally, a bridge repair manual should cover as many types of repair procedures as possible. In response to the need to select the repair methods needed often in Egypt, we chose repair methods for concrete structures, expansion joints, bridge bearings, and pavement. The chart below shows the correspondence between damage to concrete structures and repair methods.

- Crack repair work	Surface sealing method
	Injection method
	Cut and filling method
- Sectional repair work	Plastering method
	Grouting (poring) method
	Grouting (injection) method
	Prepacked concrete method
	Shotcrete method
- Partial renewal work	Concrete casting
- Surface protection work	Concrete surface coating method
- Anti-corrosion work	Anti corrosion paint on steel bar
- Watertight work	

3) Repair methods

The bridge repair manual is designed to allow GARBLT engineers to select suitable repair methods based on the type and extent of the damage. The table below gives an example of repair method classification based on damage.

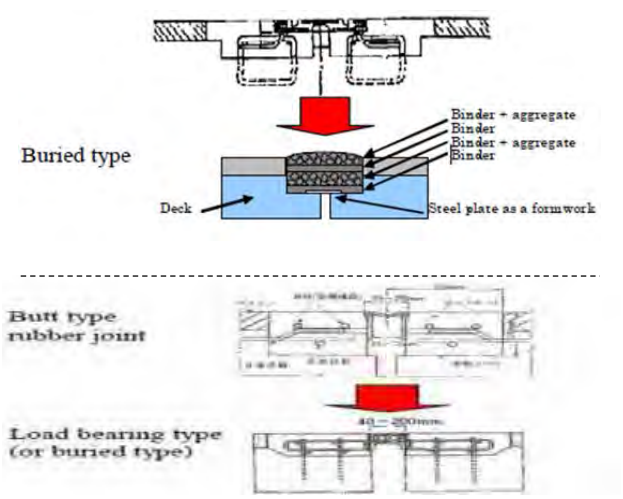
Table 2-17 Classification of repair methods by damage (example)

Damage		Repair method		Remark
Type	Magnitude			
Crack	w<0.2mm 0.2<w<1.0mm 5.0mm<w	Crack repair work	Surface sealing method	In case that cracks have deteriorated concrete, sectional repair method shall be selected.
			Injection method Cut and filling method	
Separation, Honeycomb, Void	Small	Sectional repair method	Plastering method Grouting method	
	Large		Prepacked concrete method, Shotcrete	Prepacked concrete method can be selected when installation of formwork is available.
Hole in a slab	Large area	Partial renewal work		Deck slab, etc.
Rebar exposure, corrosion		Anti corrosion work		
Discolor, deterioration	Surface zone	Surface protection work	Concrete surface coating method	
	Developed to inner zone		Sectional repair method for removing deteriorated concrete	
Free lime, water leakage		Watertight work		

■OUT LINE

When a deterioration of expansion joint can not be repaired by the partial repair method, the damaged expansion joint shall be fully replaced on the condition
that there are any problems other that wear and tear on
the existing expansion joint. In this case, other structural type or other allowable expansion gap type
shall be selected.

■SCHEMATEC DIAGRAM



■SPECIAL NOTE

1) Typical cases example:
- A conventional steel expansion joint is replaced with buried type expansion joint.
- Missing of surface rubber of a butt type rubber joint is one of typical damage. In order to avoid reoccurrence of same type damage, a buried type joint and a load bearing type joint are used.

2) Consideration
- Prior to an implementation of the work, expansion gap and amount of expansion and contraction shall be checked. Then an appropriate expansion joint shall be selected.
- Regarding an estimation of required expansion gap for new expansion joint, a dry shrinkage, a creep of superstructure, and a construction error may not be needed to be considered, but depending on age or the bridge.
- In case that the existing expansion gap is much larger than the expected expansion gap, a modification of girder-end should be studied in order to mitigate a repair cost.
- In case that the existing expansion gap is much smaller than the expected expansion gap, an application of buried type expansion joint should be studied to mitigate a repair cost.
- Full replacement method and post-cast concrete repair method is implemented in one repair work.
- This full replacement can be conducted by a unit length of the product but not whole length of the expansion line depending on the requirement of the repair.
- In case that a comprehensive length of expansion joint is replaced, impact to traffic is not minor. An appropriate mitigation regarding the traffic restriction shall be planed. Depending on the allowable conditions of traffic restriction, structural type of new expansion joint should be considered.

3) Others
- Longer construction period.
- Impact to traffic is large.

Figure 2-9 An example of a description of repair procedures

2.3.4 Repair demonstration

(1) Shotcrete OST

The shotcrete process is widely used in Egypt to repair damage to concrete structures. We examined structures repaired using the method and found that concrete in some cases is missing from the back of the rebars. We determined that this points to a need for improvements in quality control during construction. Shotcrete is used for a wide range of applications. GARBLT engineers must understand the proper procedures for applying shotcrete and the importance of quality control.

- Date : April 13, 2014
- Location : Cairo

- Details :

We provided training on the shotcrete process used to repair sectional losses in concrete structures. The process was demonstrated using both ideal and less than ideal techniques, and the results compared. The participants saw that voids were more likely to form in the back of the rebars if concrete was sprayed in the wrong direction. This demonstration provided participants with a clear understanding of the procedure, including the steps involved in mixing shotcrete materials, operating the gun, and treatment before spraying. Many of the young engineers had never seen the shotcrete process before.

Picture 2-7 OST on shotcrete process

(2) OST on washing with pressure washer

Commonly made of steel or rubber, bridge bearings are critical elements that link superstructures and substructures. Due to the need for scaffolding during inspections, bearings are rarely inspected, and dirt and foreign matter commonly accumulate around bearings.

Bridge bearings absorb superstructure deformation, a function hampered by accumulated dirt and foreign matter. This dirt and foreign matter must be removed. We performed OST to demonstrate the cleaning effects of the pressure washer, the equipment offered.

1) Session 1

- Date : April 2, 2014
- Location : El Motamadeya Bridge (Cairo Ring Road)

- Details :
  - Using the pressure washer, we cleaned the rubber bearings for the El Motamadeya Bridge on the Cairo Ring Road. The effort demonstrated pressure washers can effectively clean rubber bearings.
  - Pressure washers are considered most effective in cleaning steel bearings covered with salt-laden sand.
  - Pressure washers tend to consume modest amounts of water. In cases in which no water trucks are available, experience confirms that bucket brigades are sufficient to provide the water needed.

Picture 2-8 Accumulated dirt around a bridge bearing and cleaning with a pressure washer

2) Session 2

- Date : April 17, 2014
- Location : El Marg Bridge

- Details :

We removed dirt that had accumulated around the bearings of the abutments (pot bearing) of the El Marg Bridge, where we had performed a periodic inspection OST. From this experience, we learned the following:

- Removing dirt with a shovel in advance makes cleaning easier.
- Each bearing requires around 20 liters of water.
- Water can be supplied manually by a bucket brigade.
- The presence of a slope in front of the abutments allows transportation of the washing equipment to the site.
- Pressure washers can also be used to remove dirt from expansion joints.

(3) OST on repair method selection

1) Prior research

- Date : Tuesday, October 28, 2014
- Location : Box Culvert No. 4
- Details :

We demonstrated small-scale repairs at Box Culvert No. 4 on the Cairo Ring Road. While GARBLT had experience with repairs of two to three similar structures, the GARBLT engineers engaged in those repairs did not understand the specific factors causing the damage. We gave senior bridge engineers at the GARBLT headquarters OST on selecting repair methods.

2) OST on repair method selection

- Date : Sunday, November 2, 2014
- Location : Box Culvert No. 4
- Details :

(1) Objective

- To enable engineers to select suitable repair methods based on the actual factors causing the damage

(2) Detail

- Damage inspection: We performed an appearance check, hammering test, neutralization test, and concrete cover check to inspect the damage and degraded areas.

- Discussion of cause: We provided training on identifying the cause of damage through guided interactive discussions, based on the results of visual and detailed inspections. We determined that the damage was attributable to cracks formed during construction. These cracks resulted in rebar corrosion, which in turn enlarged the cracks and resulted in spalled concrete.
- Selecting the repair method: As we explained, the repair manual classifies this damage as “damage due to other causes”; in such cases, the damage is handled on a case by case basis.
- We explained that the degraded areas needed to be removed to inspect rebar corrosion and to determine the range of the intact rebars. Depending on the scale of the sectional concrete repairs, we also explained that the most cost-effective approach might include various different methods, including the plastering method, the grouting method, or shotcrete.

Picture 2-9 Box culvert where repair methods were demonstrated

(4) Construction control OST

- Date : Monday, November 3, 2014
- Location : Nabaruh Bridge (Al Mansoura)
- Details :

We provided construction control OST at a bridge under repair in a suburb of Al Mansoura. We also provided OST on selecting repair methods.

(1) Objective

To enable GARBLT engineers to effectively instruct repair contractors regarding what aspects to look for

(2) Details of OST

The bridge piers were being repaired by the jacket method. We pointed out that joining old concrete and new concrete required the complete removal of impurities from the joint. We confirmed that the engineers understood that existing concrete had to be inspected once again

and that cracks and the condition of the rebars had to be examined in detail. Given the emphasis on basic construction methods in prior sessions involving the selection of research and repair methods, we took this opportunity to provide training on construction control.

2.3.5 Achievements and issues

(1) Achievements

We held 13 WG meetings on bridge repair technologies. The bridge repair manual was compiled and used for OST on selecting repair methods. GARBLT engineers had previously undertaken numerous bridge repairs, during which the engineers applied their own discretion to select methods, since no repair manuals were available. The engineers were not accustomed to the practice of sharing experience with repairs. The completion of the bridge repair manual will establish some common criteria and help enhance repair quality.

The bridge repair manual encourages the selection of repair methods based on the type and extent of damage to each structure. Thanks to the OST on repair methods, GARBLT engineers are now in a position to select appropriate repair methods.

Construction control is key to ensuring quality control of repair works. GARBLT engineers now understand the importance of quality control. Thanks to the OST on construction control, they can now perform appropriate construction control of repair works.

The items of indicators on the PDM of this Project have been achieved as follows.

Items	Activities	Indicators	Means of Verification	Result
3-1	Develop Bridge Repair Manual/Guideline	Bridge inspection manual is developed.	Manual is developed in the Project.	Completed(*1)
3-2	Implement training of minor repair Implement trainings on selecting of repair methods and supervising contractors through GARBLT's works	Typical bridge repair technologies, such as minor repair, selecting of repair methods and supervising contractors are demonstrated on concrete bridges with Japanese experts.	Reports of training implementation.	Completed(*2)

(*1)

Repair Manual was prepared as developed guidelines.

(*2)

OST was held after deepening their understanding by introducing repair methods and explaining construction method selection, work procedures, etc. in WG, etc. Interviews were also held with local construction companies and consultants regarding the performance, construction methods, etc. in order to investigate the actual situation of local repair methods. The interview results were also reported to GRBLT engineers, and they were able to understand both the current repair methods and the latest repair methods that were introduced by Japanese specialists, which led to the improvement of their capabilities.

Results (time and date, place, participants, contents, etc.) of WG and OST were recorded as monthly reports. The repair records are entered in BMS after Japanese engineers reviewed them and saved as records.

2.4 Output-4: BMS Development

2.4.1 Development of bridge management system (BMS)

(1) Background

1) Bridge inventory

The bridge maintenance section of GARBLT HQ only maintains simple paper-based ledgers as the bridge inventory with basic information about bridge maintenance and management. In addition to the necessary information not being fully covered, as materials such as drawings and photographs are not attached, accurate bridge specifications have not been ascertained.

In addition, as the Cairo Ring Road, has been constructed by other organizations (such as the Ministry of Housing, Utilities and Urban Communities), whose materials and information (completion drawings, design calculation documents, etc.) concerning bridges under their jurisdiction for management have not been retained, the bridge specifications are unclear and it is difficult to perform appropriate maintenance and management.

2) Bridge inspections and maintenance work

With regard to inspections, since systematic bridge inspections have not been carried out and data has not been accumulated, changes in the soundness of bridges due to the passage of time has not been ascertained. For this reason, responses are undertaken on an ad-hoc basis, with field surveys only conducted once a bridge has suffered damage and the response measures considered thereafter. In this way, appropriate maintenance and management activities have not been carried out.

With regard to maintenance work, as the HQ bridge maintenance section has a shortage of engineers, maintenance and management services are contracted out to construction firms. As a result, it is difficult for engineers of the bridge maintenance section to keep abreast of the detailed status of bridges, to the extent that they can only confirm the true situation by personally visiting the site. Meanwhile, while local offices perform inspections on the level of patrols, as no records are kept and the only response is to report any abnormalities to the HQ bridge maintenance section, the current state of soundness of bridges are not monitored.

Generally speaking, in terms of the actual state of maintenance and management, as the current levels of bridge soundness and changes over time have not been monitored, the systems in place are far from the approach of preventative upkeep that would involve appropriate inspections and repairs aimed at extending the useful life of bridges.

3) Maintenance and repair

The bridge maintenance section does not carry out systematic management after evaluating and analyzing inspection results and assessing repair priorities; instead, the bridges which develop immediate problems are repaired on an ad hoc basis. These circumstances will lead to the useful life of existing bridges being shortened.

4) Towards establishing the desired management system

As illustrated above, in addition to performing appropriate bridge inspections, the development and operation of a BMS capable of recording and analyzing inspection results is desired. The BMS would need to have functions capable of performing numerical assessments, such as soundness levels and estimated repair costs based on bridge specifications and bridge inspection results.

(2) Activity policy and procedures

The objective of this project is to develop the infrastructure needed to carry out efficient bridge maintenance and management using the limit budget, human resources and equipment of GARBLT and enhance engineers' skills related to bridge maintenance and management by carrying out bridge maintenance and management in a systematic fashion. In developing a BMS, rather than simply developing the system and installing it at GARBLT, as well as incorporating the system into bridge inspection training, activities to link the system with the bridge maintenance and management cycle will be implemented.

(3) Flow of activities

Activities were implemented based on the following steps in accordance with the BMS development polices and details.

(a) BMS development

The content of development was wide-ranging and the development was divided into the following steps with the aim of enhancing establishment of the system through a development – testing – feedback cycle.

Table 2-18 List of Functions

STEP 1		
	1	Inputting of bridge specifications and inspection results
	2	Calculating current state of bridge soundness and estimated repair costs
STEP 2		
	3	Deterioration prediction function
	4	Priority assessment function

(b) Inputting inspection details

・Trial inputting by WG

・Input of specifications following field survey as part of bridge inspection

・Inputting of bridge inspection results (Routine/Condition Inspection)

(c) Training on operation and running

- Verification of functions through trial operation by WG
- Detailed explanation of operation with BMS personnel, along with classroom learning and practice on operation with awareness of BMS relevance in light of the bridge maintenance and management cycle

(4) Members associated with activities

The activities were primarily conducted by the WG. The members associated with the activities are given below.

Table 2-19 List of Members

Name	Role in the Project / Position
Mrs. Hala Helmy	Assistant Project Director / Head of Bridge Sector
Mr. Aly Elsafty Abdalla	Project Manager / Bridge Construction & Maintenance General Central Manager (Zone A)
Mr.Mohamed Emad	WG4 Leader (2012/02-2013/09) / Maintenance Engineer
Mr. Ahmed Mohamed Hassan	WG4 Leader (2013/10-2014/01) / Maintenance Engineer
Ms. Sara Mamdouh Mohamed	BMS Input Personnel / Support Engineer
Ms.Hanan Mohamed Gouda	BMS Input Personnel / Support Engineer
Mrs. Heba Moheeb Morsy	BMS Input Personnel / Support Engineer
Mrs. Faten Mohamed	BMS Input Personnel / Support Engineer
Mr.Mohamed Mostafa Ezz-Eldin	Inspection & BMS Personnel / Maintenance Engineer
Mr.Mohamed Mohsen	Inspection & BMS Personnel / Maintenance Engineer
Mr.Mohamed Ashry	Inspection & BMS Personnel / Maintenance Engineer
Mr.Ahmed Ateya	Inspection & BMS Personnel / Maintenance Engineer

2.4.2 BMS Development Step 1 (Inventory / Inspection Input)

(1) BMS basic design

(2) Creation of materials to translate technical terms on bridge information

As no unified terminology was being used to describe bridge types, components and materials, there were cases where the same components had multiple names. To prevent misunderstandings between personnel, common terminology was established and preparatory materials were created to translate the relevant names properly into Arabic.

(3) System format design

1) Survey of local office network

Working in parallel with development company survey work, internal consideration of the system format design was carried out. For this task, since defining the data processing methods was important to downstream processes, considerations focused on who would accumulate and obtain data, where, and in what way. These considerations did not only involve theoretical design work; interviews were conducted at GARBLT HQ, network bandwidth studies were conducted at DO (ASWAN regional office), and it was examined what kinds of data processing methods could be operated without changes to the current setup at GARBLT. As a result of the interviews and surveys performed, it was determined that the network environment had an extremely narrow bandwidth (less than a 30th of the bandwidth of a regular DSL connection from several years ago) and that no operational flow governing the exchange of information between GARBLT workers via the network had been established. For this reason, it was reasoned that at the present time, it would be difficult to introduce an operation where the inspection data from regional offices is delivered via the network. A system where data is only input at GARBLT HQ was therefore employed.

	Download	Upload
Test Site1	0.15Mbps	0.19Mbps
Test Site2	0.23Mbps	0.21Mbps
Test Site3	0.12Mbps	0.20Mbps

Figure 2-10 Speed Measurement Examples

(Screenshot of the Actual Measurement Screen at the Aswan Office)

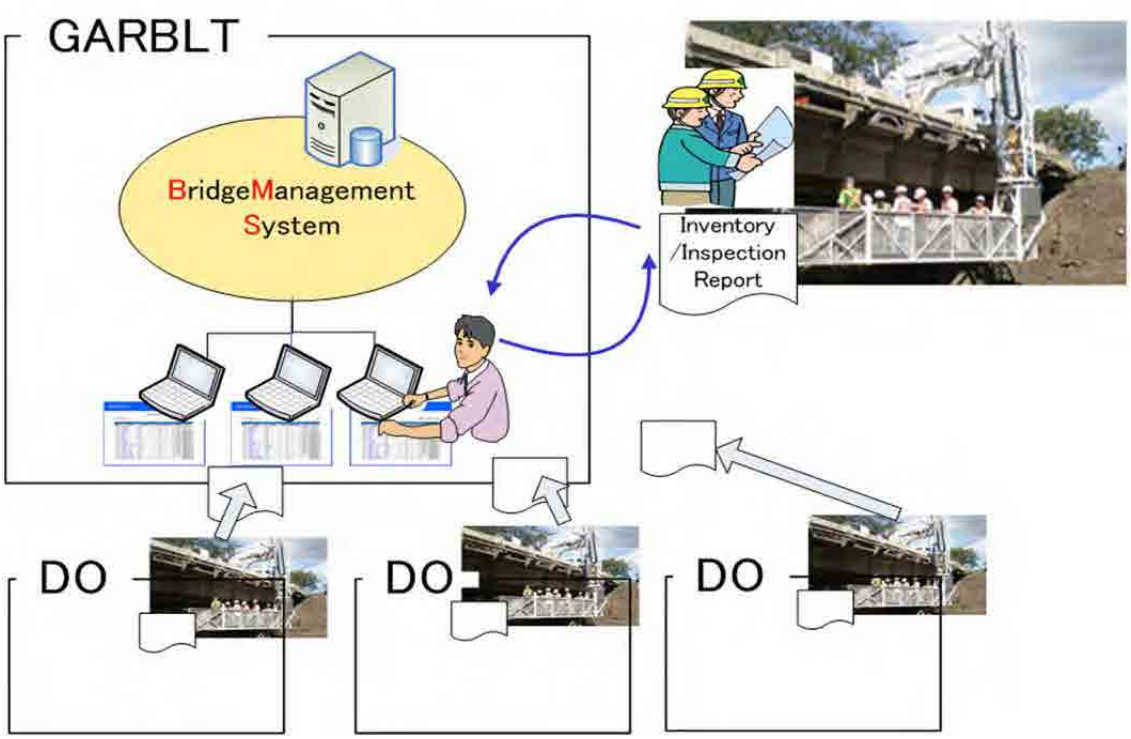


Figure 2-11 Data Input Flow

2) Data capacity

Among the bridge inspection results, inspection exercises were conducted with the policy of using as much photographic data as possible concerning the most important damage information. However, due to increases in the resolution of digital cameras, file sizes have increased year after year. The following table shows the amount of disk space required each year when storing JPEG files taking up around 6MB each.

Table 2-20 Estimated space taken up by photos

Per inspection			File capacity needed each year		
Number of photos taken	Individual file sizes (MB)	Space taken up by photos (MB)	Number of bridge inspections carried out each year	MB	GB
38	6	228	850	193,800	189

As server hard disks are relatively expensive, if a 1TB hard disk was used with remaining space of 750GB after excluding space taken up by the operating system and applications, the calculation shows that the hard disk would run out of space in just under four years. As it is assumed that the server would run out of capacity before five years had passed, a rough guide for hardware obsolescence, it was determined that some countermeasures would be required.

3) Installation of photo resizing engine and prediction of disk usage

As illustrated below, the NX Powerlite photo resizing engine, which is able to automatically compress the size of photo files without loss of quality, was installed on the server running the BMS. With this change, the system was given a service life of 16 years, far longer than the period of hardware obsolescence.

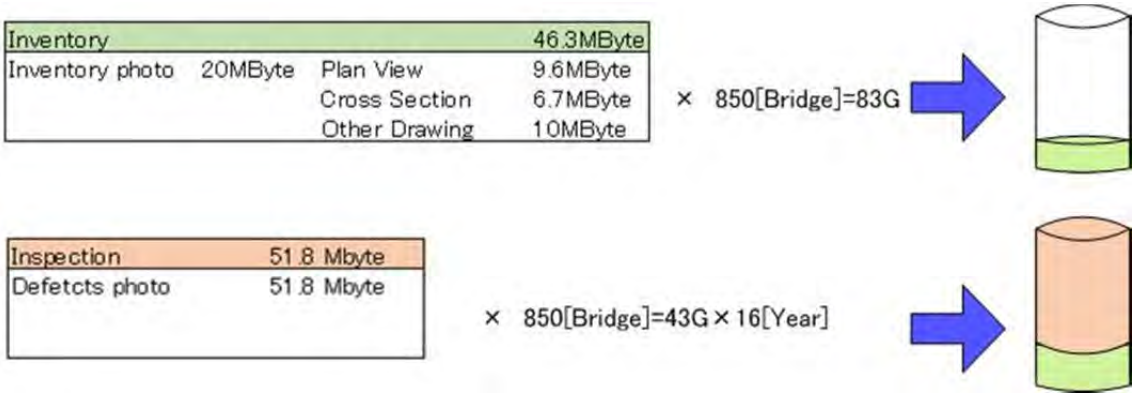


Figure 2-12 Image of disk space usage

(4) BMS development subcontractor selection

1) Investigation of development companies

For this project, considering the need for maintenance and establishment following BMS installation, it was decided that BMS development would be outsourced to a local development company. For the selection of candidate companies, a wide range of methods were employed, including the identification of development companies based on job recruitment sites using the elemental technologies to be used in the development as search criteria.

2) Development company selection and RFP release

To ascertain the actual states of the candidate companies, all of the candidate companies were visited to conduct interviews. This made it possible to eliminate paper companies and temporary staffing type companies that largely did business by contracting developers on an hourly basis. As a result, the companies able to carry out a comprehensive project were selected as candidates.

3) Determination of BMS development subcontractor

The development company was determined by conducting evaluations based on development quotations and technical proposal documents. A request for proposal (RFP) was created and distributed in advance. To eliminate misunderstandings regarding the details of the RFP on the part of the recipient companies as much as possible and to ensure that proposal assessments would be submitted smoothly, the companies were visited again to deliver explanations. The following technical proposal assessment items were used to determine the development company.

Table 2-21 Table of Technical Proposal Assessment Items

Category	Assessment Item	Assessment Perspective	Score	Remarks
Functional Aspects	Functional requirements	The ability to handle all 11 functions defined in the RFP.	4	Minimum requirements
		Validity of handling of each function	1	Items explained in the RFP
		Assessment of detailed descriptions of each function	2	Descriptions that do not contain logical contradictions
		Innovation in achieving the functions	3	Creativity, vision, and superiority
	Non-functional requirements	Understanding of non-functional requirements	4	Minimum requirements
		Assessment of detailed descriptions of non-functional requirements	3	Descriptions that do not contain logical contradictions
		Innovation in achieving the functions	3	Creativity, vision, and superiority
Project Management	Structure	Validity of overall number assigned to the project	3	Minimum requirements
		Validity of proportion of staff assigned to each role	4	Appropriate assignment of human resources
		Innovation in structure development	3	Does the company display ingenuity in project execution?
	Schedule	Validity of overall schedule	5	Check understanding of processes
		Assessment of descriptions of each of the schedule details	3	Check descriptions of essential points for each process
		Innovation in schedule management	2	Creativity, vision, and superiority
Track Record	Track record	Track record with a similar project	2	Based on actual conditions in Egypt, it is assumed that only several similar projects have been implemented.
		Track record with projects that are not similar but which share elemental technologies	1	Based on actual conditions in Egypt, points are also assigned for past projects that share elemental technologies
		Track record with projects that are not similar and do not share the same elemental technologies	0	Types of projects that are only listed are not assessed

(7) Selection of system configuration

1) Selection criteria

For the BMS to be built at GARBLT, a system that can be continuously operated with minimal burden on maintenance and management onsite is required. As the system will be based at GARBLT, the following requirements were defined.

- Multiple users are able to register data at the same time
- No additional costs (changing operating systems, etc.) are incurred when clients move between different operating systems
- The data registered by each user can be searched without performing a separate process to integrate the data
- Bridge soundness calculations, construction cost calculations and prediction assessments can be performed without relying on the PC specifications of each client (user)

The following system configuration was adopted as a configuration that meets these requirements.

Table 2-22 System Configuration (Proposed)

Item	Value	Remarks
System type	Web system	Special installation on clients is not required Improvement costs are not required even when switching to different operating systems
OS	Windows 2012 Server	As there are no IT-related engineers in GARBLT, Windows Server was adopted because it can be operated at the same level as a regular operating system
Database	Oracle12c	Open source software carries the risk of unforeseen changes to specifications and version issues may occur when switching systems in the future. As paid database software guarantees backwards compatibility, it is appropriate for long-term operation

2) Consideration of installation location

While a server-type system was selected due to the considerations outlined above, as a result of considerations concerning the installation location, the decision was made to install the system inside the GARBLT HQ building.

Table 2-23 Comparison of Systems

Assessment Item	Cloud	Installation in HQ Building
Cost	High	Low
Required network infrastructure	Users need to have a certain WAN (Internet environment) connection.	The system can be operated over LAN only. (WAN is also required if interoperation with branch offices is envisaged)
Required operational skills	Low	High

From the above table, in terms of cost, GARBLT's Internet network comprises a single and independent DSL router installed for each two to three office rooms, which are used under contracts with telecom carriers. However, the DSL usage charges are often paid late, and interruptions to Internet service taken as a punitive measure are extremely frequent. It was therefore determined that it would not be possible to use the Internet for the work. In addition, as the collection of DSL connection payments is not working well, the method of collecting monthly usage charges for a cloud service, which would require more operational costs, is not realistic.

On the other hand, if the system is installed inside the HQ building, both initial investment and running costs can be minimized. Regarding the unique operational skills required, the aversion to operation by a dedicated engineer in the case of a cloud-based system is a problem, but by adopting Windows OS, which was selected above and is relatively simple to manage, and by automating all periodic processing, the system configuration does not require administrative tasks to be performed. It should also be noted that with regard to configuration requirements defined above, the following requirements were added due to the installation location being fixed.

Table 2-24 System Configuration (Additional Requirement)

Item	Value	Remarks
Server	Tower Server	GARBLT does not have a space such as a machine room which is appropriate for installing a server. Therefore, a tower server which can be installed in general purpose space such as a bookshelf was adopted.

3) Server requirements

In line with the system configuration fixed as above, the following configuration table was created and the procurement of server equipment and software was implemented.

Table 2-25 Server Configuration Table

CPU	Xeon E3-1220V2 or faster (must meet the platform requirements for installation of Oracle SE One)
Memory	8GB or greater
Disk	1 TB or greater
Optical Drive	Able to read DVDs
Monitor	LCD display (19-inch LCD)
OS	Windows 2012 Server Standard (CAL around 5 with remote connection)
Database	Oracle 12c Standard Edition One 64-bit Named User License (16 User)
Web Server	IIS
Application Server	PHP
Anti-virus	Software compatible with the server OS must be installed.

(7) BMS development

1) List of functions

As shown in the following table, development was split into Step 1 and Step 2. At the point Step 1 was completed, the system was released to GARBLT and input was started.

Also note that during development, the benefits or two-stage development for utilized so that even after the completion of Step 1 development, whenever test input or actual inspection input was carried out, interviews for feedback and requests could be held to actively incorporate the points thought to be useful into the specifications. In the following descriptions, items that correspond to such improvements are denoted and classified as “incorporated into specifications following release.”

Table 2-26 List of Developed Functions

	Function Name	Details	Remarks
1	Registration of specifications	Registers basic specifications, superstructure information, substructure information, photos of current state and general drawings	Step 1
2	Bridge specification form output	Generates a specification form indicating the current state of a bridge. Form includes photos and drawings.	Step 1
3	Registration of bridge inspection information	Registers bridge inspection information. Photos of damage and drawings of damage can be registered.	Step 1
4	Bridge inspection form output	Generates an inspection forms. Form includes drawings and photos.	Step 1
5	Master maintenance	Edits the master used by the system.	Step 1
6	User maintenance	Edits the users that utilize the system.	Step 1
7	Search function	1~6 search functions (including CSV output)	Step 1
8	Soundness calculation	Calculates the level of soundness based on damage information obtained from the registration of bridge inspection information.	Step 1
9	Repair cost estimation	Calculates estimated construction costs based on the level of soundness of a bridge.	Step 1
10	Importance calculation	Calculates importance level based on the important specifications of a bridge.	Step 2
11	Priority calculation	Calculates the priority for repairs of a bridge based on soundness and importance values.	Step 2
12	Calculation of deterioration predictions	Calculates predictions of deterioration using deterioration of a bridge over time as the key.	Step 2
13	Search function	Search functions 8-12 (including CSV output)	Step 2

2) Essential points of development

While development of the BMS was implemented so as to fully cover the functions described in the above table, the points that were given particular attention during development and points that were optimized on-site based on feedback from test operation are given below.

(a) Multilingual support

Assuming the use of Arabic as the national language of Egypt and English as its second language, a mechanism for dynamic switching was adopted so that the system could be used in both languages. In terms of the specific process, a language attribute was set up as one of the login user attributes. The language to display is determined at the time of login and the screen is displayed in the appropriate language for the user. In addition, since Arabic text is displayed from right to left, a function to switch the system screen layout and switch the placement of each element on the input screen from left to right was incorporated to produce a system that did not produce discomfort even when used in Arabic.

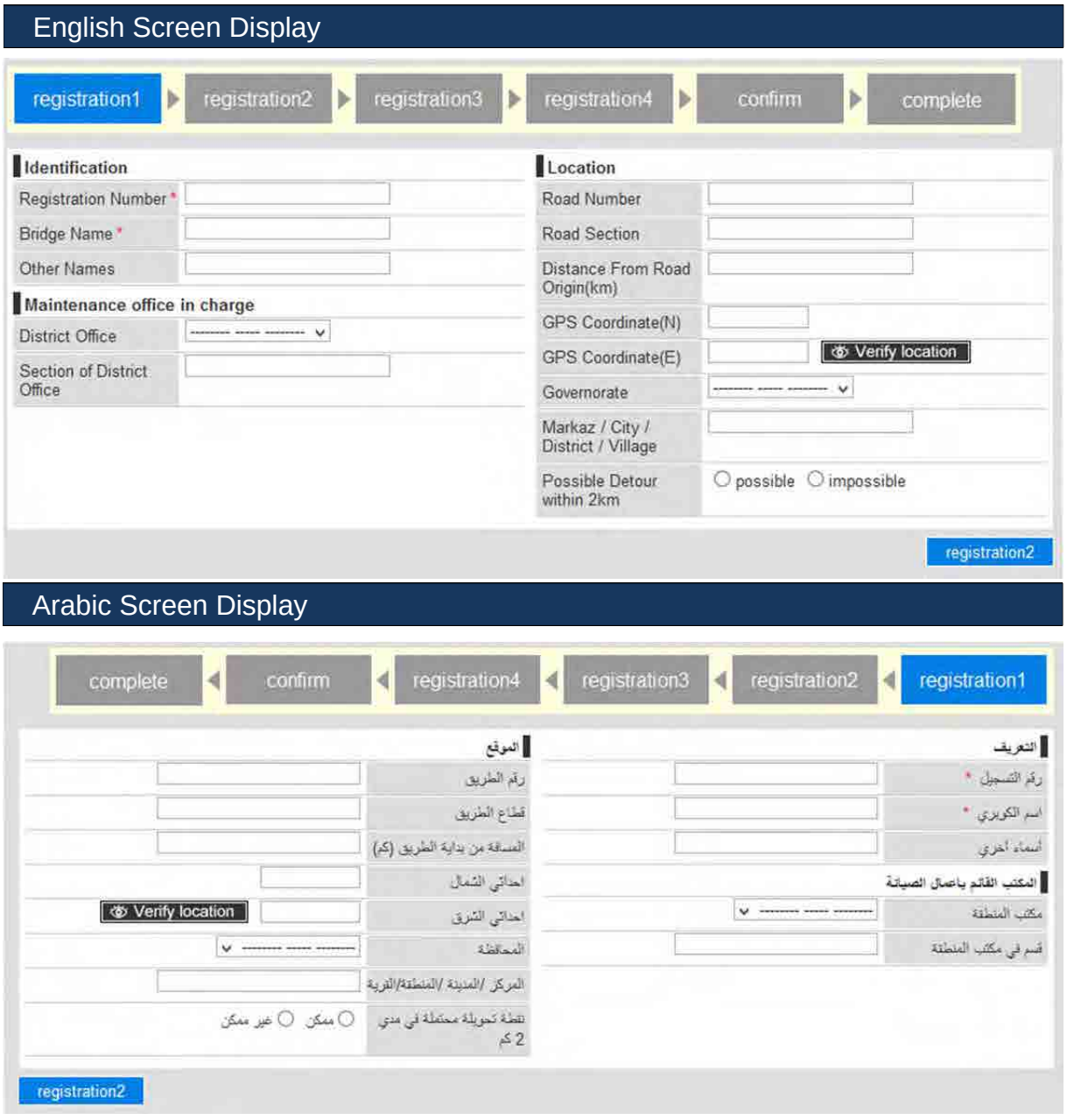


Figure 2-13 Display for Multi-Languages

(b) Map display function based on GPS positional information

As GARBLT lacks a system for accurately identifying the position of bridges such as road distance posts, it was determined that an alternate approach was needed. It was therefore decided to register the GPS positional information measured during bridge inspections to the BMS.

As it is possible to choose between multiple coordinate formats on handheld GPS devices, to prevent erroneous recording a unified format was prescribed and a function was also set up to instantly display the longitude and latitude values to be registered on a map for confirmation.

Figure 2-14 Image of Bridge Positional Information Verification

(c) Support for entry of superstructure and substructure information

In the entry of bridge specifications, for multi span bridges cases in which a large volume of superstructure and substructure information would be entered were envisaged. Efforts were made to shorten input times by developing a useful copying feature for cases when a bridge has the same specifications in terms of structure, span length and so on.

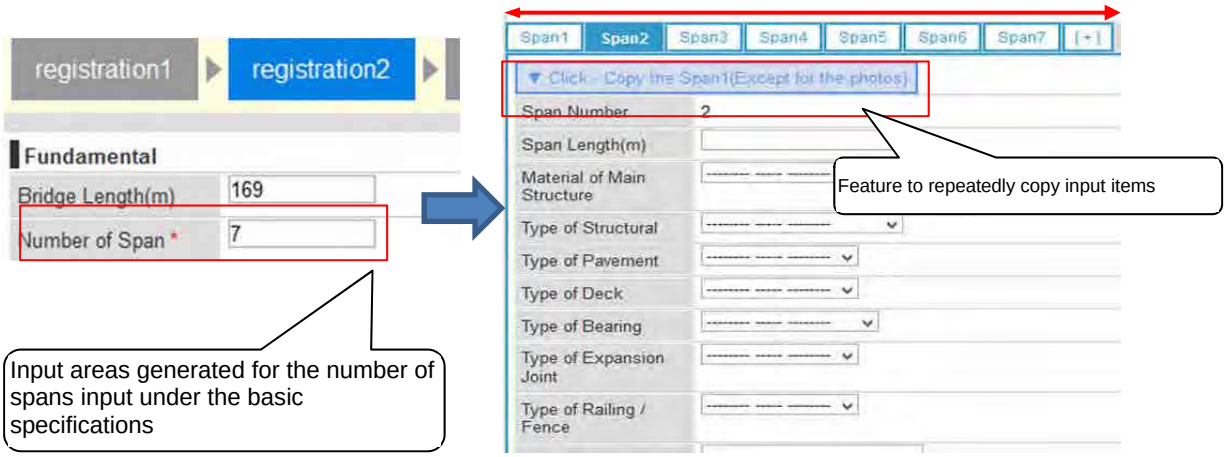


Figure 2-15 Image of Input Support

(d) Enhanced settings menu feature

Even with normal systems, it is rare for all of the functions offered to be configurable on the system screen, and there are some settings that are impossible to modify without making changes to settings files that only system engineers know about. However, since this project required development from the perspectives of on-site optimization and encouraging standalone operation on the part of GARBLT, all features offered by the system were made completely configurable via a setting menu screen.

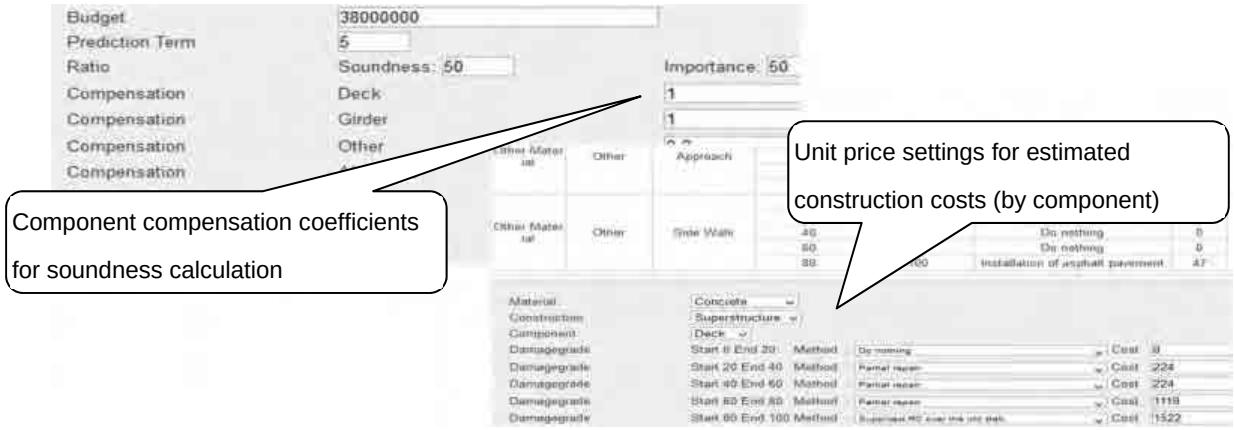


Figure 2-16 Setting Screens

(e) Registration and search functions for safety-oriented information

Degree of soundness is an indicator of the structural soundness of a bridge. Importance level is an indicator for assessment of priority which is adjusted based on the surrounding environment and role of the bridge in question. However, since it is assumed that even if a component does not affect the bridge structure it may have a significant impact on human lives, it is believe that there are many cases where early repair is preferable.

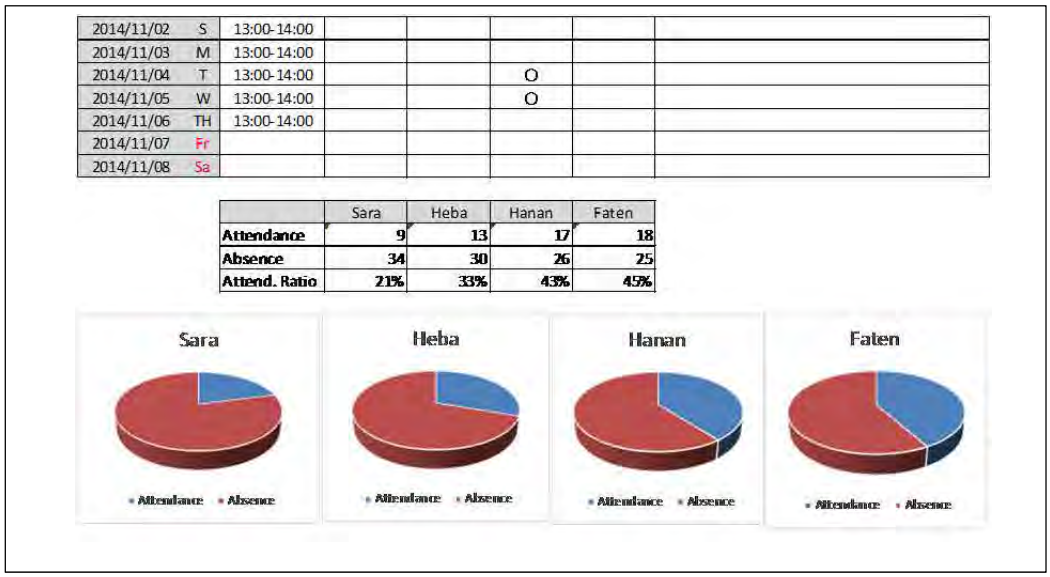
For this reason, separate from the assessment of components related to the soundness of a bridge, it was made possible to search for entries with an “Urgent” mark, denoting damage requiring urgent handling.

Figure 2-17 Screen with Urgent Indicator

(f) Complete interoperation with inspection forms –incorporated into specifications following release

When the system was initially released, an input method assuming that only damaged components (components with damaging ratings other than “Good”) would be registered to the BMS, but there was a request from GARBLT to register everything, including the soundness of all spans and all components.

However, in terms of actual conditions, it was determined that personnel necessary for the volume of input work involved could not be assigned. Specifically, with respect to BMS inputting, while it was preferable that certain core hours be set aside for input work even if not to the extent of personnel inputting data full time, in the case of GARBLT it was a question of whether around 10% of the working hours in a day could be assigned to the task of inputting, and as to whether personnel could actually engage in that work, the time spent range from 20% to a high of 45%, with no time at all assigned to the task on more than half of days.



2014/11/02	S	13:00-14:00					
2014/11/03	M	13:00-14:00					
2014/11/04	T	13:00-14:00			O		
2014/11/05	W	13:00-14:00			O		
2014/11/06	TH	13:00-14:00					
2014/11/07	Fr						
2014/11/08	Sa						

	Sara	Heba	Hanan	Faten
Attendance	9	13	17	18
Absence	34	30	26	25
Attend. Ratio	21%	33%	43%	45%

Figure 2-18 BMS Team Utilization Rates

Due to the above circumstances, there are inherent problems recognizing the importance of BMS operation and in the management of personnel at GARBLT. As for the BMS, the following improvements were made to reduce the workload by as much as possible.

Entry screen at the time of initial release

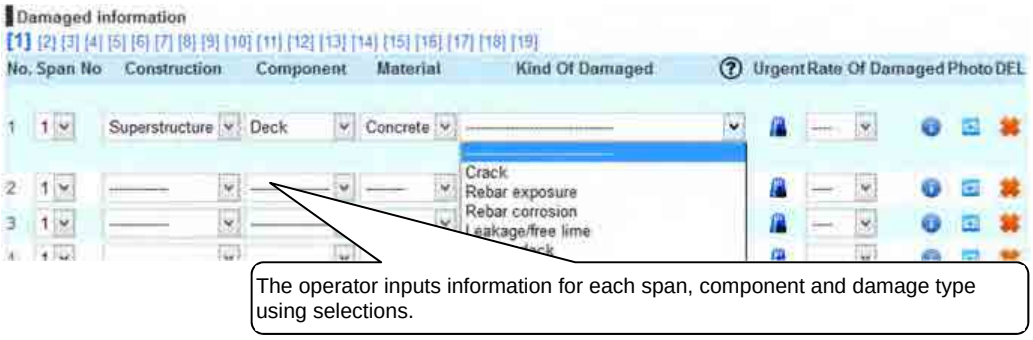


Figure 2-19 Image of User Selection System

Input Screen after Improvements

As shown in the input screen and inspection form in the following figure, at the time the initial input screen is opened, the same construction type, components, materials and damage types are provided on the input screen, significantly improving the issue of workload for operators.

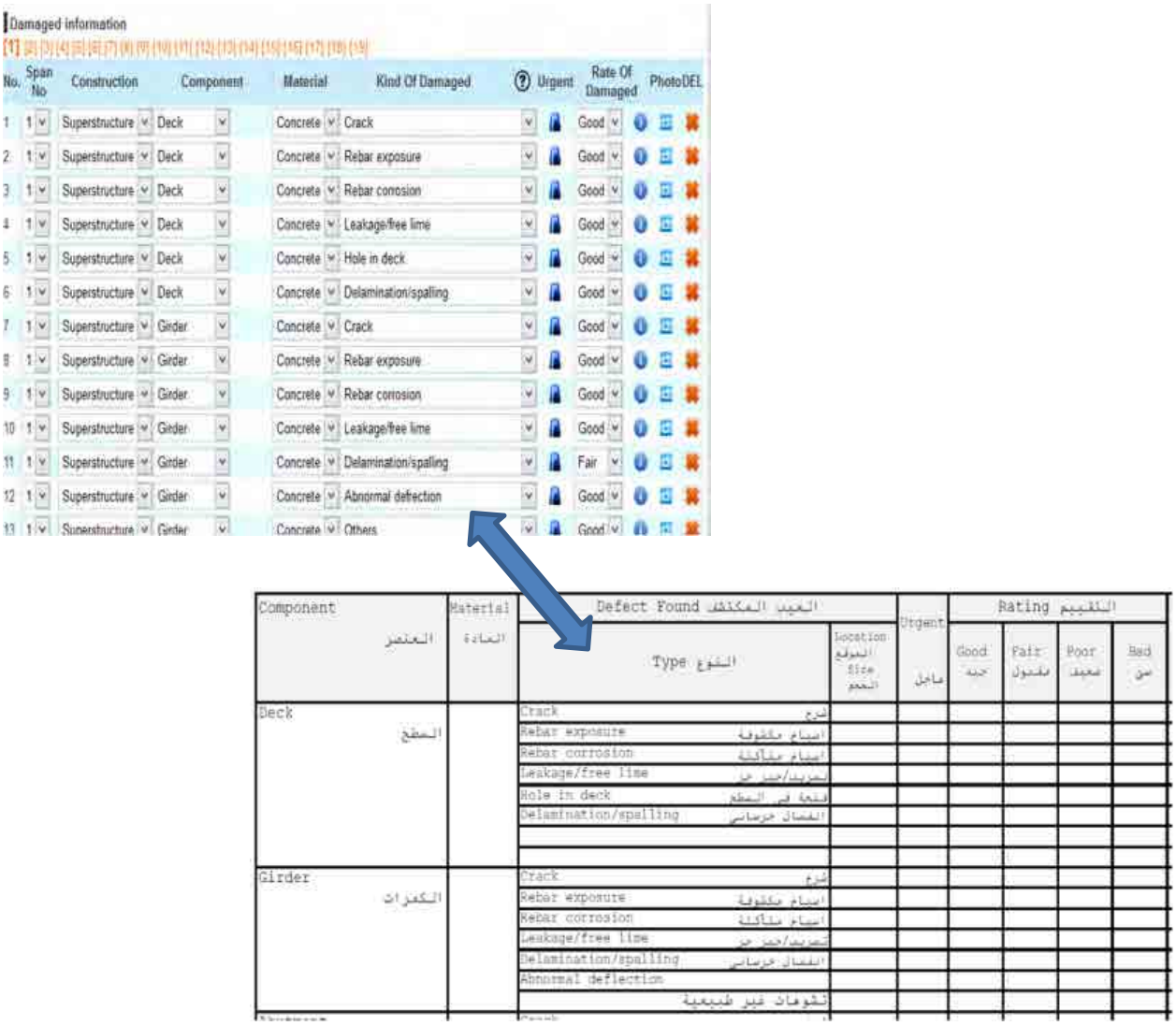


Figure 2-20 Image of Automatically Populating Fields with Representative Damage Types

(g) Optimization focused on roadside environment and regional differences – incorporated into specifications following release

With the system was first released, it was assumed that the items set by GARBLT HQ regarding component compensation coefficients for soundness calculation and repair unit prices for estimated construction cost calculations would be used for bridges nationwide, but there was a request from GARBLT to configure values considering regional differences on a per category basis, divided by four jurisdictional areas.

Therefore, in anticipation of areas being restructured in the future, the configuration of the component compensation coefficient, repair unit price and deterioration curve was enabled on a per-office basis.

Table 2-27 DO-Area Association Table

	Area Name
1	Central
2	Canal and Sinai East Delta
3	Middle & West Delta
4	Upper Egypt

No	User Group	Area Name
1	GARBLT-Central-	Central
2	GARBLT-Canal and Sinai-	Canal and Sinai East Delta
3	GARBLT-East Delta-	Canal and Sinai East Delta
4	GARBLT-Middle Delta-	Middle & West Delta
5	GARBLT-West Delta-	Middle & West Delta
6	GARBLT-6th Zone-	Central
7	GARBLT-7th Zone-	Upper Egypt
8	GARBLT-8th Zone-	Upper Egypt
9	GARBLT-9th Zone-	Upper Egypt
10	GARBLT-10th Zone-	Upper Egypt
11	GARBLT-11th Zone-	Canal and Sinai East Delta
12	GARBLT-12th Zone-	Upper Egypt
13	GARBLT-13th Zone-	Middle & West Delta
14	GARBLT-14th Zone-	Central
15	GARBLT-Suez Branch-	Canal and Sinai East Delta

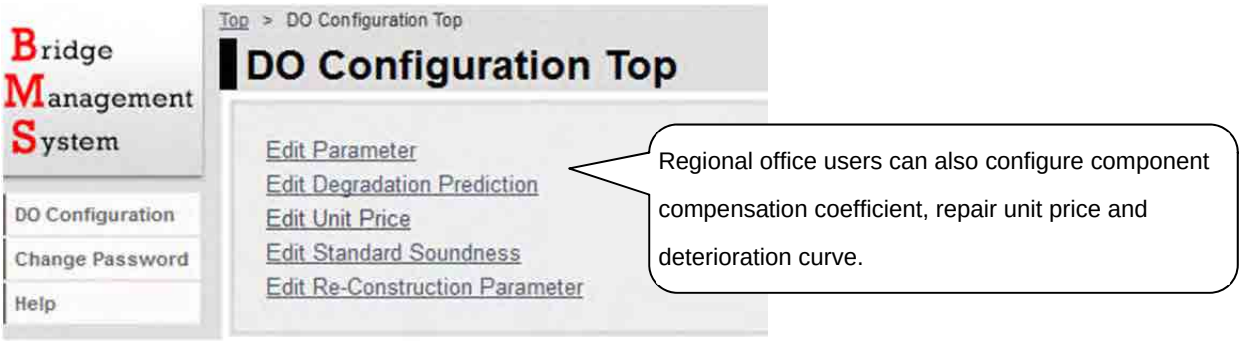


Figure 2-21 DO User Configuration Screen

(h) Registration of repair history information linked to specifications and each span – incorporated into specifications following release

A request was received to develop a feature to register the history of repairs performed in the past based on repair working to the BMS. In terms of system handling, a repair overview that could be linked to the bridge as a whole was registered to the bridge specifications. For repair histories linked to spans, an area for registering repair history was set up on the bridge superstructure input screen. In addition, for management forms with separately defined repair histories, a feature for registering information as PDF files was developed by improving the photo and drawing registration feature for bridge specifications.

Registration to Bridge Specifications

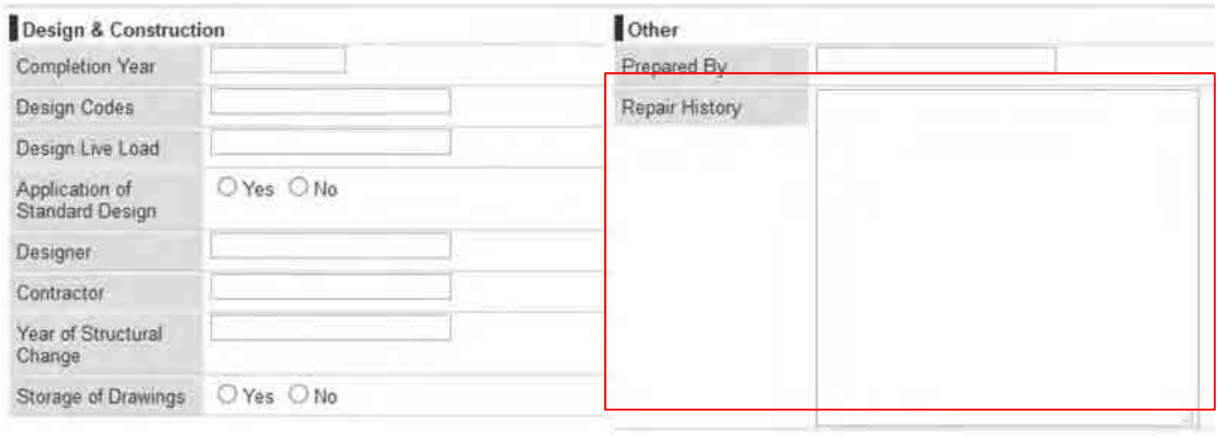


Figure 2-22 Repair Information Registration Screen

Registration to Superstructure Information

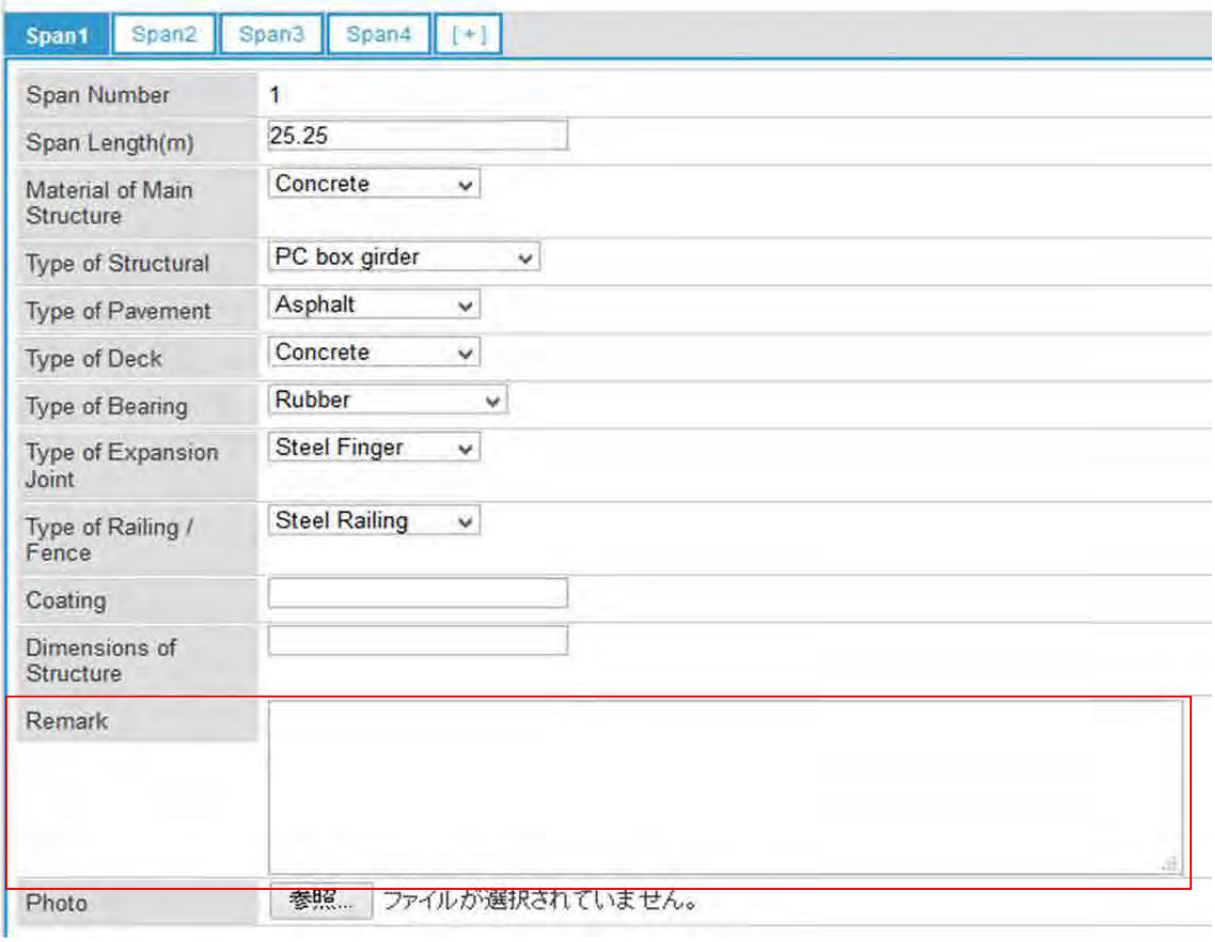


Figure 2-23 Repair Information Registration Screen 2

Registration of PDF Files in Drawing Information Section

Figure 2-24 Repair Information Registration Screen 3

(i) Assistance with functions based on computer literacy– incorporated into specifications following release

The BMS initially designed CSV output functions for soundness and estimated repair costs with the aim of creating materials for GARBLT to manage bridges. However, as a result of operational exercises conducted for GARBLT engineers, it was requested that the utilization of CSV files needed to be operated in a stepwise fashion and that the use of PDF-based printed materials was preferable for operation at the present time. Accordingly, a PDF output function was added to the exiting CSV output function in the output function area on the soundness list screen.

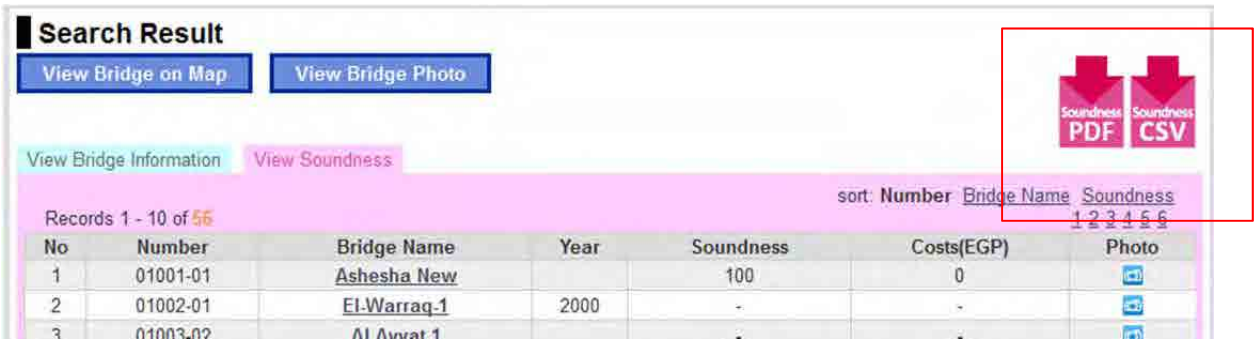


Figure 2-25 Soundness PDF Output Icon

(8) BMS Step 1 Manual Creation

Manual creation was implemented according to the following flow.

・Creation of draft manual

A draft version of the manual was created based on design documents for the developed system, the actual program and the minor improvements made following release.

Note that two editions of the manual were created, English and Arabic.

・Submission of draft manual

The created draft manual was submitted to TWG.

・Review of draft manual

In response to the TWG review, the manual was amended based on the review results.

・Screening and approval of draft manual

Following completion of the review by TWG, the draft manual was submitted to JCC, where it underwent screening and approval.

2.4.3 Inputting of bridge inspection results into the BMS

(1) List of registered bridges

The registration of bridge inspection results was carried out with respect to the following bridges, including 20 bridges targeted for inspection training. The registration work was performed by counterpart engineers, but registration was carried out to coincide with the following posting periods for the purposes of peer reviewing details and conducting training.

(a) Registrations over the period from May 2014 to June 2014

Table 2-28 Table of Registration Results

No.	Office	Bridge Name	Bridge Targeted for Inspection Training (20 bridges)
1	7th Zone	Deirout(old)	
2	Central	Ashesha New	○
3	7th Zone	Deirout	○
4	Middle Delta	Kafr El-Zayat Movable	○
5	8th Zone	Naga Hammady	○
6	EastDelta	Farskor	○
7	EastDelta	Aga Movable	○
8	EastDelta	Belbeis	○
9	7th Zone	Dairout Movable	
10	Central	Ashesha old	
11	14th Zone	El Marg	○
12	8th Zone	Sohag Bridge over railway	○
13	Central	Banha New	
14	Central	El Warrak	○

(b) Registrations over the period from August 2014 to November 2014

Table 2-29 Table of Registration Results

No.	Office	Bridge Name	Bridge Targeted for Inspection Training (20 bridges)
1	Middle Delta	Quesna	
2	Central	Al Ayyat	○
3	EastDelta	Abo Nabhan	○
4	14th Zone	Al Motamadeya	○
5	14th Zone	Masraf Al Mansuriyyah	○
6	13th Zone	Tawfigeya	
7	6th Zone	HassamWassef	
8	Central	Nekla Bridge	○
9	Central	Qaliub Old	○
10	Canal & Sinai	Nefisha	
11	14th Zone	Bashtil Canal	
12	West Delta	Intersection Br	○
13	8th Zone	Luxor Airport Bridge	
14	Canal and Sina	Wasfeya Old Bridge	
15	West Delta	Nobareya Canal Bridge	
16	14th Zone	Al-Salam bridge	○
17	7th Zone	Bani Hasseim Bridge	

(c) Registrations for the period ended February 2015

Table 2-30 Table of Registration Results

No.	Office	Bridge Name	Bridge Targeted for Inspection Training (20 bridges)
1	7th Zone	ElMinya	○
2	East Delta	El-Mansoura	○
3	Central	Dahshor	
4	Central	El robeiki-east side	

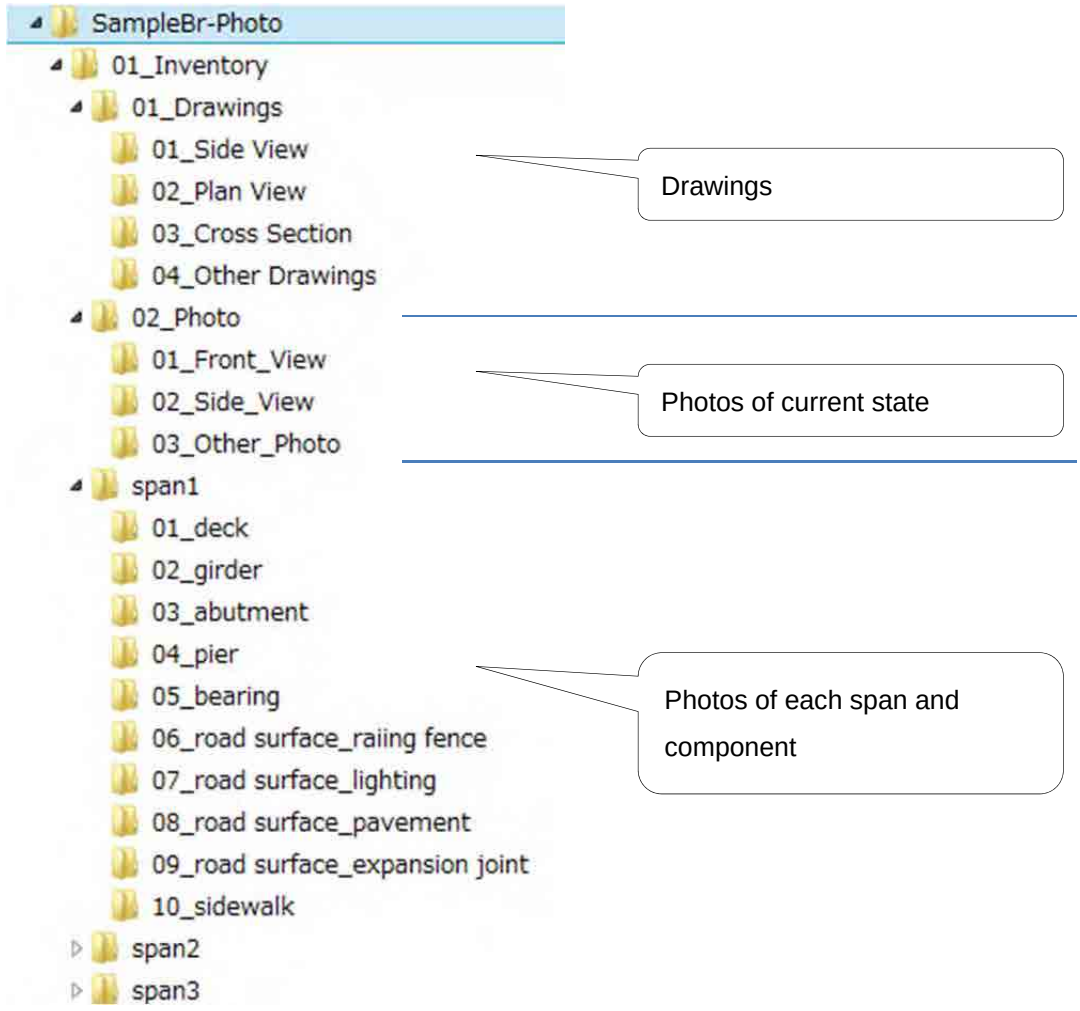
*Registration to BMS was continued after inspection and registration of 20 bridges, which were subjects for OST. The results are described in “2.4.7 Achievement Level of PDM Indicator.”

(2) Registration method

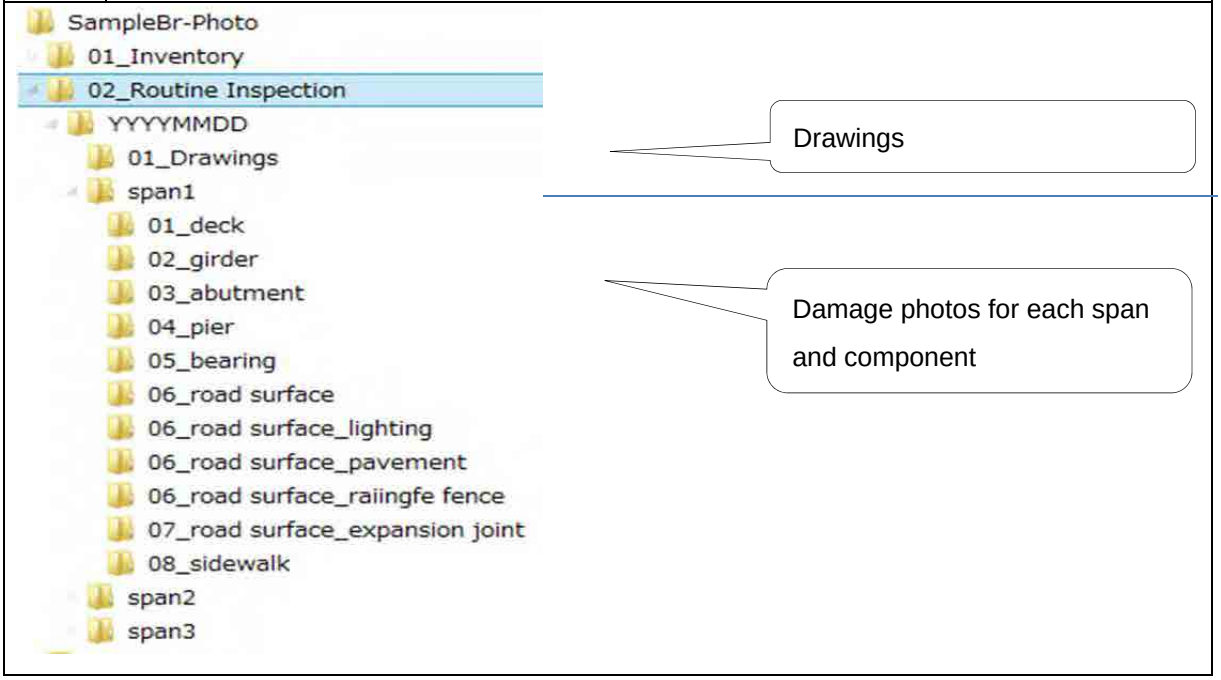
While the registration of inspection results mainly involves registering the details of inspection forms without modification, with respect to photos of current the current state of a bridge, photos of damage and damage drawings, in light of the fact that the person performing inspection and the person registering the information are different personnel, an environment that makes it easy to select relevant photos and drawings is required.

Given this, it was decided that the folder configuration shown in the following figure would be created for stored photos and scanned data of drawings.

1	Bridge Specifications



2	Routine Inspection



3	Condition Inspection

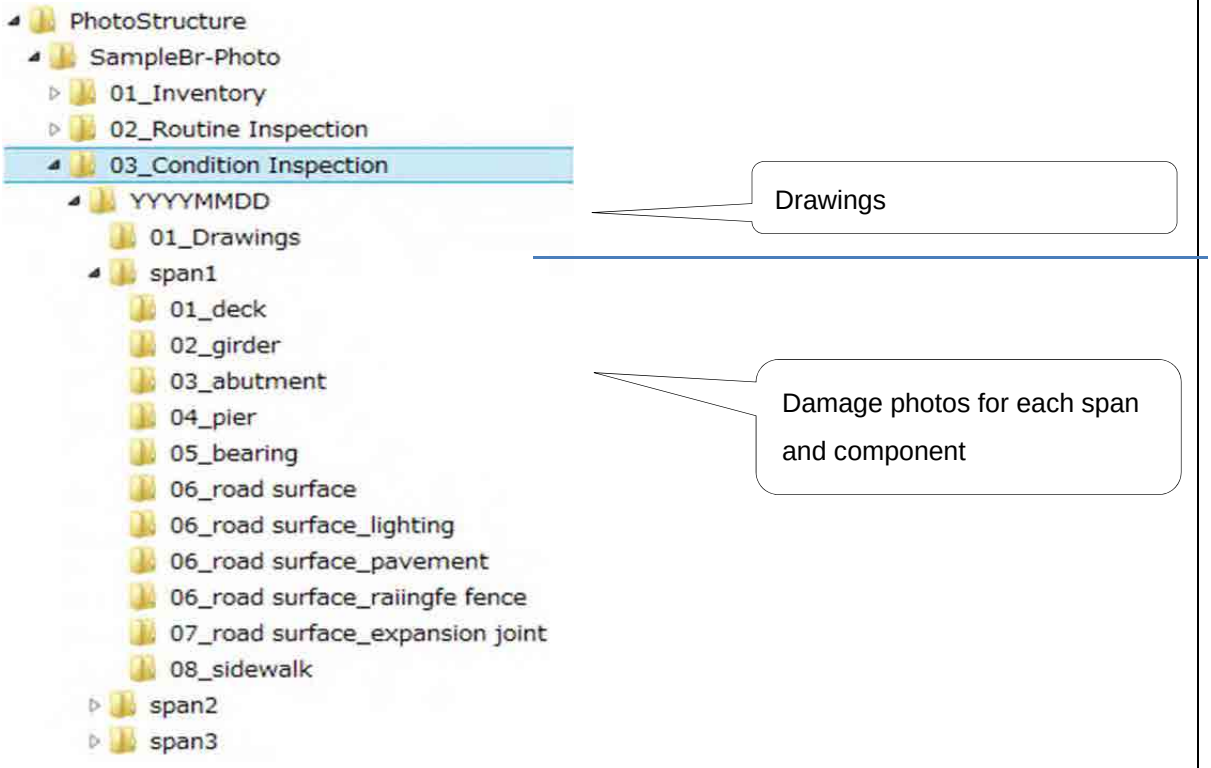


Figure 2-26 Folder Image

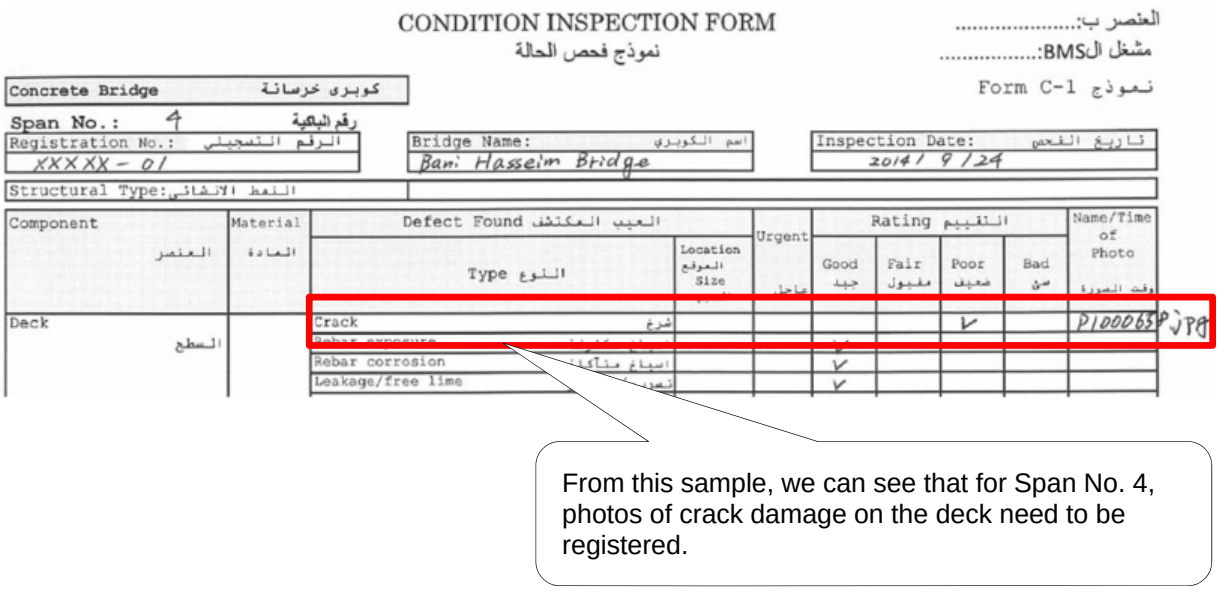


Figure 2-27 Sample Inspection Form

(3) Flow of registration confirmation

The registration of inspection results is carried out at GARBLT HQ. Regional offices copy the damage drawings and damage photos they have created to USB flash memory and deliver it to HQ. The inspection results are input into the BMS based on the received inspection result forms and contents of the USB flash memory, and based on the inspection survey forms and soundness/estimated construction cost materials output from the BMS, the results are reported to the bridge engineer with jurisdiction over the regional office, and receive their approval.

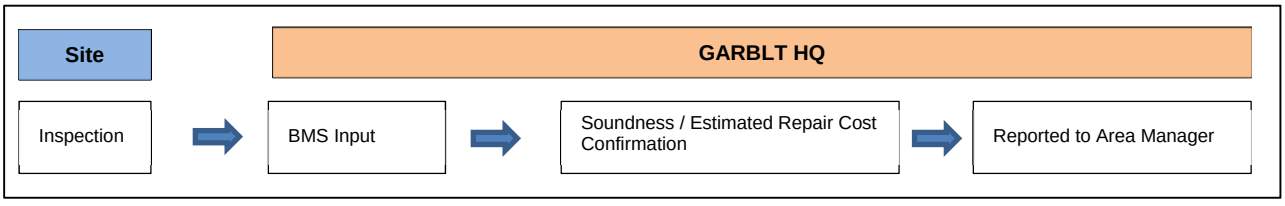


Figure 2-28 Flow of Registration Processing

2.4.4 BMS Development: Step 2 (damage rating/approximate repair cost/cost estimation)

1) List of functions

As the table below shows, the Step 2 development was carried out with regard to the analytical functions to be used after populating the data. The development of the Step 2 functions is aimed at helping to establish a method of managing road structures in a well-planned, efficient manner by regarding roads including bridges as assets, checking and evaluating the current conditions of road structures objectively to undertake the medium- and long-term prediction of the assets' conditions, and considering the optimal measures and optimal time for implementing the measures within the budget constraints.

Table 2-31 List of Developed Functions

	Name of Function	Description	Remarks
1	Registration of specifications	Registering the basic specifications of the bridge and information about its superstructure and substructure Registering pictures showing the current conditions and general drawings	Step 1
2	Output of bridge specification files	Generating specification files showing the current conditions of bridges These shall be files that include pictures and drawings.	Same as above
3	Registration of bridge inspection information	Registering bridge inspection information The registration of pictures and drawings showing damage shall be possible.	Same as above
4	Output of bridge inspection files	Generating inspection files These are files that include pictures and drawings.	Same as above
5	Master maintenance	Editing masters to use with the system	Same as above
6	User maintenance	Editing users of the system	Same as above
7	Search function	Search function for functions 1 to 6 above (including CSV output)	Same as above
8	Soundness calculation	Calculating soundness based on damage information obtained through the registration of bridge inspection information	Same as above
9	Repair cost calculation	Calculating the approximate repair cost based on the soundness	Same as above
10	Importance calculation	Calculating the importance based on the key specifications of the bridge	Step 2
11	Priority calculation	Calculating the priority for the repair of the bridge based on the values for soundness and importance	Same as above

12	Calculation of predicted degradation	Calculating the predicted degradation based on the aging degradation of bridges	Same as above
13	Search function	Search function for functions 8 to 12 above (including CSV output)	Same as above

2) Key Points of Development

The following sections describe some of the points of the Step 2 development, including points that were taken special note of and those in which local optimization was undertaken as a result of feedback from the trial operation.

(a) Review of the set values

- Importance of components

Among the functions created in Step 1, the importance of each of the components constituting each bridge was reviewed. Specifically, a review was conducted concerning setting correction factors for evaluating damage by clearly distinguishing between the components that have an impact on the soundness of a bridge itself, such as the girders and slabs, and those that do not.

- Setting the repair unit rate

It is desirable to set a unit repair rate that reflects the actual conditions in Egypt. A survey of the unit rate was conducted by studying case examples of bridge repair in the three areas of Egypt where the Expert Team received the information on the unite rate. The data obtained from the unit rate survey were studied in the following procedures. The received data from the unit rate survey do not cover all the components and do not focus on the level of repair required for each level of damage. Accordingly, case examples of repairs in Japan were studied separately, and survey data covering all components and individual levels of damage were created at the same time.

Once the creation of the unit rate of each component based on the received data was completed, a cross-check was carried out with the survey data of unit rates in Japan to study the appropriateness. Basically, the unit rates in Egypt were given priority in the survey. However, it was decided that data based on the unit rates in Egypt could be supplemented with data from within Japan where it was judged to be appropriate to do so.

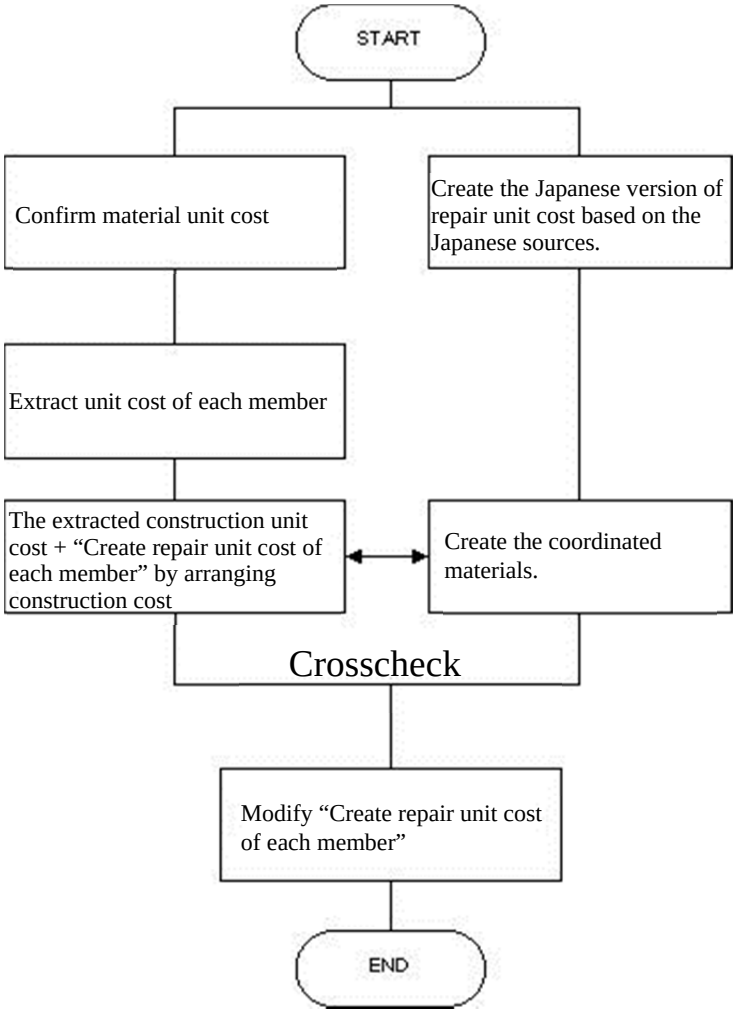


Figure 2-29 Flow of Study

(b) Degradation prediction settings and prediction function

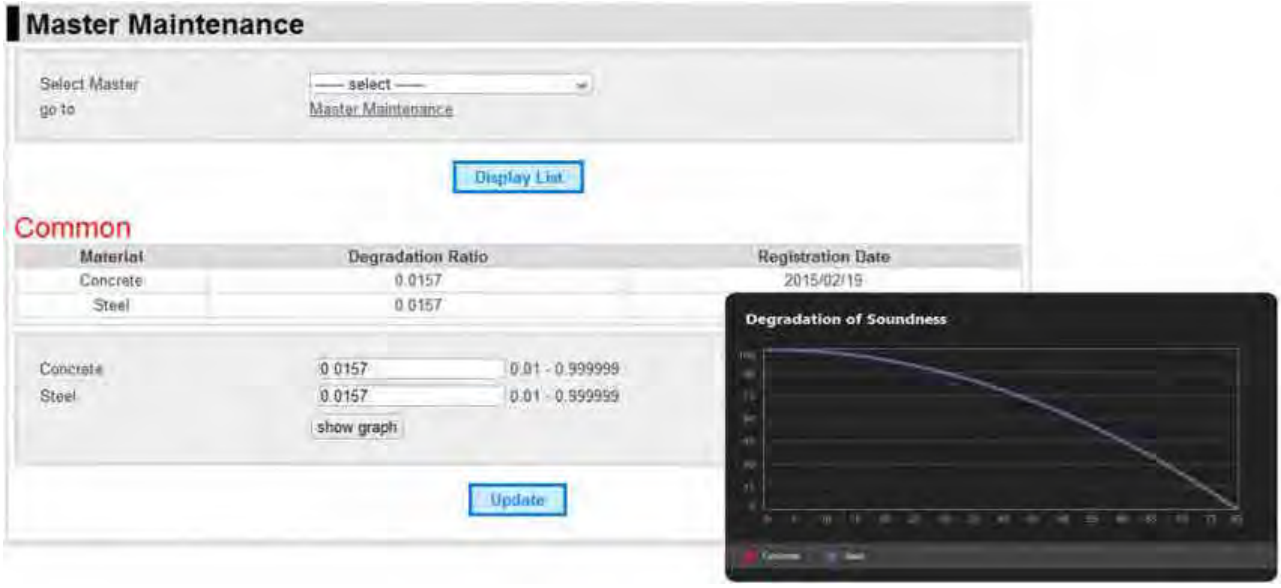


Figure 2-30 Degradation Prediction Setting Screen

With regard to the degradation prediction function, the degradation curve as the benchmark was indicated in the form of a quadratic curve. As for the parameters, it was made possible for the user to set them for concrete bridges and steel bridges, respectively, on the setup menu screen. The actual values to be set for starting the operation are to be based on consideration of the following.

As a general understanding of bridge age, a concrete bridge should desirably remain serviceable for a long period of preferably 100 years or more. Based on this, the service life of a bridge is assumed to be 100 years in many cases. However, this concept applies only to newly built bridges. Judging from the general conditions of existing bridges in Egypt, a bridge life span of 80 years has been set based on the results of the following two validations.

Validation 1: Age Distribution of Bridges in Egypt and Comparison with Estimated Ages of Bridges in Japan

Table 2-32 Egyptian Bridge Age Distribution (BMS)

Bridge Age Group	Count	Remarks
0 to 10 years old	5	2015
11 to 20	153	2005
21 to 30	204	1995
31 to 40	82	1985
41 to 50	272	1975
51 to 60	411	1965
61 to 70	40	1955
71 to 80	47	1945
81 to 90	2	1935
91 to 100	0	1925
101 or older	0	1915
Total	1216	

Table 2-33 Bridge Age Estimate Example in Japan (Concrete)

Construction Year			Average Life Span
1920	to	1930	60
1931	to	1940	60
1941	to	1950	60
1951	to	1960	60
1961	to	1970	70
1971	to	1980	100
1981	to	1990	100
1991	to	2000	100

- Of the 1,216 bridges registered in BMS, those with a relatively large amount of data are those constructed between 1965 and 1975.
- According to the statistics, the life span of bridges constructed between 1961 and 1980 is between 70 and 100 years.

Validation 2: Estimated Average Age of All the Bridges in Egypt

Based on the statistics in Japan, the simple average of the age of all the bridges under the jurisdiction of GARBLT is 82 years.

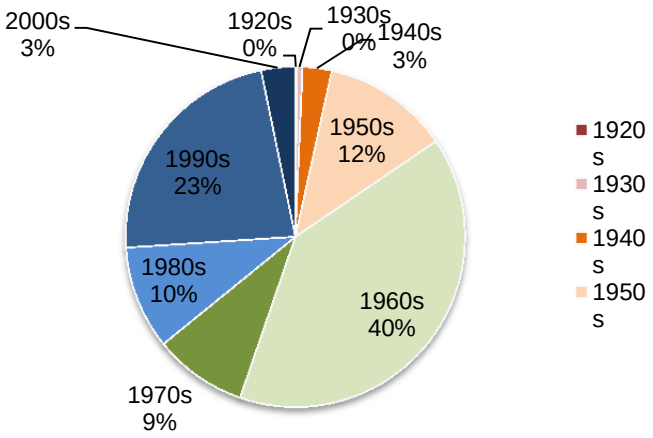


Figure 2-31 Breakdown by Year of Erection

Table 2-34 Number of Bridges of GARBLT by Year Opened

Year	Bridge Number	Life Span	Subtotal
1940	51	60	3,060
1950	205	60	12,300
1960	682	70	47,740
1970	153	100	15,300
1980	171	100	17,100
1990	392	100	39,200
2000	51	100	5,100
	1705		139,800

Arithmetic average = 139,810/1705 = 82

*Total number of bridges: 1,705 (including ones that have yet to be registered in BMS and whose specifications have yet to be checked)

Outline of the Functions

Reflecting the degradation prediction settings, information about the actual prediction results can be obtained in the form of a table such as the following. Fields for entering the years are created on the right, and the results of the calculation of approximate costs for the requested years are displayed on the screen.

Order	Bridge code	Bridge name	Office	Year of erection	Subject year		
					Soundness	Approximate repair cost	Method of construction

Figure 2-32 Example of Screen Showing Degradation Prediction Results

(c) Output for suggesting short-term repair plan -- Import of specifications after release

As a result of consultations and interviews with GARBLT, it was reported that GARBLT has never formulated, managed, or operated an annual budget plan. As the results of the preliminary survey show, bridges have been maintained in a completely ex post facto manner, and have been repaired using a special budget only when a problematic bridge has been found. Even when repairs of multiple bridges were deemed necessary, GARBLT did not formulate a repair plan based on an evaluation of priority for repair or other. This has revealed the necessity of providing operational training, starting from the initial stage of control.

Based on the above, it has been decided that support for commencing budget control will be provided by adding an output function for short-term repair plans that focuses on the selection of bridges that need to be repaired in each fiscal year, rather than simulations of medium- and long-term investment plans.

橋梁コード	橋梁名称	橋梁諸元	橋梁諸元2	橋梁諸元3	～割愛～	健全度	重要度	優先度ランク	補修金額
XXXX1-XX	AAA	○	○	○	○	0	10	1	2,090,736
XXXX2-XX	BBB	○	○	○	○	10	7	2	1,050,000
XXXX3-XX	CCC	○	○	○	○	20	5	3	1,737,405
					～				
99999-XX	CCC	○	○	○	○	100	0	1500	0

Bridges to be repaired can be selected by simply glancing at the soundness, importance, priority, and repair costs.

Figure 2-33 Image of Output for Short-term Repair Plans

2.4.5 Photo Management System (PMS) for BMS development

(1) Background

After the development and release of BMS, it was judged to be useful to install a subsystem for managing pictures (Photo Management System; PMS) as an extended function of BMS. Accordingly, PMS was implemented. PMS is effective for the following.

1) Effective use of location information of bridges

As described above, BMS is supposed to show the locations of bridges on a map based on information obtained with a hand-held GPS. Regarding this, it was judged to be desirable to enable BMS to display the locations of bridges on a single map to check the relative locations of multiple bridges for inspection plans, to undertake trend analyses of damaged components on an area-by-area basis, and for other purposes.

In addition, not only GPS but also digital cameras released in recent years are capable of embedding GPS positioning information in the image file as EXIF metadata. It is therefore desirable to make effective use of such location information embedded in photos, which is generally available from digital cameras and smartphones, for BMS as well.

2) Improvement of skills for judging the degree of damage

In Japan, training sessions for improving inspection skills are held by officers every year in many cases. In such sessions, people in charge of bridge management gather and are given opportunities to discuss the appropriateness of the inspections performed each year, for example by using a projector to share examples of damage found in the inspections and the rating given based on the inspection results.

An initiative such as the above is also required for this project. That is, the project should include an initiative for improving skills proactively after the end of the project, even in the absence of a Japanese expert. Specifically, it is deemed to be desirable to add a function that enables the necessary information to be obtained with an easy operation and allows the review of photos of damaged parts and their ratings in a user-friendly manner.

Reflecting the above, a subsystem (PMS) was developed with a focus on automatically importing the positioning information of photos and the visualization of search results on the map based on coordinate information.

(2) Functions

Table 2-35 List of Functions

	Name of Function	Description	Remarks
14	Coordinate import function	Importing to the system coordinate information contained in pictures of bridges' actual conditions and damage pictures	PMS
15	Bridge location correction function	Correcting location information using simple operations where the information imported using the function in 14 is more accurate than the pre-set location information	Same as above
16	Damage information search	A function for searching by type of work, component, material, or rating of each type of damage and the display of search results (including additional files) as thumbnail photos	Same as above
17	Displaying locations of multiple bridges and damage pictures on a map	Displaying searched bridges on a map and displaying the position of each damaged component of a single bridge	Same as above

(3) Image of the system

(a) GIS display

The locations of multiple bridges are displayed on a single map.

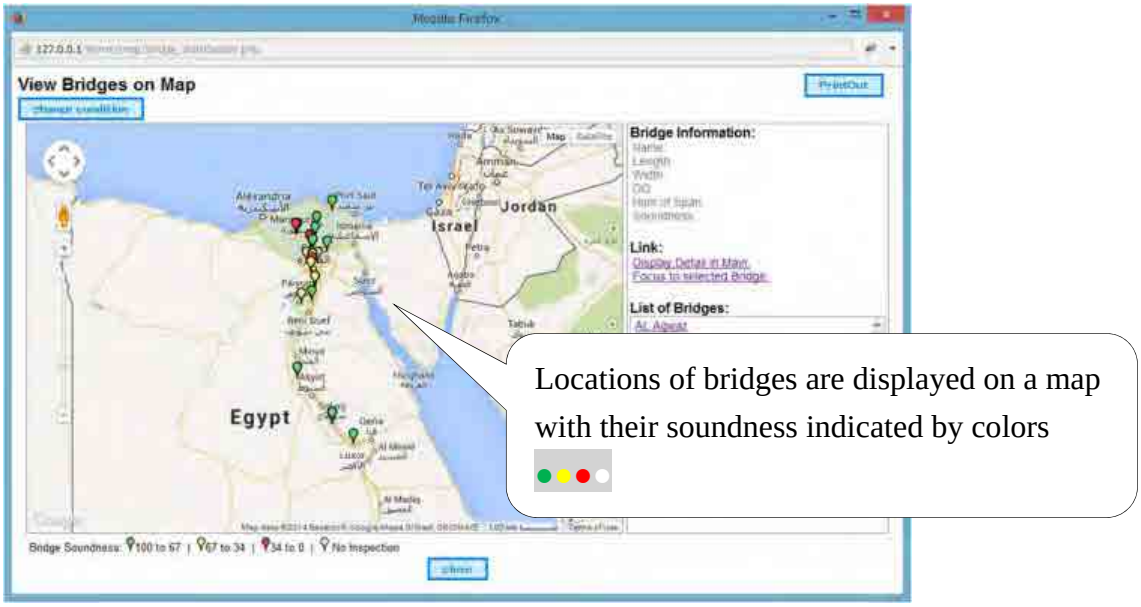


Figure 2-34 Map Showing Distribution of Bridges

Photos of multiple damaged parts of a single bridge are displayed.

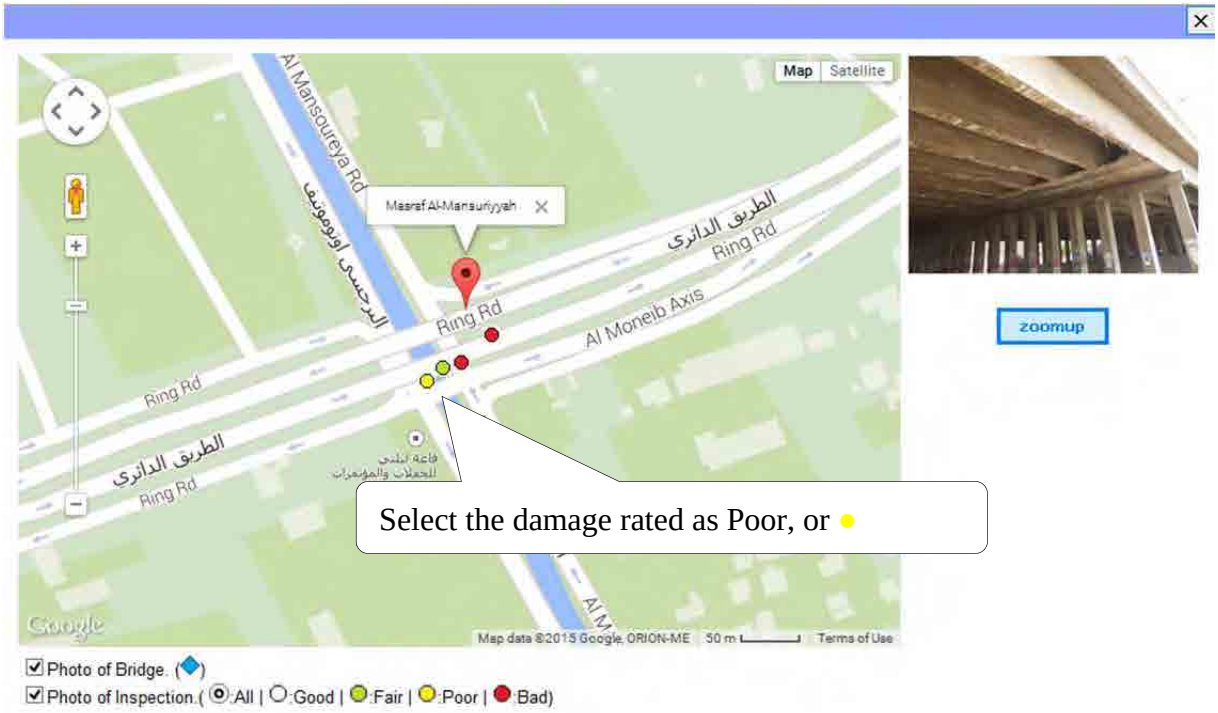


Figure 2-35 Image of Display of a Single Bridge (Showing Multiple Damaged Parts)

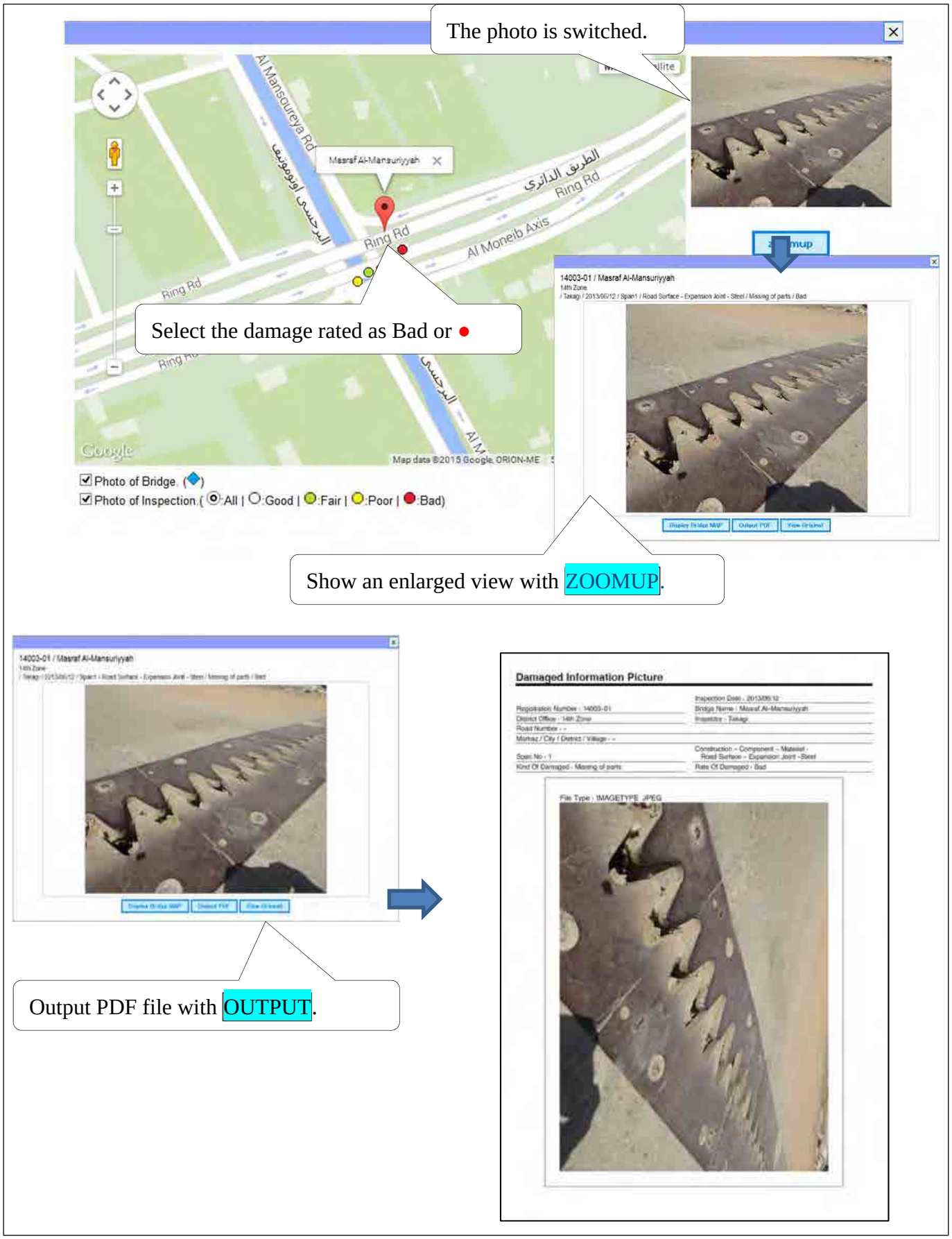


Figure 2-36 Image of Transition of Damage Information Screen

Search - Thumbnail display section

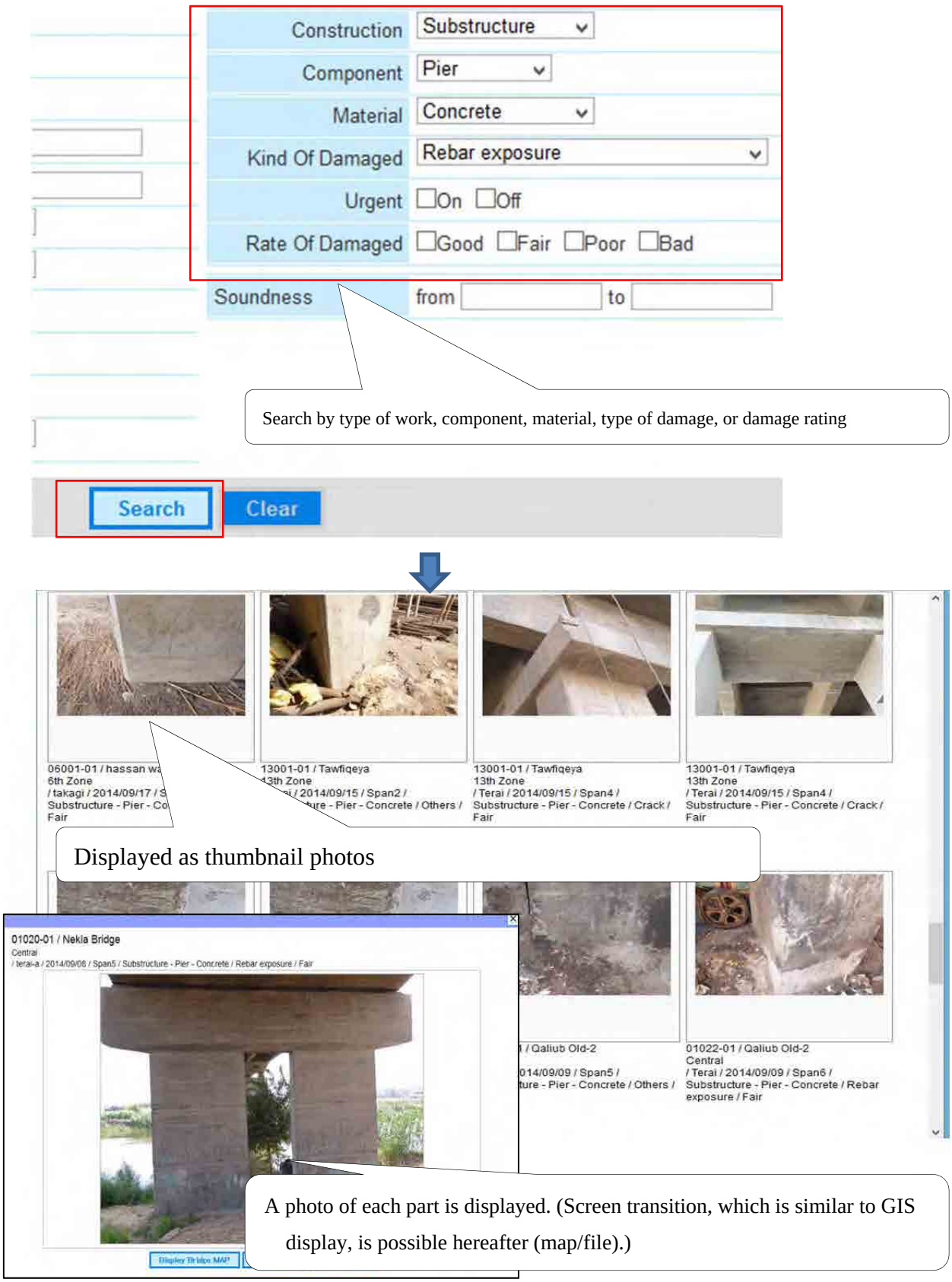


Figure 2-37 Image of search

2.4.6 Training on BMS Operation

Operation training and exercises were carried out with the aim of performing the effective operation of the functions in Step 1 and Step 2. The following exercise materials were created.

Table 2-36 List of Documents Created

Item	Document Name	Remarks
1	BMS Operation Manual Bridge Management System Manual Photo Management System in BMS Manual	English/Arabic
2	BMS operation materials for explanation	English
3	Bridge Management Guidelines	English
4	BMS Step 2 consideration materials (component correction factors, materials for consideration of construction costs)	English
5	Inspection survey sheets (results of bridge inspection)	English/Arabic

(1) Operation Training and Exercises for the BMS Team

Operation Style

A consultation was held with Mr. Aly Elsafty Abdalla, Project Manager, and it was decided that a LAN should be in place and operated in the BMS team's office next to the Project Office.

- Registration/operation in BMS is performed by the engineers appointed by Mr. Aly.
- Information about BMS shall not be disclosed to all the engineers, but only to those approved by Mr. Aly.

Detailed Exercises

Training on the system operation and exercises for operation in Step 1 and Step 2 were carried out based on the following schedule.

Table 2-37 List of Exercise Items

Step	Function	No	Detail	End of Training Date
1	Input inventory data	1	Inventory data	September 3, 2014
		2	Photo	September 3, 2014
		3	Drawings	September 3, 2014
	Inspection Result	4	Inspection data	September 3, 2014
		6	Defect Photo	August 26, 2014
		7	Drawings	August 26, 2014
		8	Changing	August 26, 2014
	Search	9	Bridge Inventory Information	September 16, 2014
		10	Bridge Inspection Information	September 10, 2014
		11	Bridge Soundness	September 10, 2014
	Output	12	Inventory	September 10, 2014
		13	Inspection	September 7, 2014
		14	Soundness	September 10, 2014
	Print Out	15		August 28, 2014
	Check Data	16	Inventory	September 11, 2014
		17	Inspection	September 11, 2014
		18	Soundness	September 11, 2014
2	Parameter Setting	19	Set Weighting Factor	September 4, 2014
		20	Set Unit price for repair	September 4, 2014
		21	Set about Prediction	September 4, 2014
		22	Set Typical Damage	September 11, 2014
	Run Evaluate Deterioration Prediction	23		September 11, 2014
	Explanation	24	Soundness	October 13, 2014
	Explanation	25	Repair Cost	October 23, 2014
	Explanation	26	Importance	October 23, 2014
	Explanation	27	Annual Budget	October 13, 2014
	Explanation	28	Deterioration curve	October 13, 2014
3	Photo Management System	29	Search and registration of photo	October 21, 2014

(2) Operation Training and Exercises for Four Newly Assigned GARBLT Engineers

Circumstances

The BMS team was dissolved by Mr. Aly Elsafty Abdalla, Project Manager. In response to the request that four newly employed engineers should be trained to learn all the details, the following exercises were carried out. In order to support the technology transfer from trained people to new engineers, a new video explaining the operation of BMS was created and distributed to prepare for the change of the persons in charge in the future.

Detailed Exercises

Training on the system operation and exercises for operation in Step 1 and Step 2 were carried out again, and a discussion was also held about the component correction factors, the unit price of construction costs, and predictions regarding deterioration by using materials No. 3 and 4.

Table 2-38 List of Exercise Items

Step	Function	No	Detail	End of Training Date
1	Review of previous training	1		February 22
2	Input inventory data	2	Inventory data(El-Mansoura/Al-Menya)	February 22
		3	Photo	February 22
		4	Drawings	February 22
	Input Inspection Result	6	Inspection data(El-Mansoura/Al-Menya)	February 22
		7	Defect Photo(El-Mansoura/Al-Menya)	February 22
		8	Drawings(El-Mansoura/Al-Menya)	February 22
		9	Changing(El-Mansoura/Al-Menya)	February 22
	Search	10	Bridge Inventory Information	February 22
		11	Bridge Inspection Information	February 22
		12	Bridge Soundness	February 22
	Output	13	Inventory(El-Mansoura/Al-Menya)	February 22
		14	Inspection(El-Mansoura/Al-Menya)	February 22
		15	Soundness(El-Mansoura/Al-Menya)	February 22
	Print Out	16	(El-Mansoura/Al-Menya)	February 22
	Check Data and make report to Eng Sayed	17	Inventory	February 23
		18	Inspection	February 23
		19	Soundness	February 23
3	Parameter Setting	20	Set Weighting Factor	February 23
		21	Set Unit price for repair	February 23
		22	Set about Prediction	February 23
		23	Set Typical Damage	February 23
	Run Evaluate Deterioration Prediction	24		February 23
	Explanation	25	Soundness	February 22
	Explanation	26	Repair Cost	February 23
	Explanation	27	Importance	February 23
	Explanation	28	Annual Budget	February 23
	Explanation	29	Deterioration curve	February 23
	Check Evaluate Deterioration Prediction	30		February 23

4	Photo Management System	31	Search and registration of photo	February 22
5	Input inventory/inspection data (El-Mansiora/Dashr/ElRobeiki/Al-Menya)	32	Inventory	February 24
		33	Inspection	February 24
	Discuss about BMS Step 2 Function (Optimized to GARBLT)	34	Soundness	February 24
		35	Repair Cost	February 24
		36	Importance	February 25
		37	Annual Budget (try 3 or more case)	March 1
	Server maintenance	38	Introduce of server maintenance	March 5
		39	Operation training	March 4
		40	Discuss about maintenance way	March 5
	Make report of all training	41	Make report and discuss with manager	March 5
		42	Review report	March 8

(3) Scenes from Exercises

The GARBLT attendees initially had passive attitudes. The exercise method was designed to encourage them to think actively and increase the number of opportunities for them to express their opinions. While classroom lectures using textbooks are important, there are limitations to their concentration.

The method of arranging cards to consider the importance of the components was extremely effective for recognizing each component by using the hands to play a game. A lively discussion was held about the names written on the cards in English/Arabic. Although they may seem shy on paper, moving their hands triggered a lively discussion and led them to the right track.

Exercises for the BMS team

Consideration of the importance of the components (implemented using the card method)

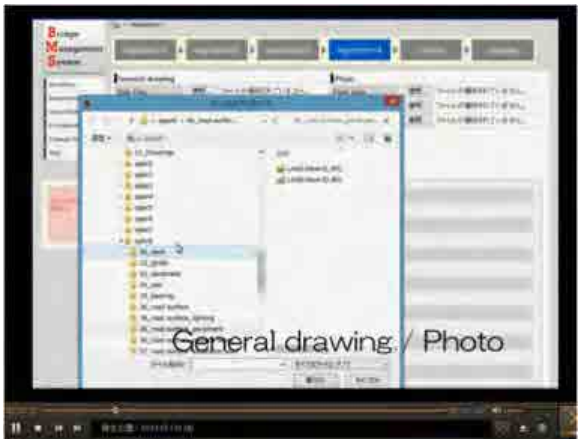
A lecture method to promote voluntary attitudes was adopted for exercises for the four new people. The lectures were provided with a focus on “Why do you think this way?” Consequently, the GARBLT engineers took the initiative in discussing BMS Step 2 related issues with Mr. Eng Aly several times, and a lively discussion was held in Arabic. In addition, desirable approaches were undertaken for surveys during a consultation with the road section regarding the road classification methods and the concept of traffic, which are related to the importance of routes: the GARBLT engineers reflected voluntarily, made appointments and held interviews.

Providing an explanation to Mr. Eng Aly

Consultation with the road section

Test on the level of understanding of BMS

Providing an explanation to the Project Manager



BMS operation video (DVD was distributed)

Status of installing the BMS server

Explanation of functions led by local engineers

Damage assessment review meeting

In terms of the specific bridge damage assessment review meeting where BMS damage pictures were extracted arbitrarily and referred to, not only GARBLT managers but also HQ engineers

attended and discussed the validity of the criteria for the assessment of specific damage. Eng Mohsen, who took the BMS exercises, implemented operations and provided explanations. Based on the displayed bridge, the damage and component repair costs were explained, and then the validation of the damage assessment was carried out by using the damage picture list function of the picture management subsystem. One example was to thoroughly discuss the damage caused by the construction defects of major components. For the components whose damage is assessed as fair, the construction costs are calculated. However, there may be cases where it is a construction defect that does not affect the soundness of the components. In this case, the damage should be assessed as good. Specifically, components whose lower flange has waving do not affect the soundness of the components, and therefore it might be better for this not to be recorded as damage. This issue was discussed with inspection experts to improve the criteria for the assessment of damage in the future. The issue of the method of assessing construction defects was also addressed.

2.4.7 Achievement Level of PDM Indicators

In terms of the items designated as indicators in the PDM Project, the operations have been completed as shown in the following table. The confirmation results of each item are provided below.

Table 2-39 Achievement Level of PDM Indicators

Item	Activity	Indicator	Means of Verification	Result
4-1.	Develop BMS (inventory function) (Step 1)	Step 0: Basic system design Step 1: Database development	Manual/guidelines prepared in the Project	Completed (*1)
4-2.	Input bridge inspection results into BMS	Results of bridge inspection and repair operations are properly recorded in BMS	BMS data	Completed (*2)
4-3.	Hold BMS operation training			Completed (*3)
4-4.	Upgrade BMS (to add damage evaluation and cost assessment functions for bridge repair) (Step 2)	Step 2: Addition of cost analysis function	Manual/guidelines prepared in the Project	Completed (*4)

(*1) Step 1 BMS development completion

After preparing the BMS basic development design, the development of the bridge specifications, inspection result input function, current soundness level of bridges and approximate repair cost calculation function were completed with the full cooperation of the local development company, and subsequently the practices were implemented.

(*2) Checking the bridge inspection results input

As shown in the following table, it was confirmed that the inspection results were continuously registered in BMS at the initiative of GARBLT.

(1) Registration in the period from May 2014 to June 2014

Table 2-40 Checking the bridge inspection results input

No.	Office	Bridge Name	Inspection Training Object Bridge (20 bridges)	Specification	Inspection	Photograph of Damage
2	Central	Ashesha New	○	Registered	Registered	Registered
3	7th Zone	Deirout	○	Registered	Registered	Registered
4	Middle Delta	Kafr El-Zayat Movable	○	Registered	Registered	Registered
5	8th Zone	Naga Hammady	○	Registered	Registered	Registered
6	East Delta	Farskor	○	Registered	Registered	Registered
7	East Delta	Aga Movable	○	Registered	Registered	Registered
8	East Delta	Belbeis	○	Registered	Registered	Registered
9	7th Zone	Dairout Movable		Registered	Registered	Registered
10	Central	Ashesha Old		Registered	Registered	Registered
11	14th Zone	El Marg	○	Registered	Registered	Registered
12	8th Zone	Sohag Bridge over railway	○	Registered	Registered	Registered
13	Central	Banha New		Registered	Registered	Registered
14	Central	El Warrak	○	Registered	Registered	Registered

(2) Registration in the period from August 2014 to November 2014

No.	Office	Bridge Name	Inspection Training Object Bridge (20 bridges)	Specification	Inspection	Photograph of Damage
1	Middle Delta	Quesna		Registered	Registered	Registered
2	Central	Al Ayyat	○	Registered	Registered	Registered
3	East Delta	Abo Nabhan	○	Registered	Registered	Registered
4	14th Zone	Al Motamadeya	○	Registered	Registered	Registered
5	14th Zone	Masraf Al Mansuriyyah	○	Registered	Registered	Registered
6	13th Zone	Tawfigeya		Registered	Registered	Registered
7	6th Zone	HassamWassef		Registered	Registered	Registered
8	Central	Nekla Bridge	○	Registered	Registered	Registered
9	Central	Qaliub Old	○	Registered	Registered	Registered
10	Canal &	Nefisha		Registered	Registered	Registered

	Sinai					
11	14th Zone	Bashtil Canal		Registered	Registered	Registered
12	West Delta	Intersection Bridge	○	Registered	Registered	Registered
13	8th Zone	Luxor Airport Bridge		Registered	Registered	Registered
14	Canal & Sinai	Wasfeya Old Bridge		Registered	Registered	Registered
15	West Delta	Nobareya Canal Bridge		Registered	Registered	Registered
16	14th Zone	Al-Salam Bridge	○	Registered	Registered	Registered
17	7th Zone	Bani Hasseim Bridge		Registered	Registered	Registered
18	Middle Delta	Buesma-4		Registered	Registered	Registered

(3) Registration in the period ended February 2015

No.	Office	Bridge Name	Inspection Training Object Bridge (20 bridges)	Specification	Inspection	Photograph of Damage
1	7th Zone	El Minya	○	Registered	Registered	Registered
2	East Delta	El-Mansoura	○	Registered	Registered	Registered
3	Central	Dahshor		Registered	-	Takenouchi
4	Central	El Robeiki - East Side		Registered	-	Takenouchi

(4) Registration in the period from March to May 2015

No.	Office	Bridge Name	Inspection Training Object Bridge (20 bridges)	Specification	Inspection	Photograph of Damage
	Central	Banha		Registered	Registered	Registered
	10th Zone	Edfu Bridge		Registered	Registered	Registered
	8th Zone	Luxor Bridge		Registered	Registered	Registered
	8th Zone	Qena Bridge		Registered	Registered	Registered
	7th Zone	Sohag Bridge		Registered	Registered	Registered
	7th Zone	Asyut Brigde		Registered	Registered	Registered
	7th Zone	El Minya Bridge		Registered	Registered	Registered
	14th Zone	Beni Suef Bridge		Registered	Registered	Registered
	14th Zone	Suez Road Bridge		Registered	Registered	Registered

	14th Zone	Autostrad Bridge		Registered	Registered	Registered
	14th Zone	El Mounib Bridge		Registered	Registered	Registered
	14th Zone	El Warraq Bridge		Registered	Registered	Registered
	14th Zone	Alexandria Road Bridge		Registered	Registered	Registered
	14th Zone	Mustrod Bridge		Registered	Registered	Registered

(*3) BMS operation training

As a result of the following practices, BMS operation technologies and operation flow were acquired in full. Subsequently, the local engineers were able to prepare the materials for the final seminar by themselves.

Table 2-41 Number of Practices

No	Period	Number of Practices
1	June to November 2014	17
2	February to March 2015	12
3	June to July 2015	16
		45

(*4) Step 2　BMS development completion

The development of the damage forecast function and the priority evaluation function was completed. For these functions, in addition to the training on the operation method, planning and practices for short-term repairs were undertaken and a survey was conducted of the actual repair cost and approximate repair cost calculated by the system at the initiative of GARBLT to check the appropriateness of the unit cost of repair as part of bridge maintenance and management.

(*5) Involvement of BMS in the entire Project

The measurement of the effects of the involvement of BMS for the objective of the entire Project, "Improvement of Bridge Management Capacity," as well as for the PDM indicators, is classified into three categories as follows:

1) Support for bridge inspection operations

Table 2-42 Effect of Activities

Activity	Effect
Gain an overview of uninspected bridges (provision of search function)	Contribute to the preparation of an inspection plan
Provide a function to extract inspected bridges (assessment of necessity for detailed inspection/repair)	Contribute to the preparation of a detailed inspection plan and repair plan
Provide a function to output the bridge specification table	Contribute to streamlining the next inspection operation
Provide a function to output the inspection results	Contribute to the appropriate condition evaluation
Provide a function to output a list of the photographs of damage (by bridge)	Contribute to the improvement of the damage evaluation technology

2) Support for approximate damage evaluation, soundness calculation and approximate repair cost

Activity	Effect
Provide a function to calculate the soundness of member evaluation, repair type evaluation, span evaluation and overall evaluation of the bridge	Contribute to the appropriate condition evaluation
Provide a function to calculate the repair cost by member, by span and for the entire bridge	Contribute to the appropriate condition evaluation and investigation of what countermeasures should be taken

3) Support for the improvement of bridge maintenance and management cycle

Activity	Effect
Provide a function to output a medium- to long-term forecast table	Contribute to the cultivation of budget management skills
Provide a function to output a short-term repair plan table	Contribute to the preparation of a repair plan (for all bridges managed)
Examine the unit cost of repair and reflect each unit cost of repair examined	Contribute to gaining an understanding of the approximate repair cost
Improvement of BMS Step 2 documents (maintenance and management guidelines, member correction coefficient, repair cost examination, importance, priority evaluation method examination)	Contribute to the investigation and examination of bridge maintenance and management methods

4) Established structural chart

The project established the below structure for desirable bridge maintenance management cycle. The below roles were defined based on OST and lectures for cycling maintenance management.

(a) 2 manages of Head of Bridge Sector responsible for "bridge inspection planning", "bridge repair planning"

(b) General Manager of Bridge Maintence for validation and approval of inspection result

(c) 4 engineers responsible for inspection, BMS input and utilization

(d) DO engineers responsible for inspection of bridges under the jurisdiction of the DO

(e) HQ engineers responsible for maintenance of BMS hardware

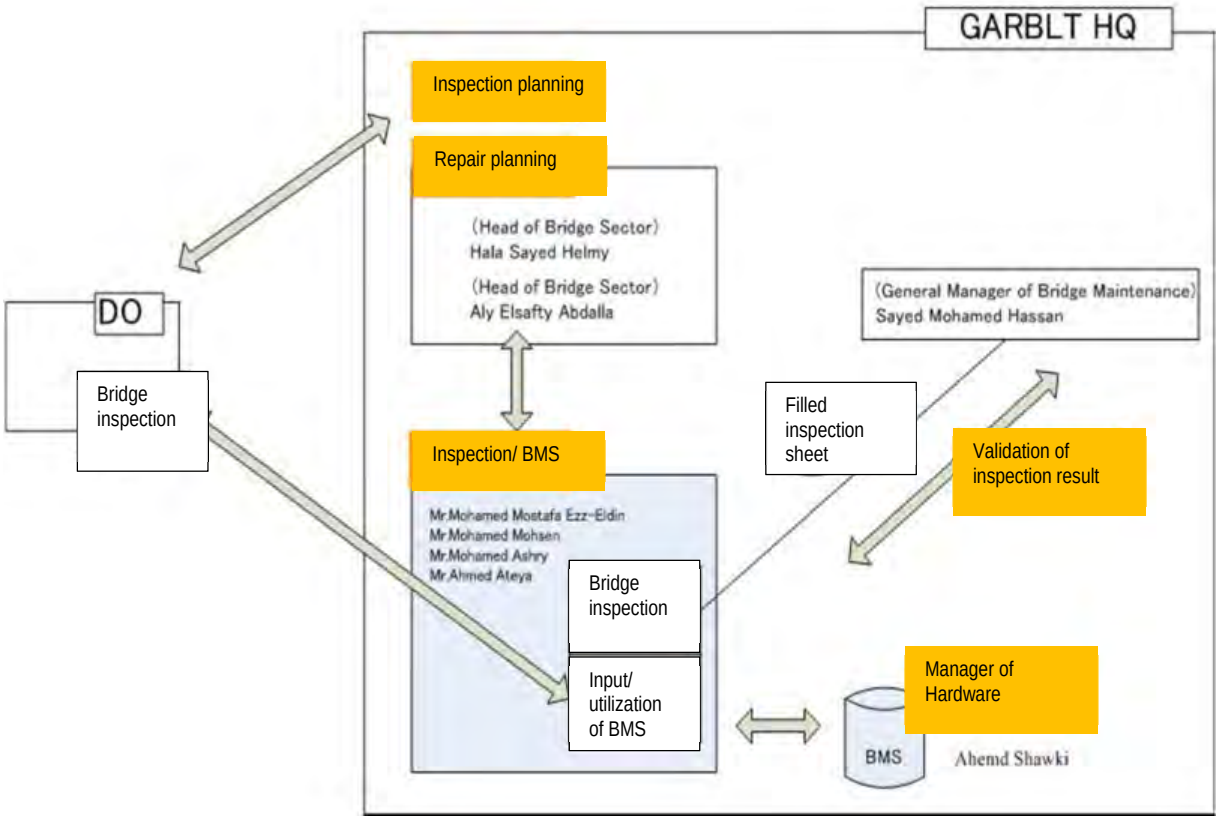


Figure 2-38 Proposed bridge maintenance management organization

2.5 Steel Bridge Fatigue

2.5.1 Background

As many of the bridges in Egypt are concrete bridges, the fatigue phenomenon, which is common for steel bridges, has not been paid attention. However, the bridge survey showed that there are fatigue damages in some steel bridges. Subsequently, the main bridge girder of the Birket El Sab Bridge, which connects Cairo and Tanta, completely fractured on March 21st, 2013. This accident drew the people's attention for steel bridge fatigue for the first time.

Therefore, experts were dispatched twice on a short-term basis to conduct on-site training for steel bridge fatigue under this Project. Surveys focusing on fatigue of steel bridges and the concrete deck were conducted, and on-site training and seminars targeting GARBLT and engineers in the private sector were held.

2.5.2 The First Dispatch

(1) On-site training

In addition to Birket El Sab Bridge, the survey was conducted on steel-deck bridges in Cairo city, Dokki Bridge and Sarwat Bridge. The engineers of GARBLT were present at each survey except for the bridges in Cairo city, and instructed how to conduct fatigue damage inspection. The survey results were reported to GARBLT and a part of the information was lectured at the seminars.

Moreover, the meeting to discuss fatigue strength, maintenance, fabrication and welding was held with the bridge-engineering consultants in the private sector of the steel bridge, which is scheduled to be constructed by GARBLT.

(2) Seminar

Date and Time : May 22nd, 2014 11:00 – 15:00

Location : GARBLT lecture hall

Attendee : 69

Lecture content :

Table 2-43 Contents of Lectures

No.	Program	Lecturer
1	Opening Remarks	Dr. Saad Moh Elgioshy
2	Outline of the Project	Mr. Muneo Okawa
3	Mechanism of Fatigue and Fatigue Test	Mr. Hiroyuki Takenouchi
4	Report on Fatigue Investigation on the Banha Bridge	Dr. Emad Said
5	Repair Works for Fatigue on Expressway	Mr. Hiroyuki Takenouchi
6	Inspection for Fatigue on Steel Bridge	Mr. Hiroyuki Takenouchi
7	Closing Remarks	Dr. Saad Moh Elgioshy

There were 48 attendees from GARBLT, 3 from the Ministry of Transportation, 12 from other government agencies, and 12 from the private sector consultants at the seminar, which showed a high interest in fatigue. The main questions were as follows.

(a) Regarding the presentation by Mr. Takenouchi, Short-term advisor.

- Fatigue discussion needs to be continued in Egypt.
- A chapter for fatigue needs to be added in the Egyptian Code.
- Eng. Samir Abd El Sabour of GARBLTE stated that fatigue examination would be mandatory for the GARBLT designed steel bridges.
- Can FRP sheet be used for fatigue crack repair?

→ There were cases where it was used in Japan, however they were on trial basis.

(b) PM Eng. Aly's comment

- It was very meaningful for GARBLT that a fatigue inspection was conducted on Banha Bridge over the Railway (Zagazik - Banha). As our knowledge of fatigue was limited, we could gain important information from this inspection.
- We plan to conduct fatigue inspections on other bridges.
- GARBLT has commenced large-scale repair work. The GARBLT's maintenance cycle has improved.
- BMS development is in progress. Data from all the bridges managed by GARBLT is supposed to be imputed into BMS, and we have a high expectation for the future use.
- The current issue for GARBLT is that we manage the bridges built by other organizations. Many of them have construction flaws, which need to be dealt with.

(c) Topics related to Dr.Emad

- We are interested in a comparison with the fatigue inspection results of Banha Bridge and the loads under the revised Egyptian Code.
- Other bridges need to be inspected as well.

Outputs of the seminar are as follows.

- This seminar gave bridge engineers in Egypt the awareness of the importance of fatigue design in engineering, and fatigue examination during the maintenance.
- However, the information on fatigue needs to be delivered to steel bridge fabricators, as there was no discussion regarding the importance of quality control during fabrication of steel bridges. One can say that this is the issue that remains to be solved regarding steel bridge fatigue in Egypt, as well as constructing of quality control system on the contractee's side including GARBLT.
- It is necessary to take measures such as conducting ongoing seminars to increase the awareness for strategies in the fabrication process.

2.5.3 The Second Dispatch

(1) Inspection of Fabrication Factory

We visited the following three steel bridge fabrication factories operating in Egypt, and inspected the facilities and the actual fabrication processes, as well as inquired the quality control engineers of the fabrication quality control.

(a) The Petroleum Projects and Technical Consultations Company (Petrojet)
(b) Successors Moustafa Aly
(c) The Arab Contractors

The inspection results of each factory are described as follows.

1) Petrojet

- Date/Time : Monday, January 12th, 2015
- Location : Petrojet
- 4Attendee : (Petrojet) Tarik A.M. EliZahby, QA/QC Manager
  Abdel Hamid El Sabbagh, Account Manager for Process Equipment Fabrication
  Dr.Eng. Mohamed Raouf Gouda, QA Manager
- Content :
  (1) Factory inspection
    - Welding and assembling yard for pipes and pressure vessels.
    - Material testing room.
  (2) Discussion
    - The basic principle of quality control
    - Implementation system of quality control
    - Seminar II, regarding fatigue

2) Successors Moustafa Aly

- Date and Time : Tuesday, January 13th, 2015
- Location : Moustafa Aly
- Attendee : (Moustafa Aly) Eng. Ahmed Moustafa Aly, Vice President
- Content :
  (1) Factory inspection
    - The entire fabrication yard
    - Each equipment
    - Assembling and welding of each bridge

(2) Discussion

- The basic principle and company history
- The company's technical approach
- Material procurement
- Partially indicated welding of poor quality
- Possibility of a technical tour in Japan to observe the skills in Japan
- Seminar II, regarding fatigue

3) The Arab Contractors

- Date and Time: Wednesday, January 14th, 2015
- Location : The Arab Contractors
- Attendee : (The Arab Contractors) Eng. Ahmed Moustafa Aly, Vice President
- Content :

(1) Factory inspection

- The entire fabrication yard
- Each equipment
- Repairing of fatigue damages on the construction machinery.
- There was no actual assembling or welding of a bridge at the time of inspection. We inspected the demonstration of welding.

(2) Discussion

- How to deal with on-site welding work of poor quality.
- Material procurement
- Seminar II, regarding fatigue

(2) Bridge inspection

The following three bridges were inspected, especially the welded parts where fatigue is more likely to be an issue, as requested by GARBLT.

The inspection was conducted using a bridge inspection vehicle (BIV), which was introduced for this Project, expect for the EL-Marg Bridge inspection in which an aerial work platform was used as conventionally done. This inspection was also an on-site training (OST) to learn how to conduct the inspection using the vehicle.

(a) Dahsor Bridge
(b) El-Robeiki Bridge
(c) El-Marg Bridge

(3) Seminar

- Date and Time: January 27th, 2015 11:00 – 15:00
- Location: GARBLT Conference room

- Attendee: 50
- Lecture content:

Table 2-44 Contents of Lectures in the Seminar

No.	Program	Lecturer
1	Opening Remarks	Dr. Saad Moh Elgioshy
2	Fatigue of Steel Bridges(Brief Review)	Mr. Hiroyuki Takenouchi
3	Fatigue Problems of RC and Steel Bridge Deck	Mr. Hiroyuki Takenouchi
4	Fatigue Problems of RC and Steel Bridge Deck	Mr. Hiroyuki Takenouchi
5	Closing Remarks	Dr. Saad Moh Elgioshy

There were 37 attendees from GARBLT, 7 from steel bridge fabricators in the private sector, which showed a high interest in fatigue. The main questions were as follows.

(a) Statement from Dr. Saad
  - Now is the time for Egypt to commit in tackling the fatigue issue
  - We need to study seriously to do so.
  - We appreciate the support from JICA and have an expectation.

(b) How to choose a connection method (Rivet, Bolt, Welding)
  - Bolt welding has an advantage in terms of the fatigue strength in principle, however, welding has an advantage in terms of the increase of dead loads. Rivet has not been used recently.

(c) An impact caused by different directions of bolts.
  - Our view is that it does not have a profound impact.

(d) Accuracy of assembling.
  - Assembling accuracy and fabrication accuracy are factors that influence fatigue strength. It is required to achieve the accuracy that allows the designed fatigue strength.

(e) Assembling accuracy and cost
  - Increasing the assembling accuracy generally leads to a cost increase.

(4) Suggestion for the future works

The Project introduced basic knowledge on fatigue of steel bridge. Technology need to be improved in broad areas as fatigue is influenced by design, fabrication, and traffic. GARLBT engineers explained that GARBLT will check fatigue at design stage for newly constructed bridges.

(a) Instruction of plant fabrication work procedures

There was no fabrication instruction, which clearly describes work procedures, assembling accuracy standards and welding method during plant fabrication, and also the quality control standards of these items. We believe that preparation of detailed and clear work procedure instructions, and fabrication and management, by both contractor and contractee, in accordance with the instructions will lead to quality improvement.

(b) Management of On-Site Welding

It seems that welds of poor quality are resulted from on-site welding work being performed without sufficient reviewing.

The site conditions shall be well taken into consideration in the designing process, however, it is possible that a connection method needs to be changed to accommodate a change in the site conditions. In this case, it is important that the contractor and the contractee review the changes thoroughly, and ensure the actual structure will not change from the one initially designed. Moreover, when on-site welding is performed, its difficulty shall be fully understood, and performed under sufficient means and quality control system. If this is too difficult to achieve, measures such as changing a structure with relatively easier on-site work such as bolt welding shall be taken into consideration.

(c) Bridge Inspection System

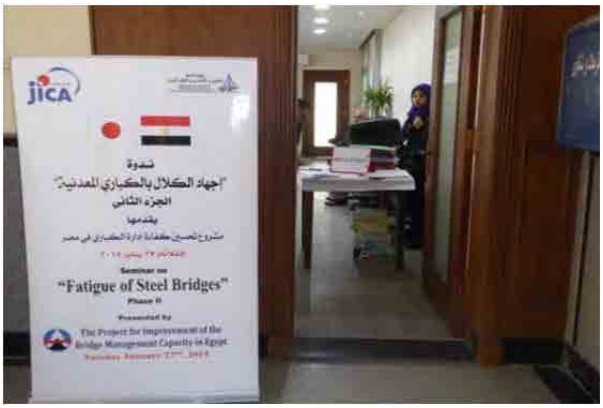
Bridge inspections shall include not only observation of bridge members and recording of them, but also comprehensive work of management, operation, and securing traffic safety for the equipment such as a bridge inspection vehicle, and securing safety of inspectors. Therefore, team effort with a clear chain of command, appropriate role allocation, and a leader who fully understands the whole process is essential for the proper inspection. It is our hope that the importance of teamwork is understood, and that smooth and safe inspection can be achieved through OST training.

1st seminar reception desk

Lecture by Mr. Takenouchi

Questions from attendee

Weld line liquid penetrant inspection



2nd seminar information

Lecture at 2nd seminar

Picture 2-10 Seminar of Steel Bridge Fatigue

2.6 Training in Japan

The purpose of the training was to send Egyptian counterparts of the Japanese engineers to Japan, where they were introduced to the Japan's great bridge management skills, which promotes their understanding of the importance of bridge maintenance, and raises their motivation to actively participate in the Project work. Our expectation was that the participants of the training would share the knowledge and understanding they learned and experienced with the bridge management department of GARTLT, and contribute in achieving the goal of the Project.

The two-week training in Japan was held once a year for three years. Five of the GARBLT engineers participated in each time.

2.6.1 The First Year

(1) Training Period

Sunday, November 25th, 2012～Sunday, December 9th, 2012 (Technical training period: November 27th～December 8th)

Table 2-45 Training participant

Name	Position
1. Eng. Sayed Mohamed Hassan Abdelalim	Manager for Bridge Maintenance Bridge Sector
2. Eng. Ayman Mohamed Metwally	Manager of West & Middle Delta, Maintenance Engineer, Bridge Sector
3. Eng. Monged Mostafa Mohamed	Manager of Central Department, Maintenance Engineer, Bridge Sector
4. Eng. Adbelrehim Kameleldin Mostafa Mohamed	Maintenance Engineer Bridge Sector
5. Eng. Tarek Fouad Abdalhafez Shaban	Maintenance Engineer Bridge Sector

(2) Training Schedule

In the preparation for the first year training, as this was the very fist training session, we focused on giving the participants an understanding of the meaning and the purpose of the Project. The lectures covered diverse topics including the Japan's bridge conditions, a need to underatke bridge

management, the current bridge management by the Ministry of Land, Infrastructure, Transport and Tourism of Japan, moniroring skills, and how to manage the Honshu-Shikoku Bridge. The training also included practical trainings of bridge inpsection and repair. We scheduled as many opportunities as possible for them to see the Japan's great bridge conditions during the time of the training.

The conceptual diagram of the training is described as follows.

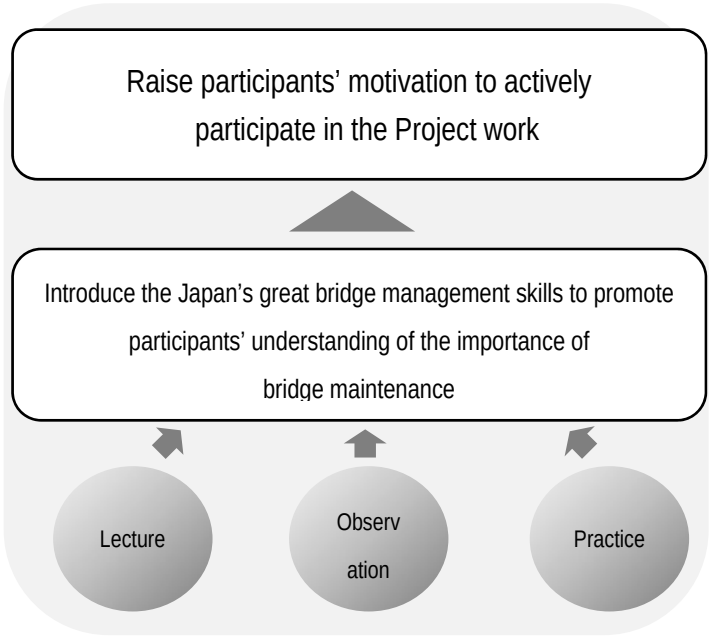


Figure 2-39 Concept of the training

Table 2-46 1st year training in Japan

Day(s)	Date	Location	Content		Lecturer
1	11/25 (Su)	(Travel day)		1900 Depart Cairo (EK924)	
2	11/26 (Mo)	(Travel day)		0030 Arrive Dubai 0255 Depart Dubai (EK318) 1720 Arrive Narita	
3	11/27 (Tu)	JICA Tokyo		JICA Briefing	JICA
				Course Orientation	Nippon Engineering Consultants Co.,Ltd.
			Lecture	Bridges and the maintenance in Japan	Nippon Engineering Consultants Co.,Ltd.
4	11/28 (We)	Nippon Engineering Consultants Co., Ltd.	Lecture	Maintenance of bridge expansion joint	Bridge maintenance
			Lecture	Bridge inspection method established by the Ministry of Land, Infrastructure, Transport and Tourism	Nippon Engineering Consultants Co.,Ltd.
			Lecture	Bridge repair skills	Nippon Engineering Consultants Co.,Ltd.
5	11/29 (Th)	Chiba National Highway Office	Lecture	Road maintenance and management system	Chiba National Highway Office
		Kita-Kashiwa Bridge	Lecture	Management system of inspection results	Chiba National Highway Office
			Practice	Inspection practice using an elevated work platform car Non-destructive testing practice	Nippon Engineering Consultants Co.,Ltd.
6	11/30 (Fr)	Nippon Engineering Consultants Co., Ltd.	Discussion	Interim discussion	Nippon Engineering Consultants Co.,Ltd.
			Lecture	Bridge measuring/monitoring skills	Nippon Engineering Consultants Co.,Ltd.
			Lecture	Maintenance system of road bridges and introduction of a case example	Nippon Engineering Consultants Co.,Ltd.
7	12/1 (Sa)	Tokyo area	Observation	A tour to observe bridge maintenance situations (Katsushika Harp Bridge, Tokyo Gate Bridge, Tokyo Bay Aqua-Line Bridge, etc.)	Nippon Engineering Consultants Co.,Ltd.
8	12/2 (Su)	(Travel day)		1210 Tokyo→1458Kobe (Nozomi No.31)	
9	12/3 (Mo)	Honshu-Shikoku Bridge Expressway Company Limited	Lecture	Outline of skills for designing and construction of long-span bridge	Honshu-Shikoku Bridge Expressway Company Limited
			Lecture	Outline of bridge maintenance	Honshu-Shikoku Bridge Expressway Company Limited
10	12/4 (Tu)	Akashi Kaikyo Bridge Exhibition Center	Observation	A tour of Akashi Kaikyo Bridge Exhibition Center	Honshu-Shikoku Bridge Expressway Company Limited
		Kobe Operation Center of	Observation	A tour of Kobe Operation Center/Management office	Honshu-Shikoku Bridge Expressway

		Honshu-Shikoku Bridge Expressway Company Limited			Company Limited
		Akashi Kaikyo Bridge	Observation	A tour of the inspection corridors of Akashi Kaikyo Bridge	Honshu-Shikoku Bridge Expressway Company Limited
		Nojima Fault Preservation Museum	Observation	A tour of Nojima Fault Preservation Museum	Honshu-Shikoku Bridge Expressway Company Limited
11	12/5 (We)	Honshu-Shikoku Bridge Expressway Company Limited	Lecture	Outline of bridge inspection skills	Honshu-Shikoku Bridge Expressway Company Limited
			Lecture	Outline of monitoring system of Honshu-Shikoku Bridge	Honshu-Shikoku Bridge Expressway Company Limited.
			Discussion	Presentation	Honshu-Shikoku Bridge Expressway Company Limited
12	12/6 (Th)	(Travel day)		Kobe→Sakaide	Honshu-Shikoku Bridge Expressway Company Limited
		Sakaide Operation Center of Honshu-Shikoku Bridge Expressway Company Limited	Practice	Inspection practice on the long-span bridge	Honshu-Shikoku Bridge Expressway Company Limited
13	12/7 (Fr)	Sakaide Operation Center of Honshu-Shikoku Bridge Expressway Company Limited	Practice	Inspection practice on a general bridge	Honshu-Shikoku Bridge Expressway Company Limited
		(Travel)		Sakaide→Kobe	
		JICA Kansai		Completion ceremony/Informal meeting	JICA
14	12/8 (Sa)	(Travel day)		2340 Depart KIX (EK317)	
15	12/9 (Su)	(Travel day)		0540 Arrive Dubai 0840 Depart Dubai (EK927) 1055 Arrive Cairo	

(3) Training Achievement

The training in Japan revealed the following issues of the bridge maintenance in Egypt. Our expectation is that the awareness raised among the participants for the issues will drive them to take part in the future projects and provide ideas to improve the situations.

- Egypt does not have sufficient manpower, experience or equipment for the maintenance. It is also an issue that maintenance is hardly considered at the designing stage. Only emergency repairs are carried out, however, the maintenance is rarely performed.

- Our observation following the training is that; monitoring and documentation of bridge data is necessary, non-destructive testing shall be introduced, maintenance staff shall be trained, legal reform is necessary to prevent from overloading, and an increase in the maintenance budget is required
- The remaining issues for the better maintenance are a shortage of staff, and that there are many bridges constructed by other organizations, of which GARBLT does not have data.

The training once again revealed a shortage of bridge engineers, a lack of general knowledge of a bridge, low interest in the maintenance, and highly divided labor system of GARBLT. Although these are serious problems, they are also greatly helpful information in reviewing the implementation principle of the Project.

It is difficult to obtain information about the structure of GARBLT under normal circumstances, therefore, this training was a highly valuable opportunity, which provided us with information directly from the participants.

(d) Evaluation by Participants

The training environment was good, and we received good reviews for the training items on the questionnaires filled out by the participants. However, the training schedule was partially altered due to the strong wind and the low temperature, which forced us to cancel a tour of the top of Akashi Kaikyo Bridge.

Photos from the training

5 training attendees

Explanation of expansion joint structure

Inspection practice using a bridge inspection vehicle

A tour of Chiba National Highway Office to observe the road management

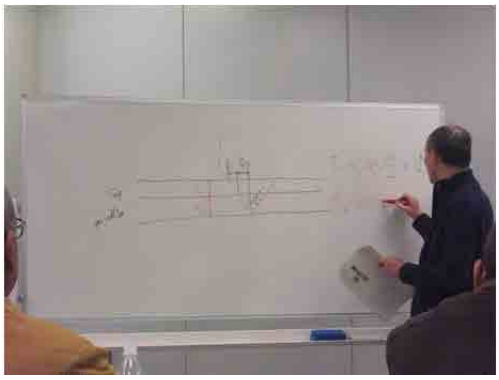
Discussion among the participants

A tour to observe bridge condition

Lecture on maintenance of a long-span bridge

A tour of Kobe Operation Center to observe the control room

A tour of Akashi Kaikyo Bridge to observe the inspection facilities.



Lecture on the maintenance of Honshu-Shikoku Bridge

Discussion with Japanese engineers

A tour of Great Seto Bridge to observe the inspection facilities.

Inspection practice at Great Seto Bridge

Inspection practice of expansion joint

Inspection practice using a bridge inspection vehicle

Completion ceremony

Picture 2-11 Training in Japan (1st Year)

2.6.2 The Second Year

(1) Training Period

August 24th, 2013～September 6th, 2013 (Technical training period: August 26th, 2013～September 5th, 2013)

Table 2-47 Training Participant

Name	Position
1. Eng. Ali Mohamed Abou Nesir Ahmed	Civil Engineer (Project Manager), Bridge Sector
2. Eng. Hassan Ahmed Mohamed Ahmed	Maintenance Engineer, Bridge Maintenance Department
3. Eng. Shahat Mamdouh Soliman Hakim	Bridge Maintenance Engineer, Bridge Sector
4. Eng. Saad Mohamed Emad Mohamed Amer	Construction Engineer, Bridge Sector
5. Eng. Nada Ahmed Gamal Elsayed	Site Engineer, Bridge Construction Department

(2) Training Schedule

In the preparation for the second year training, we focused on giving the participants' an understanding of the importance of bridge inspection, and the concept of bridge mainteannce cycle, which will raise the participant's motivation to activly take part in the on-site work for the Project. At the same time, we included lectures about the researches on bridge maintenance by Public Works Research Institute, and National Institute for Land and Infrastructure Management to give the participants an understanding of handling of the aging bridges which Japan faces.

Same as the first year, the training included the lectures on the current bridge management by the Ministry of Land, Infrastructure, Transport and Tourism of Japan, moniroring skills, and how to manage the Honshu-Shikoku Bridge, and practical trainings of bridge inpsection and repair.

Table2-48 2nd year training in Japan

Date	Location	Content		Lecturer
8/24(Sa)	(Travel day)		Travel (Cairo→Doha)	
8/25(Su)	(Travel day)		Travel (Doha→Narita)	
8/26(Mo)	JICA Tokyo		JICA Briefing	JICA
			Course Orientation	Nippon Engineering Consultants Co., Ltd.
		Lecture	Bridge maintenance policy by the Ministry of Land, Infrastructure, Transport and Tourism.	Chodai Co.,Ltd./ Nippon Engineering Consultants Co., Ltd.
8/27(Tu)	Nippon Engineering Consultants Co., Ltd.	Lecture	Bridge inspection method/manuals by the Ministry of Land, Infrastructure, Transport and Tourism.	Nippon Engineering Consultants Co., Ltd.
		Lecture	Bridge measuring/monitoring	
		Lecture	Maintenance of bridge expansion joint	KYOURYOU MAINTENANCE, Inc
		Lecture	Municipal management/road bridge maintenance system	Nippon Engineering Consultants Co., Ltd.
8/28(We)	National Institute for Land and Infrastructure Management	Lecture	Scientific maintenance of road structure (sophistication and streamlining of maintenance)	National Institute for Land and Infrastructure Management
	Public Works Research Institute. Center for Advanced Engineering Structural Assessment and Research	Lecture	Intruction of Public Works Research Institute/CAESAR Technical issues and actions for road bridge maintenance	Public Works Research Institute. Center for Advanced Engineering Structural Assessment and Research
		Observation	Observation (Structure testing facility, structural dynamics testing facility, storage of removed materials for on-site study)	
8/29(Th)	Ministry of Land, Infrastructure, Transport and Tourism. Kanto Regional Development Bureau. Tokyo National Highway Office	Lecture	Management road information system	Ministry of Land, Infrastructure, Transport and Tourism. Kanto Regional Development Bureau. Tokyo National Highway Office
		Lecture	Bridge repair and maintenance	
	National HW No.357 Arakawa Estuary Bridge	Observation	Observation of a bridge repair work	
	Tokyo Gate Bridge Rainbow Bridge	Observation	A tour of bridges in Tokyo	Nippon Engineering Consultants Co., Ltd.
		Lecture	Travel (Tokyo→Kofu)	
8/30 (Fr)	Ministry of Land, Infrastructure, Transport and Tourism. Kanto Regional Development Bureau. Kofu River and National Highway Office.	Lecture	Outline of bridges manage by the Kofu River and National Highway Office.	Ministry of Land, Infrastructure, Transport and Tourism. Kanto Regional Development Bureau. Kofu River and National Highway

				Office.
	National HW No. 20 Anayama Bridge	Practice	Inspection practice using an elevated work platform car Non-destructive testing practice	Nippon Engineering Consultants Co., Ltd.
			Travel (Kofu→Tokyo)	
8/31 (Sa)			(Material organization)	
9/1 (Su)			Travel (Tokyo→Onomichi)	
9/2 (Mo)	Honshu-Shikoku Bridge Expressway Company Limited. Onomichi Building	Lecture	Outline of bridge maintenance skills (1)	Honshu-Shikoku Bridge Expressway Company Limited
	Ikuchi Bridge	Practice	General bridge inspection practice	Honshu-Shikoku Bridge Expressway Company Limited
9/3 (Tu)	Ikuchi Bridge	Practice	Long-span bridge inspection practice	Honshu-Shikoku Bridge Expressway Company Limited
	Tatara Bridge/ Kurushima Kaikyo Bridge	Observation	Observation of Tatara Bridge and Kurushima Kaikyo Bridge	Honshu-Shikoku Bridge Expressway Company Limited
			Travel (Onomichi→Kobe)	
9/4 (We)	Akashi Kaikyo Bridge Exhibition Center	Observation	A tour of Akashi Kaikyo Bridge Exhibition Center	Honshu-Shikoku Bridge Expressway Company Limited
	Kobe Operation Center of Honshu-Shikoku Bridge Expressway Company Limited	Observation	A tour of Kobe Operation Center/Management office	Honshu-Shikoku Bridge Expressway Company Limited
	Headquarters of Honshu-Shikoku Bridge Expressway Company Limited	Lecture	Outline of bridge maintenance skills (2)	Honshu-Shikoku Bridge Expressway Company Limited
9/5 (Th)	Top of Akashi Kaikyo Bridge. 3P	Observation	A tour of the top of Akashi Kaikyo Bridge 3P	Honshu-Shikoku Bridge Expressway Company Limited
	Headquarters of Honshu-Shikoku Bridge Expressway Company Limited	Discussion	Group discussion	Honshu-Shikoku Bridge Expressway Company Limited
	JICA Kansai	Discussion	Evaluation meeting, completion ceremony	Nippon Engineering Consultants Co., Ltd./ Chodai Co., Ltd.
			Travel (KIX→Doha)	
9/6 (Fr)	(Travel day)		Travel (Doha→Cairo)	

(3) Achievement of Training

The training confirmed that there are some great differences in bridge maintenance system in Egypt and Japan: Japan has engineers who are highly skilled and trained specifically in the field of bridge maintenance, the clearly defined inspection method and frequency, and a database of information at the time of construction, inspection records, and so on. We introduced them to damage management,

recording of a damaged location and a type of the damage, during the inspection practice of inside of a bridge girder, which is a useful method in Egypt.

Importance of establishing the inspection frequency and methods were recognized, and a strong desire for creating a database of information at the time of construction and inspection records was expressed during the final discussion. Our expectation is that inspection methods and frequency, and how to create a database, all of which were leaned through the training will be shared and reviewed among the working groups, and successfully applied in Egypt.

(4) Evaluation by Participants

The trainees' motivation was extremely high, and they evaluated that the training was very meaningful. As a result of the high motivation, on the other hand, we received poor evaluations on some lectures for redundancy in the contents or poor English skills of the lecturers. Their evaluations become more favorable as the lecture methods and contents were modified over the course of the training period. Some trainees commented that two weeks training period was too short.

Lecture on expansion joint

Observation of damaged members stored by Public Works Research Institute

Observation of maintenance system of Kofu River and National Highway Office.

Observation of bridge repair

Magnetic particle inspection practice

Inspection practice with cover meter

Observation of concrete sampling

Observation of maintenance of Honshu-Shikoku Bridge

Concrete bridge inspection practice

A tour to observe Honshu-Shikoku Bridge control center

Observation of inspection corridor of Akashi Kaikyo Bridge

A tour of Akashi Kaikyo Bridge

A tour of the top of Akashi Kaikyo Bridge

Discussion with the engineers of Honshu-Shikoku Bridge Expressway Company Limited

Discussion with the engineers of Honshu-Shikoku Bridge Expressway Company Limited

Completion ceremony

Picture 2-12 Training in Japan (2nd Year)

2.6.3 The Third Year

(1) Training Period

November 8th, 2014～November 22nd, 2014(Technical training period: November 10th, 2014 ～November 21st, 2014)

Table 2-49 Training Participant

Name	Position
1. Eng. Mohamed Salem Amin Salem	Maintenance and Construction Engineer Bridge Sector
2. Eng. Mahmoud Mohamady	Maintenance and Construction Engineer Bridge Sector
3. Eng. Hossam Nagy Mostafa Abdelhamid	Maintenance and Construction Engineer Bridge Sector
4. Eng. Tamer Mohamed Abdelazim Aly	Maintenance and Construction Engineer Bridge Sector
5. Eng. Mahmoud Ibrahim Hassan Ahmed	Maintenance and Construction Engineer Bridge Sector

(2) Training Schedule

In the preparation for the third year training, we focused on not only concrete bridges, which were the main training contents in the past years, but also maintenance of steel bridges. The training contents include fatigue of steel bridges as there is a growing awareness for this matter in Egypt. We scheduled lectures and practices regarding the basic knowledge of the fatigue phenomenon, fatigue inspections, steel bridge fabrication and quality control, and prepared the lectures which maintain the participants' interest and with no redundant content.

With a more emphasis on practical training compared to the last two trainings, we ensured that all the trainees could participate in practices of bridge inspections, non-destructive testing, and welding.

Table2-50 3rd year training in Japan

Date	Location	Content		Lecturer
11/8 (Sa)	(Travel day)		Travel (Cairo→Doha)	
11/9 (Su)	(Travel day)		Travel (Doha→Narita)	
11/10 (Mo)	JICA Tokyo Center		JICA Briefing	JICA
			Course Orientation	Nippon Engineering Consultants Co., Ltd.
		Presentation	Bridges and maintenance in Egypt	Trainee
		Lecture	The current bridge maintenance situation in Japan	Japan Bridge Engineering Center
11/11 (Tu)	Public Works Research Institute. Center for Advanced Engineering Structural Assessment and Research	Presentation	Bridges and maintenance in Egypt	Trainee
		Lecture	Bridge maintenance skills	Public Works Research Institute.
		Observation	A tour of Public Works Research Institute.	
11/12 (We)	Chiba National Highway Office	Lecture	Bridge maintenance by the Ministry of Land, Infrastructure, Transport and Tourism of Japan	Chiba National Highway Office
	Kisarazu, Otayama Bridge	Practice	Inspection practice	
11/13 (Th)			Travel (Tokyo→Shin-Fuji)	
	Japan Construction Machinery and Construction Association. Japan Construction Method and Machinery Research Institute	Presentation	Bridges and maintenance in Egypt	Trainee
		Lecture	Bridge maintenance research by JCMMRI	Japan Construction Machinery and Construction Association. Japan Construction Method and Machinery Research Institute
		Lecture	Fatigue phenomenon at welds of steel bridges.	
		Practice	Observation of testing facilities and measurement practice	
11/14 (Fi)	Japan Construction Machinery and Construction Association. Japan Construction Method and Machinery Research Institute	Lecture	Fatigue phenomenon of steel deck plate	Japan Construction Machinery and Construction Association. Japan Construction Method and Machinery Research Institute
		Observation	Skills and maintenance equipment of expressway bridges	
11/15 (Sa)		Observation	Inspection of bridge condition	Japan Construction Method and Machinery Research Institute
			Travel (Shin-Fuji→Sakaide)	
11/16 (Su)			Day off	
11/17 (Mo)	Kawada Industries, Inc. Shikoku plant	Presentation	Bridges and maintenance in Egypt	Trainee
		Lecture	Outline of welding and ultrasonic penetrant inspection	Kawada Industries, Inc. Shikoku plant
		Practice	Steel bridge fabrication and quality control skills and inspection skills	
11/18 (Tu)	Sakaide Operation Center of	Lecture	Maintenance by Honshu-Shikoku Bridge Expressway Company Limited.	Honshu-Shikoku Bridge Expressway

	Honshu-Shikoku Bridge Expressway Company Limited		(Preventative maintenance of Great Seto Bridge)	Company Limited
	Minami Bisan-Seto Bridge	Observation	Maintenance by Honshu-Shikoku Bridge Expressway Company Limited (Re-painting, etc.)	
			Travel (Sakaide→Naruto)	
11/19 (We)	Naruto Operation Center of Honshu-Shikoku Bridge Expressway Company Limited	Lecture	Maintenance by Honshu-Shikoku Bridge Expressway Company Limited. (Prevention of delamination, etc.)	Honshu-Shikoku Bridge Expressway Company Limited
	Onaruto Bridge, Muya Bridge	Practice	Maintenance by Honshu-Shikoku Bridge Expressway Company Limited. (Prevention of delamination, etc.)	
			Travel (Naruto→Kobe)	
11/20 (Th)	Akashi Kaikyo Bridge Exhibition Center	Observation	Long-span bridge training (Akashi Kaikyo Bridge Exhibition Center)	Honshu-Shikoku Bridge Expressway Company Limited
	Kobe Operation Center of Honshu-Shikoku Bridge Expressway Company Limited	Observation	A tour of the control room of Kobe Operation Center	
	JICA Kansai Center	Practice	Action plan preparation	
11/21 (Fi)	JICA Kansai Center		Action plan presentation, discussion	Honshu-Shikoku Bridge Expressway Company Limited
			Report preparation, completion ceremony	
	(Travel day)		Travel (KIX→Doha)	
11/22 (Sa)	(Travel day)		Travel (Doha→Cairo)	

(3) Training Achievement

Same as the second year training in Japan, it was pointed out that Japan has engineers who are highly skilled and trained specifically in the field of the bridge maintenance, the clearly defined inspection method and frequency, a database of information at the time of construction, inspection records, and so on, and has many research institutions with testing facilities, all of which remain to be solved in Egypt. It was also stated that a shortage of engineers and their lack of experience are major problems of GARBLT.

Similar to the last two trainings, the trainees gave several short presentations prior to the lectures to give the lecturers a better understanding of the bridge conditions in Egypt, which allowed us more time to spend on the explanations for important issues. It helped the lecturers and the trainees share a common awareness of the issues, and raised the trainees' motivation to participate in the training.

(4) Evaluation by Participants

The five participants in the third year training, being relatively younger than the ones in the last two years might be relevant, were highly motivated, and took part in all the training activities with positive manners. They showed high interest especially in the maintenance method, new construction skills, and the bridge engineering in Japan, and asked many questions during the site visits and practical trainings.

The participants commented that it will take time that the Japan's excellent maintenance method that we learned in the training can be directly applied in Egypt, however, we would share the information with the departments in charge as the measures against the issues we currently face.

Observation of damaged bridge members at Public Works Research Institute.

Observation of testing facilities at Public Works Research Institute.

A tour to observe Chiba National Highway Office

Inspection practice of a concrete bridge

Observation of a fatigue test

Observation of bridge construction site

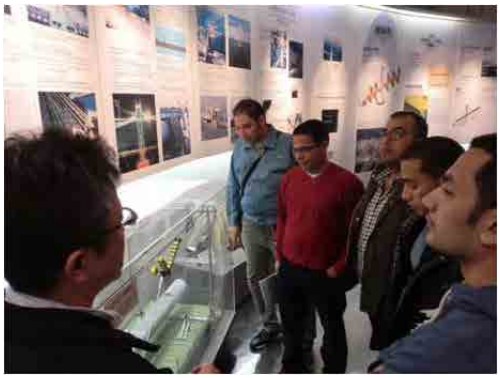
Observation of steel bridge fabrication factory

Welding practice

Management training of Great Seto Bridge

Observation of bridge reinforcement work

Experience scaffolding for repair work



A tour of Akashi Kaikyo Bridge Exhibition Center

Observation of maintenance facility of Akashi Kaikyo Bridge

A tour to Akashi Kaikyo Bridge

Action Program presentation

Comletion ceremony

Picture 2-13 Training in Japan (3rd Year)

3 Project Administration

3.1 Administration Committee

Based on the agreement of the Record of Discussion (R/D), the JCC chaired by GARBLT Chairman controls the entire activity as the top administration; under which are the Technical Working Group (TWG) for leading actual work and Working Groups (WG) for implementing actual work conducted in the projects.

It was agreed in 3rd JCC that 1) Eng. Hala Helmy, the Head of Project Sector would be "Assistant Project Director" to make a strategic decisions in the absence of Chairman of GARBLT.

5 WGs were set up for 5 outputs. Organization chart is as shown in Figure 2-1, member, function, and role of JCC、TWG、WG are as shown in Table 3-1.

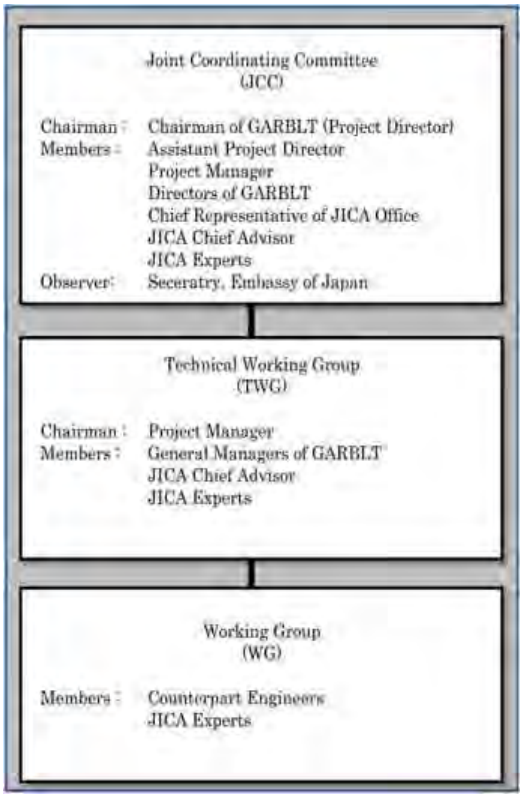


Figure 3-1 Organization Chart

The First JCC

The Second JCC

The Third JCC

The Fourth JCC

The Fifth (Final) JCC

The Fifth (Final) JCC

Picture 3-1 JCC

Table 3-1 Joint Coordination Committee, Technical Working Group, and Working Group

		Joint Coordination Committee	Technical Working Group	Working Group
Meeting		Once a year. (Timely consultation will be took place, if necessary)	3～4meetings a year. (Timely consultation will be took place, if necessary)	Several meetings a year. Scheduling will be checked monthly.
Role		・ Discussion of project issues ・Approval of Yearly Plan (including review of the plans and check the progress) ・ Discussion on arising problems ・Approval of Manuals/Guidelines and products developed by Project ・ Provision of supports for project implementation ・Support to recommendations to GARBLT ・ Participation to On-site trainings/Seminars	・ Discussion on arising problems ・ Review of Yearly Plan and Check of progress ・ Support to implementation of the Project ・Submission of Manuals/Guidelines and products developed by Project to JCC ・ Support to improve maintenance management cycle in GARBLT ・ Participation to On-site trainings/Seminars	・ Necessary Work in the Working Group ・Preparation of Draft Manuals/Guidelines including revision ・ Preparation of and participation to On-site trainings/Seminars
Members	Chair	Chairman of GARBLT	Project Manager	Selected among counterparts
	Egypt	Project Assistant Director General Managers of GARBLT Project Manager	General Managers of GARBLT Counterpart engineers Project Coordinator	Counterpart engineers
	Japan	Secretary, Embassy of Japan Chief Representative of JICA Office JICA Expert (Chief Advisor) JICA Experts	JICA Expert (Chief Advisor) JICA Experts	JICA Experts

3.1.1 JCC

Table 3-2 JCC Member

(GARBLT)

Name	Position
Eng. Ahmed Kamal Tolba	Chairman of GARBLT (– 2012/7)
Eng. Ebrahim Amer	Chairman of GARBLT (2012/7 – 2013/2)
Eng. Ramzy Lashine	Chairman of GARBLT (2013/2 – 2014/3)
Eng.Dr. Saad El-Geyoshi	Chairman of GARBLT (2014/3 – 2015/3)
Eng. Adel Saleh Tork	Chairman of GARBLT (2015/4 –)
Eng. Ebrahim Amer	Head of Sector for Bridges (– 2012/7)
Eng. Hala Sayed Helmy	Head of Central Department for Construction, Maintenance and Design of Bridge
Eng. Samir ABD El Saboor	Head of Central Department for Bridge Design
Eng. Samy Farag	Head of Central Department for Roads
Eng. Aly Elafty Abdalla	Head of Central Department for Bridge Maintenance in Lower Egypt

*The above names are of member at the end of the Project.

(JICA)

Name	Position
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Leader, JICA Short-term Expert
Mr. Hideo Nagao	JICA Short-term Expert
Mr. Osamu Tsukahara (Mr. Takefumi Yamazaki)	JICA Short-term Expert
Mr. Takashi Matsuo	JICA Short-term Expert
Mr. Teruyuki Miyakawa	JICA Short-term Expert
Mr. Kokichi Terai	JICA Short-term Expert
Mr. Hirofumi Uemura	JICA Short-term Expert
Ms. Nagisa Okada (Mr. Jun Nakamura)	Coordinator, JICA Short-term Expert

(1) 1st JCC

1st JCC was held on 2nd July, 2012. The contents are as shown below,

- The Team Leader of JICA Expert Team explained outline of the Project, including background, purpose, outputs, administration and activities.
- Work Plan was approved by Team Leader of JICA Expert Team and GARBLT chairman.

(2) 2nd JCC

2nd JCC was held on 15th May, 2013. The contents are as shown below

- JICA Expert Team presented the report of the 1st year activities and the plan of 2nd year activities. JICA Expert Team requested GARBLT Chairman for more active cooperation in the second year so that GARBLT engineers could lead the project's activities in the third year, which was agreed by GARBLT Chairman.
- JICA Expert Team explained concept for selecting 20 bridges, which was agreed by GARBLT Chairman.
- Type and size of Bridge Inspection Vehicle, while Platform type was recommended by JICA Expert Team, would need to be concluded after JCC.
- JICA Expert Team requested that a system engineer and an infrastructure engineer should join the WG to support BMS activities, which was affirmed to be solved by GARBLT Chairman.
- JICA Expert Team explained that the main problem of the Project was shortage of maintenance engineers in GARBLT. GARBLT Chairman made comment that this matter should be discussed in detail at MOT.
- JICA Expert Team requested GARBLT Chairman to add observer from MOT to JCC, which was agreed by GARBLT Chairman.

(3) 3rd JCC

3rd JCC, based on Mid-Term Evaluation. was held on 13 February, 2014. The contents are as shown below.

-The results of the Mid-Term Review on 5 evaluation items were explained by JICA Mission Team. Amendment of PDM was proposed by JICA Mission Team, which was agreed by JICA Expert Team and GARBLT. The amendment includes the exclusion of steel bridges from the object of repair demonstration, considering the progress, bridge condition, and remaining project periods.

- It was agreed that 1) Eng. Hala Helmy, the Head of Project Sector would be "Assistant Project Director" to make a strategic decisions in the absence of Chairman of GARBLT, 2) GARBLT would assign core inspection trainers to be responsible for the technical transfer of experience and technologies from JICA Team to all district offices, 3) GARBLT would assign two engineers for BMS, "System Maintenance Engineer for BMS" to maintain BMS technically, in addition to "BMS Operator" for the inputs of inspection data and utilizing information.

- The Chief Advisor introduced a recommendation about new organization structure of Bridge Maintenance in GARBLT. GARBLT Chairman understood the recommendation of the proposed structure and he would make time to study it.
- Since some project activities were delayed, GARBLT requested a "6 months" extension of the project in order to have sufficient time for training on using the Bridge Inspection Vehicle. JICA Mission Team explained that the purpose of the Mid-Term review was to introduce some recommendations to meet the project targets within the period of the project, and it was too early to take a decision regarding this matter.

(4) 4th JCC

4th JCC, based on Terminal Evaluation. was held on 13 February, 2014. The contents are as shown below.

-Extension of the project was recommended, whose period was agreed to be three months.

- It was recommended to develop Core Inspection trainers. GARBLT confirmed the appointment of four new engineers for the project.
- It was recommended to establish the organization related to BMS. GARBLT confirmed that they would assign two engineers for BMS Management.

(5) Final JCC

Final JCC was held on 23 June, 2015, at the end of the Project. The contents are as shown below.

- It was confirmed that the Project had successfully completed the activities in Egypt.
- Manuals developed by the Project, including Bridge Inspection Manual/Handbook, Aswan Bridge Inspection Manual, Detailed Inspection Manual, Bridge Repair Manual and BMS Operation Manual, were handed over, and GARBLT agreed to utilize the manuals and develop by themselves.
- JICA transferred to GARBLT ownerships of the equipment procured in the Project.
- JICA handed over the Bridge Management System (BMS) to GARBLT.
- In order to ensure the sustainability of the Project, both sides agreed to hold regular discussions every 6 months.

3.1.2 TWG

Table 3-3 TWG Member

(GARBLT)

Name	Position
Eng. Aly Elsafty Abdalla	Head of Central Department, Bridge Maintenance (Lower Egypt)
Eng. Mohamed Gouada	Head of Central Department, Bridge Maintenance (Upper Egypt)
Eng. Osama Fahmy	Head of Central Department, Bridge Construction
Eng. Ashral Hamad	Head of Central Department, Bridge Design
Eng. Wafaa Mubarak	General Manager, Bridge Electricity
Eng. Ibrahim Khail Ibrahim	General Manager, Bridge Design
Eng. Dalia Adel Aly	Coordinator
Eng. Mamdouh Sliman	Full time Counterpart
Eng. Abd El Wahab Mosleh	Full time Counterpart

(JICA)

Name	Position
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Leader, JICA Short-term Expert
Mr. Hideo Nagao	JICA Short-term Expert
Mr. Osamu Tsukahara (Mr. Takefumi Yamazaki)	JICA Short-term Expert
Mr. Takashi Matsuo	JICA Short-term Expert
Mr. Teruyuki Miyakawa	JICA Short-term Expert
Mr. Kokichi Terai	JICA Short-term Expert
Mr. Hirofumi Uemura	JICA Short-term Expert
Ms. Nagisa Okada (Mr. Jun Nakamura)	Coordinator, JICA Short-term Expert

3.1.3 WG

The activities of the blow WG were started. Comparison between plan and actual performance, outputs of WGs are as shown below. WGs were held more than planned.

Table 3-4 Performed WGs

Activities	Plan	Performance
WG 0 (Bridge Management Cycle)	4	22
WG 1 (Bridge Inspection)	4	19
WG 2 (Aswan Bridge)	4	9
WG 3 (Bridge Repair)	5	13
WG 4 (Bridge Management System)	4	11

In addition to the aforementioned WG, a seminar on steel bridge fatigue was held on 22nd May, 2014 and the final seminar on bridge management capacity was held on 21st June, 2015. On the final seminar, keynote speech was made by a Professor of Azhar University. Presentations were made by GARBLT engineers, whose topics were bridge inspection in GARBLT, utilization of BMS, report of counterpart training in Japan, and future bridge management plan by GARBLT.

Table 3-5 WG Member

(GARBLT)

Name	Position	Role in the Project	Remark
Eng. Sayed Hassan	Manager for Bridge Maintenance	WG0 Leader	
Eng. Ahmed Mohamed Hassan	Maintenance Engineer	WG1 Leader	
Eng. Abo Noser Ahmed Aly	Chief, Maintenance Engineer	WG2 Leader	
Eng. Hosaam Halmy Zydan	Maintenance Engineer		
Eng. Eslam Hafez	Maintenance Engineer	WG3 Leader	
Eng. Mohamed Emad	Maintenance Engineer	WG4 Leader	
Eng. Mamdouh Saliman	Maintenance Engineer	Fulltime Counterpart	
Eng. Dalia Adel Aly	Maintenance Engineer	Coordinator	
Eng. Ayman Metwally	Maintenance Engineer		Added
Eng. Monged Mostafa	Maintenance Engineer		Added
Eng. Reham Abdelrahman	Maintenance Engineer	Assistant Coordinator	Added
Eng. Malwa	Part-time Engineer	Assistant Coordinator	Added

(JICA)

Name	Position
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Leader, JICA Short-term Expert
Mr. Hideo Nagao	JICA Short-term Expert
Mr. Osamu Tsukahara (Mr. Takefumi Yamazaki)	JICA Short-term Expert
Mr. Takashi Matsuo	JICA Short-term Expert
Mr. Teruyuki Miyakawa	JICA Short-term Expert
Mr. Kokichi Terai	JICA Short-term Expert
Mr. Hirofumi Uemura	JICA Short-term Expert
Ms. Nagisa Okada (Mr. Jun Nakamura)	Coordinator, JICA Short-term Expert

3.2 Cooperative Framework

1) Project Member

GARBLT has not have the department specialized for bridge maintenance, and only a limited number of the bridge engineers from the headquarters perform their tasks and are responsible for all the bridge maintenance and bridge construction across the country in each region of the charge.

All the coordinators and engineers from GARBLT who are assigned for the project must manage their own tasks, not only cooperating in the project. Therefore it was difficult for them to work as full-time staff in the project. However, in the end of the third year, in October 2014, four young engineers were positioned as full-time counterparts, and this made it clear that the BMS project would be take over successfully.

Picture 3-2 4 Counter-part Engineers

2) Facilities

An office for expert was provided from GARBLT, as well as storage for equipment. Equipment was moved into headquarters building due to removal of the storage.

Conference room and projector were provided for WG and seminars, Cooperation from District Offices was requested, cost for GARBLT engineers' trip was burdened, and permission for drawings was provided from GARBLT headquarter.

3.3 Disincentive Facts

There were no disincentive facts that affect policy and the purpose though schedule has been change due to instable security.

1) The Effect of the Security Concerns

The project has experienced the assumption and dislodgement of the former President Morsi and the assumption of the President Sisi. Because of the political and security unstableness in Egypt, the project team had to leave the office early or stand by on the hotel due to the frequent riots. Furthermore, there were times when the project team had to suspend the Detailed Inspection and Routine Inspection at the District Offices, because of the security situation in the districts. Particularly, during July to October, in the second year, the political disorder in Egypt was severe, and the project team had to leave the country for the safety reasons. Later, the security situation in Cairo had been reformed by the assumption of the President Sisi. However, the explosion incidents have been occurring since February, 2015.

Under the influence of the unstable security situation, introduction of the Bridge Inspection Vehicle had been delayed, and the period of the project was extended for three months. Also, since the period of interruption of the activities was not clear, it was difficult to decide the dispatch period for the short-term experts, therefore most of the suspended activities in the second year were conducted in the third year.

2) Frequent Replacement of Chairman of GARBLT

Due to the political unstableness in Egypt, the Chairman of GARBLT has been replaced five times during the project. Due to replacement of chairmen, assignment of GARBLT counterpart engineer was delayed, which did not have serious effect on Project activities.

3) Bridge Inspection Engineer in GARBLT

For the purpose of activating the activities of the project, based on the recommendations of the mid-term evaluation survey results, participants in the trainings in Japan was appointed to the core team of bridge inspection. However, since the technician was appointed to the core team, without increasing the number of the engineers, the establishment of the core team did not activate the project.

After coordination with GARBLT, 4 engineers were appointed for the Project. They were active for participating the Project, which gave positive impacts on facilitating technical transfer.

3.4 The Furtherance Factors

1) Recognition of the Importance of Maintenance

Some serious incidents, which reminded us the importance of the Bridge Maintenance Management, occurred during the project period. The incidents were the fatigue failure occurred at the steel bridge in the highway and the severe damage caused by the fire in the highway. Fortunately, no one perished in the incidents. However, those remained as a huge impact for the bridge management authority.

2) Appointing Four Young Engineers

Although the performance of the project could be seen to be decreasing because of the failure of core team, in October 2014, four young engineers were appointed as full-time counterpart in the project and cooperated in the activities conducted by the Japanese staff. The four engineers are highly motivated, and they showed interest through the Bridge Inspections, the Detailed Inspections, the Repair OST and by operating BMS.

3.5 Ingenuities in the Activity

1) Communication Facilitation

During the three year project, the activities were planned as follows.

- In the first year, the Japanese expert play the main role in the activities.
- In the second year, the Japanese expert and the GARBLT engineers cooperate in the activities.
- In the third year, the GARBLT engineers play the main role and the Japanese experts support them in the activities to transfer the technical methods step by step to the GARBLT engineers.

However, there were dificuluty with implementation of conference or seminars due to the language barrier. For coping with the language barrier, the following methods were taken.

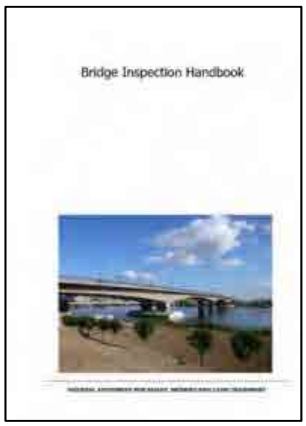
- The materials and documents for WG were translated into Arabic and explained by the GARBLT engineer in Arabic.
- The questions and answers in the WG were also made in Arabic.

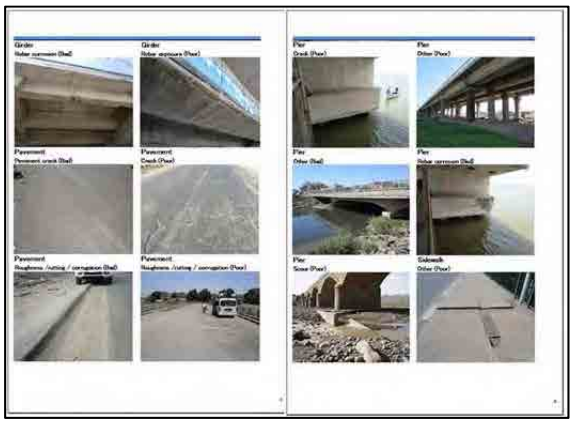
This idea made a positive effect in the WG, such as:

1) the descriptor's understanding were deepened,
2) the contents could be much easier to understand by the listener,
3) because there was no language barrier, the question and answer became more active.

2) Inspection

Handbook was prepared by extracting damage cases, judgment stabdard and pictures from manual, for efficient inspection. This handbook was helpful for explaining outline, convenient to carry around, which was useful also for expert team.





Picture3-3 Bridge Inspection Handbook

3) Utilization of Media

The Project introduced Bridge Inspection Vehicle for the first time in Egypt. Inspection using Bridge Inspection Vehicle was broadcasted on TV.

This could contribute to facilitate understanding of people in Eygpt for importance of bridge maintenance management.

Picture3-4 Interview from TV

3.6 Publicity

Since there is no official website run by GARBLT, contrary to our first expectation, it was impossible to introduce the project's activities by a website. However, the information on the project's activities were reported to the JICA official website.

The project's news lists are shown below:

Table 3-6 Project News

DATE	TOPICS	CONTENTS
27th May, 2012	Outline of the Project	The outline of the Project was explained to the Chairman of GARBLT, and the request for the first JCC was made in the meeting.
2nd of July, 2012	1st JCC	The plan for the project's activities, the expected result and the cooperation agreement were discussed, and the work plan has been approved.
17th July, 2012	Inspection at Aswan Bridge	The expert engineer for cable-stayed bridge who is responsible of the Inspection Manual for Aswan Bridge conducted the inspection onsite, also checked the maintenance management system in the District Office.
9th December, 2012	Counterpart Training in Japan	From 25th of November to 9th of December, 2012, 5 counterpart engineers from GARBLT visited Japan to study the bridge maintenance management methods in Japan.
4th March, 2013	Aswan Bridge inspection trial	The trial was conducted in order to verify the validity of the frequency of Condition Inspection and the Routine Inspection, and to set the Judgment standard.
21st March, 2013	OST for the Routine Inspection	The training on the Routine Inspection was conducted in order to confirm the usefulness of the Inspection Forms at Tanta District Office
15th May, 2013	2nd JCC	The results from the activities in the first year and the activity plans for the second year were discussed. Also, the activation of WG was discussed, and Increasing the number of WG engineers has been approved.
13rd June, 2013	OST at the Bridge on Cairo Ring Road	The OST was conducted for the bridge on Ring Road, and trainings on the Condition Inspection and the Routine Inspection were given to the engineers. The Judgment standard based on the Inspection Manual was confirmed.
13th April, 2014	OST of Repair Work	The OST was focused on the repair work by using shotcrete to give more understandings for the appropriate repair work.
DATE	TOPICS	CONTENTS

22nd May, 2014	Seminar on Steel Bridge Fatigue	The seminar was held to give the basic understandings of steel bridge fatigue.
28th May, 2014	OST of the Condition Inspection	The OST was conducted based on the Inspection Manual. Types of damage and the judgement standards were explained to the participants at the site.
11th June, 2014	OST of the Detailed Inspection	The OST of the Detailed Inspection was conducted for the participants. During the training, the non-distractive testing equipment and the usage were introduced at the site.
15th June, 2014	Training in Operating BMS	The training was provided to give the instruction about BMS, which stores the bridge data and the results from the inspections.
8th November, 2014	Introduction of Bridge Inspection Vehicle	The Bridge Inspection Vehicle to be used for specific inspections has been introduced to GARBLT. The trainings to operate the vehicle was also provided.
21st November, 2014	Counterpart Training in Japan	The third counterpart training in Japan was conducted, and 5 engineers from GARBLT participated in the training. The participants studied Fatigue testing of steel bridge
14th January, 2015	OST of the Condition Inspection	The training by using the Bridge Inspection Vehicle was given to the engineers. The safety methods to operate the vehicle was studied and understood by the engineers.
27th February, 2015	Seminar on Steel Bridge Fatigue	The second seminar on steel bridge fatigue was conducted, and the engineers from the private enterprise have joined the seminar as well as the engineers from GARBLT.
16th March, 2015	Inspection at Aswan Bridge	The inspection by using the Bridge Inspection Vehicle was conducted at Aswan Bridge. The vehicle is ideal for the inspection at long-span bridges.
21st June, 2015	The Final Seminar	Overall activities and bridge condition in Egypt, inspection by GARBLT, utilization of BMS, training in Japan and future management plan were reported. Lecture of Prof in Azhar University was implemented.

The followings are examples of Project News on JICA website.

(Examples of Project News on JICA website)

独立行政法人 国際協力機構

本邦研修

2012年11月25日～12月9日

2012年11月25日から12月9日、GARBLT職員にわが国のすぐれた橋梁維持管理の実情を紹介することで、橋梁維持管理の重要性に対する理解を促進するため、本邦研修が実施されました。5名の職員が来日し、橋梁維持管理に関する講義および実習に参加しました。


意見交換を行う研修員


塔頂部視察を行った研修員


伸縮装置の点検実習


橋梁点検車を用いた維持管理実習

わが国の橋梁維持管理の経験や技術を伝えるため、本州四国連絡高速道路株式会社の協力を受け、明石海峡大橋の点検路視察や瀬戸中央自動車道の高架橋での橋梁点検車を用いた実習等を行いました。研修を通じ、橋梁維持管理の重要性が理解されたとともに、エジプト国の維持管理に対する問題意識が研修員間で明確化されました。研修員が今後のプロジェクトに積極的に参画し、問題点を改善するための提案が行われることが期待されています。

独立行政法人 国際協力機構

定期点検の現場実習　Naga hammady橋ほか

定期的に橋梁を点検することによって、その時点での橋梁の状況が把握できるだけでなく、過去の点検結果との比較によって、損傷・劣化の進展の度合いを知ることができます。定期点検は基本的に目視で実施するため、点検員は損傷の種類、特徴、損傷のレーティングを十分に理解していることが大事です。
プロジェクトでは実際の橋梁を対象に定期点検の訓練を行っています。ハンマーでの打音検査、クラックゲージを使ったキレツ幅の測定など、基本的な点検方法を指導し、伸縮装置の破損、支承周辺の土砂の堆積、防護柵の破損、コンクリート床版のキレツ、鋼橋の溶接個所の異常などの一般的な損傷事例を現地で確認しています。


記録用紙の使い方を説明する


発見した損傷を記録する


近寄れないところは双眼鏡で確認する

4. Equipment

4.1 Procurement method

All the provided equipment was procured locally, the procurement was processed according to the JICA procurement guidelines and the procurement rules by JICA Egypt Office, and the process was carried out in six times depending on the progress of activities. In principle, we began with confirming with retailers, collecting estimate reference, preparing technical specifications, confirming procurement principles, submitting estimates, and appointing suppliers in this order.

Procurement of five generators to supply power to high-pressure washers was planed at the time of commencement of the project, which was then postponed as we could obtain the ones equipped with generators. An additional core drill was procured to collect concrete samples to measure the neutralization of concrete, and a generator was procured to supply power to the drill. As the rebar inside the bridge substructure concrete is installed at a location deeper than the surface compared to the superstructure, one radar type and one magnetic type Reinforcement detectors were procured.

As the BMS development was completed and the operation system, which was not determined at the time of the contract signing, was then determined, an additional server for the BMS was procured. A photo resize engine to considerably reduce the size of photo data was procured additionally as the BMS handles a large volume of photo data.

4.2 Provided equipment

The types, major specifications and quantity of the equipment provided for the local activities are described as follows.

Table 4-1 Equipment and Specifications

No.	Item	Basic Function	Spec.	Model	Qty	Unite Price Total Price
1	Concrete Rebound Hammer	To test concrete strength	Measurement range from 10 to 70 N/mm2. Impact energy: 2.207 Nm. Autonomy (non continuous use): more than 5 hours. Rebound values are read from a dial..	Proceq Original Schmidt Type N	2	
2	Testing Anvil for Concrete Rebound Hammer	Calibrator of the above equipment	the model suitable for the above concrete hammer	Proceq Testing anvil Type N	2	
3	Ultrasonic Tester for Concrete Crack	To measure depth of concrete cracks	Transit time range: 0.1-9999 µs Resolution: 0.1 µs Energising pulse: 125 V, 250 V, 350 V, 500 V, AUTO Tx frequency range: 125 V, 250 V, 350 V, 500 V, AUTO Transit time: Yes Pulse velocity: Yes Path length: Yes Surface velocity: Yes Crack depth: Yes Memory: > 500 readings Power supply: Mains/Battery(>20h)/USB Integrated gain stage: 1x, 10x, 100x Accessories: Standard 54kHz Transducer (Quantity: 2) , Carrying Bag	Proceq Pundit Lab	1	

No.	Item	Basic Function	Spec.	Model	Qty	Unite Price Total Price
4	Carbonation Test (Phenolphthalein)	To measure carbonation of concrete	Alkalinity Reagent System Phenolphthalein End Point 0-500mg/liter. Sufficient for 50 Tests.	ELE 433-096 *Control 58-E0063	20	
5	Half Cell (Chloride ion Penetration Tester)	To survey corrosion of reinforcement in concrete	Display: 3½ digit plus sign via 12.5 mm LCD Range/Resolution: +1999 mV / +1 mV Battery operated: giving typically 1000 hours use with low battery indication Copper sulphate reservoir for measurement/ reference electrode Container of copper sulphate (250ml) Wetting agent reservoir (125ml) Dispending sponge. Accessories: Cable reel with 80m cable, Carrying Case	Controls 58-E0065/A *James Instruments CM-4500	1	
6	Paint Thickness Meter	To measure thickness of coating on the steel surface	Typical Applications: Ferrous metals (steel and cast iron) Interchangeable Connecting Probe. Range: 0- 60 mils, 0- 1500 μm Accuracy: ±(0.05mils + 1%) 0-2 mils, ±(0.1mils + 1%) >2 mils, ±(1μm + 1%) 0-50μm, ±(2μm + 1%) >50μm Memory storage of 5000 reading in up to 100 groups. Software for charting and graphing, USB port Accessories: separate probe, precision plastic shims, protective rubber holster, couplant, 3 AAA batteries, instructions, nylon carrying case, Software for charting and graphing, USB cable	PosiTector 6000-FS3 Memory	1	

No.	Item	Basic Function	Spec.	Model	Qty	Unite Price Total Price
7	Reinforcement Detector (Magnetic Type)	To locate reinforcement in concrete	Memory: non-volatile memory for 40'000 measured values and 60 objects respectively Display: LCD with backlight option Interface: RS 232 or with Adapter for USB Port on PC Software: ProVista for downloading data and evaluation on PC Batteries: 6 x 1.5V for 45h operation; 30h with backlight on Temperature Range: -10° to +60° C	Proceq Profometer 5 Model S	1	
8	Ultrasonic Metal Thickness Gauge	To measure thickness of steel plate	Applicable for measuring thickness of metal and ceramics, and extent of corrosion on metal and ceramics Range: 0.0060-1.0000" (0.15–25.40 mm) Other ranges available with optional probes. Resolution: .0001" (0.001 mm) Display: 4 1/2 -Digit, 0.5" Backlit LCD Velocity Range: 6,500-33,000 ft./sec (1250-10000 m/sec.) Probe: 1/4", 15 MHz, actual wearface is 3/8" (9.5mm) Probe Wearface: PEEK (Polyethylethylkeytone) Cable: 4 ft. (1.2 m) waterproof cable with non-polarized, quick-disconnect connectors. Optional lengths up to 50 ft. (15 m) Accessories: gauge, probe, 4 oz. bottle of coupling fluid, 2 AA batteries, NIST Calibration Certificate and Operating Instruction Manual, carrying case	CheckLine TI-007	1	
9	Portable Water Pressure Washer	To clean up surface of bridge before inspection	3.0 GPM @ 2500 PSI, 170 bar pressure washer with Engine Engine Type Air-cooled 4-stroke OHV, Net Power Output: 4.8 HP (3.6 kW) @ 3,600 rpm Fuel: Unleaded 86 octane or higher Fuel Tank Capacity: 3.3 U.S. qts (3.1 liters) Starting System : Recoil Starter with pump, gun, hose	Pump washing factories and workshops DLQ5/ GX160	5	

No.	Item	Basic Function	Spec.	Model	Qty	Unite Price Total Price
10	Generator	To provide electricity to Microcore Drill	Gasoline engine type, Capacity 3000W, Automatic voltage regulator	Pump washing factories and workshops DLQ5/ GX160	1	
11	Repair Materials	To repair concrete section by shotcrete method	Bonding Material Shotcrete Material Curing Material	BASF Rheomix 140, BASF Shotpatch 10, BASF Mastercure 102	1	
12	Coating Paint	To protect steel surface	Protective Coating Paint Repair Grout materials Surface Protection Coat	Sika Zinc Rich – 2, Sikagrout – 214, SikaFerrogard – 903	10	  
13	Microcore Drill	To drill a hole in concrete structure to sample concrete material	Electric drill (Concrete Coring: 20mm×160mm), 2000W, AC220V 50/60Hz-Single Phase Drillingf guide stand, Diamond core bit 20mm×300mm, 25 anchors 8Dia. 12mm) for guide stand, Handy Pump Water Spray	WEKA Wet+Dry 3-speed Diamind Core Drill DK17	1	
14	Reinforcement Detector (Radar Type)	To locate reinforcement in concrete structure	Detective radar, Handy type, Measuring depth range: 0.5 to 30cm approx. Search Distance: 15m or more, Max. scanning rate: 40cm/s, Display: TFT color LCD (640×480 bits), Memory card capacity: 1G or more, Printer interface, Rechargeable battery: AC220 50/60Hz Single phase,	Handy Search Proceq 39000001	1	
15	BMS Server	To control BMS operation	DELL PE T110 II Intel Xeon E1220 ((3.1GHz, 4C/4T, 8M Cache, 80W, Turbo), 16 Ram LV UDIMMs) 1333MHz, , 2x1TB HDD SATA 7.2K 3.5-inch NPL , iDrac6 embedded C4 Cabled MST R1 With PERC S100	Dell PE T110 Intel Xeon E1220	1	

No.	Item	Basic Function	Spec.	Model	Qty	Unite Price Total Price
16	Photo Resize Engine	To downsize photo data to be stored in BMS	FileType: Microsoft Word（97-2013）, Microsoft Excel（97-2013）, Microsoft PowerPoint（97-2013）, JPEG, PDF, TIFF File(Not archive), ZIP, XP, Windows Standard (Windows XP、7、8.1), Win ZIP(Ver 17.5), Lhaplus (Ver 1.59), 7-ZIP(Ver 9.20) Function: Configuration, Execute status monitor, Report, Scheduling	NX PowerLite	1	

4.3 Other Equipment

The types, major specifications and quantity of the equipment are described as follows.

Table 4-2 Equipment and Specifications

No	Item	Model	Qty	Photo
1	Projector	Epson EB-925	1	
2	Video Camera	Sony Handycam HDR-XR260 with $GB SD	1	
3	Voice Recorder	Olympus VN-8110	1	
4	Copier	Toshiba e-studio 225 MY 1038+KA164	1	
5	Digital Camera	Panasonic FH2R with 4GB SD	3	
		Panasonic Lumix DMC FT4	2	
6	Laptop Computer	Dell Latitude E6420 Win Pro 7 SP1	3	
		Dell Latitude E6420 Win Pro 7 SP1	2	
7	Helmet	MSA V Guard	60	 
8	Rubber Cone	Cone 100cm	30	
9	Safety Belt	FAT	60	
10	Safety Vest	Phosphoric vest	60	
11	Handy GPS	Garmin Etrex30	4	
12	Distance Meter	Hilti PD5	4	

5. Achievement the Project Purpose

This Project was implemented to improve the GARBLT's bridge maintenance performance by helping the GARBLT engineers understand the concept of preventive maintenance of bridges, and introduce and facilitate bridge maintenance inspection performance, bridge repair performance, and the BMS system. We aimed that the bridge maintenance skills are effectively and assuredly transitioned from the Japanese specialists to the GARBLT's engineers.

Due to the worsening security in 2013, we were forced to halt the local activity for three months, and the introduction of a bridge inspection vehicle was delayed. However, it was handled by extending the Project's local activity for three months, therefore inspection training with use of the vehicle was implemented effectively.

As described in the chart below, activities by the Japanese specialists were performed as scheduled in general.

GARBLT increased the staff in November 2014, and four newly hired engineers were assigned as special counterparts of the Project, which realized the focused skill transition in all the activities in including bridge inspection, bridge repair and BMS. Therefore, the Project purpose was achieved by the completion of the Project.

Objectively Verifiable Indicator	Achievement
1. Bridge inspection on 20 selected bridges are carried out by GARBLT engineer properly	・ OST for all 20 bridges subjected to the inspection was completed as of March 2015. ・ Skills of the four GARBLT engineers reached to a point where they can teach OST as of April 2015. ・ OST with use of the bridge inspection vehicle was carried out intensively from February to May in 2015.
2. Typical repair technologies are demonstrated on several bridges	・ Washing OST by high-pressure washers and the shotconcrete method were carried out in April 2014. ・ Selecting OST for repair method of the concrete structure was carried out in November 2014. ・ Installation management OST was carried out in November 2014.
3. GARBLT starts inspection on bridges other than target bridges in each district and the inspection and repair records are properly input in the BMS	・ The four GARTBLT engineers performed the regular inspection without a support by the Japanese engineers. ・ In addition to the 20 bridges subjected to the inspection, inspection results of 18 more bridges were input into the BMS.

6. Other Issues

6.1 Collaboration with the Donor Organization and Other Projects

There was no coordination with other donor organizations and projects during the project implementation period. Pavement management system (PMS) introduced by the World Bank, has been placed in the office in the Road Management Section of GARBLT Headquarters, which made it possible to assume the future issues and the application of BMS.

It was found that the pavement management system in GARBLT is a separate system which is not connected to any external communication, such as the Internet, and no single maintenance was done by the system specialist since the system had been installed.

The assumed conditions determined by considering the current situation of the Pavement Management System are shown below. The further details will be described in the pages on the Development of BMS .

- The necessity of the Full-time Counterpart for BMS

  In order to manage and operate BMS appropriately, it is necessary to assign full-time counterparts. To operate the system without having responsible structure could cause the breakdown of the whole system even by very simple error, which can be a concern about the operation after the Project.

- The Necessity of Maintenance of the Equipment

  Stand Alone System could be unstable since it depends on the soundness of the client's PC. In contrast, the Web System, by creating an environment to let multiple users to operate the system, could make it possible to run a self-checking for the continuous operation of the system.

7. The Transition of PDM

Although the project has been carried out the activities based on PDM which instructed at the time of contract, taking the results from the Mid-term Evaluation into consideration, some of the contents of PDM have been modified. The reasons of the modification are as follows:

1) Overall Goal

GARBLT are required to concentrate more on the maintenance management of the bridges managed by GARBLT itself while bridges managed by the local governorates, whose numbers were limited, were excluded.

2) Indicator of the Project Purpose

Reflecting the situation in Egypt, demonstrations of repair work at the other bridges, not only the 20 target bridges have been taken into account.

Some of the expressions about BMS input have been modified.

3) Indicator of Output-3

Remove the steel bridge from the target of repair technology, limit the subject to concrete bridges.

4) Output -3

Assuming the scale of work to be directed by GARBLT, the range of repair works has been limited to the minor repair works. Strengthen the capacity of selecting a repair work method and supervision of the contractors by exploiting the construction works ordered by GARBLT.

5) Input

Establish the Project Assistant Director, and appoint the Head of the Bridge Sector. Except the Trainings for Counterpart in Japan, there was no other training was planned, therefore, input only for the Trainings for Counterpart in Japan have been assumed.

6) Technical Terms

The technical terms have been unified according to the Inspection Manual.

7) Pre- Conditions

Since the political instability had continued, we removed the term “Political Stability” from PDM.

8) Important Assumptions

The terms in the documents have been unified. The security concerns have been mentioned as a

major effect to the Project activities and its results.

PDM transition and comparison are as show below. PDM at completion of the Project is ver. 4, in which project period in ver. 3 March 2012- March 2015 (36 months) to March 2012 – June 2015 (39 months).

PDM	Ver. 1	Ver. 2	Ver. 3
Overall Objectively Verifiable Indicators	a. GARBLT holds regular workshops for local government engineers to spread proper bridge maintenance over Egypt.	a. GARBLT holds regular workshops for local government engineers to spread proper bridge maintenance over Egypt.	a. GARBLT holds regular workshops for its ~~local government~~ engineers to spread proper bridge maintenance over Egypt. Reason : There are few bridges managed by local government
Project Purpose Objectively Verifiable Indicators	b. Typical repair work on several Target Bridges is completed	b. Typical repair technologies are demonstrated on several Target Bridges. Reason: To avoid impression that project activity is repair construction of bridges by Japan side.	b. Typical repair technologies are demonstrated on several ~~target~~ bridges~~.~~ Reason: To coordinate inspection schedule considering security condition and construction schedule
Project Purpose Means of Verification	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	Records of inspection & repair. b. Records of inspection & repair. ~~c.~~ Records of inspection & repair and data in BMS. Reason: To integrate basis of several data.

PDM	Ver. 1	Ver. 2	Ver. 3
Output3. Objectively Verifiable Indicators	b. Bridge repair is carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	b. Typical bridge repair technologies are demonstrated on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	b. Typical bridge repair technologies, such as minor repair, selecting of repair methods and supervising contractors are demonstrated on concrete bridges ~~typical three types of bridges (RC, PC and Steel)~~ with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts. Reason: To concentrate on concrete bridges as 90% of bridges in Egypt are of concrete. To integrate b. and c.
Output3. Means of Verification	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	a. Manual developed in the Project. b. Repair reports by GARBLT engineers Reason: due to integration of above b. and c.
Activities for Output 3	3-2 Implement the Pilot Project for bridge repair (minor repair)	3-2 Implement trainings of typical bridge repair technologies through the Works for bridge repair (minor repair) Reason: To avoid impression that project activity is repair construction of bridges by Japan side.	3-2 Implement trainings of minor repair Reason: To make it clear that training will be performed in minor repair construction implemented by GARBLT.

PDM	Ver. 1	Ver. 2	Ver. 3
Activities for Output3	3-3 No description	3-3 No description	3-3 Implement trainings on selecting of repair methods and supervising contractors through GARBLT's works Reason: To improve capacity for selection of construction method and supervision utilizing construction contracted with GARBLT.
Inputs Egyptian side	No description	No description	Project Assistant Director Reason: As new head of bridge sector would be appointed.
Inputs Japanese side (3) C/P Training in Japan and/or third country	(3) C/P Training in Japan and/or third country	(3) C/P Training in Japan and/or third country	(3) C/P Training in Japan ~~and/or third country~~ Reason: only training in Japan has been planned.
Technical term	Periodic Inspection	Periodic Inspection	Condition ~~Periodic~~ Inspection Reason: To integrate terminology
Pre-conditions	Political stability	Political stability	Political stability Reason: Political stability cannot be pre-condition under the continuous instability.

PDM	Ver. 1	Ver. 2	Ver. 3
Important Assumptions	GARBLT Central Office	GARBLT Central Office	GARBLT HQ Reason: To integrate terminology. To avoid confusion with Central District Office.
Important Assumptions	No description	No description	The security circumstances are not worsened. Reason: As aggravation of security can give serious influence on the Project.
Important Assumptions and Pre-conditions	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions C/Ps allocation without any delay.	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions C/Ps allocation without any delay.	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions The project budget and C/Ps are allocated without any delay. Reason: To integrate into pre-conditions.

8. Recommendations

"The Project for Improvement of the Bridge Management Capacity in Egypt" achieved its purpose "Capacity of GARBLT on bridge maintenance management is improved." It is expected that GARBLT engineers trained in the Project will take initiative for inspection using manuals developed in the Project and donated equipment. The below is recommendations for achieving overall goal "Bridges in Egypt are maintained properly."

8.1 Recommendation for Bridge Management of GARBLT

1) Establishment of the Bridge Maintenance Department in GARBLT Headquarters

Improvement of capacity of GARBLT can be shown by the fact that inspection can be implemented only by GARBLT, whose data cannot be defected.

In order to enhance the bridge maintenance capacity of GARBLT, it is desirable to hold a seminar once a year. At the seminar, it is required to find a solution to the questions related to the Bridge Maintenance Manuals and sharing the information gained from the activities at the District Offices.

Necessity for follow-up was mentioned by GARBLT side in final JCC hold in 23 June, 2015, which can be appreciated.

2) Utilization and Revision of the Manuals

The Manuals developed through this Project can be viewed on BMS server. These need to be distributed to GARBLT engineers via intra-net, which can be realized through improvement of facilities for LAN or intra-net.

The Manuals of bridge maintenance management that are created in this Project, should be utilized to conduct an appropriate maintenance for bridges.

Moreover, the Manuals should be updated and reviewed in accordance with the improvement of design technology, repair material and inspection equipment. Continuous revision and utilization of manuals can be expected from the experience that GARBLT engineers made documents and presentations by themselves in the final seminar.

3) Human Resource Development

The full-time counterpart who joined the Project substantially, assigned by GARBLT, were the four young engineers who were assigned in October, 2014. They have the experience of participating in the daily activities of the Project along with the Japanese experts, and are expected to be a core of personnel to take the responsibilities for the bridge maintenance of

GARBLT after the end of the Project.

In order to carry out an appropriate maintenance of bridges, the engineers are required to be experienced in design, construction and maintenance of bridges. GARBLT should focus more on development of human resources to enhance the ability of the bridge management engineers.

To avoid the shortage of the bridge inspection engineers, GARBLT should support the development of human resources of each District Office.

8.2 Lessons

1) Method on technology diffusion

Competition

Two operators for Bridge Inspection Vehicles have been allocated. Acquisition of technique for the operation could be facilitated by completion between two operators, which can be utilized for future training.

Selection of engineers

Engineers who are not specialized in the bridge fields sometimes actively participated in the Project. It was learnt that engineers in the fields other than bridge can be assigned to the Projects for facilitation.

Utilization of Arabic

Arabic translated materials were distributed for engineers who cannot understand English. This contributed to 1) improve understanding of engineers, and 2) facilitate question and discussion by eliminating language barriers, which can be utilized in the future WGs.

2) How to hold OST

One Japanese expert sometimes had to train 10 GARBLT engineers, which affect efficiency of explanation. At least Two Japanese engineers would be required for explanation in OST.

1) PDM

Comparison and Reasons in relation to Revised PDM

PDM	Ver. 1	Ver. 2	Ver. 3
Overall Objectively Verifiable Indicators	a. GARBLT holds regular workshops for local government engineers to spread proper bridge maintenance over Egypt.	a. GARBLT holds regular workshops for local government engineers to spread proper bridge maintenance over Egypt.	a. GARBLT holds regular workshops for its ~~local government~~ engineers to spread proper bridge maintenance over Egypt. Reason : There are few bridges managed by local government
Project Purpose Objectively Verifiable Indicators	b. Typical repair work on several Target Bridges is completed	b. Typical repair technologies are demonstrated on several Target Bridges. Reason: To avoid impression that project activity is repair construction of bridges by Japan side.	b. Typical repair technologies are demonstrated on several ~~target~~ bridges~~.~~ Reason: To coordinate inspection schedule considering security condition and construction schedule
Project Purpose Means of Verification	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	Records of inspection & repair. b. Records of inspection & repair. ~~c.~~ Records of inspection & repair and data in BMS. Reason: To integrate basis of several data.

PDM	Ver. 1	Ver. 2	Ver. 3
Output3. Objectively Verifiable Indicators	b. Bridge repair is carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	b. Typical bridge repair technologies are demonstrated on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	b. Typical bridge repair technologies, such as minor repair, selecting of repair methods and supervising contractors are demonstrated on concrete bridges ~~typical three types of bridges (RC, PC and Steel)~~ with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts. Reason: To concentrate on concrete bridges as 90% of bridges in Egypt are of concrete. To integrate b. and c.
Output3. Means of Verification	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	a. Manual developed in the Project. b. Repair reports by GARBLT engineers Reason: due to integration of above b. and c.
Activities for Output 3	3-2 Implement the Pilot Project for bridge repair (minor repair)	3-2 Implement trainings of typical bridge repair technologies through the Works for bridge repair (minor repair) Reason: To avoid impression that project activity is repair construction of bridges by Japan side.	3-2 Implement trainings of minor repair Reason: To make it clear that training will be performed in minor repair construction implemented by GARBLT.

PDM	Ver. 1	Ver. 2	Ver. 3
Activities for Output3	3-3 No description	3-3 No description	3-3 Implement trainings on selecting of repair methods and supervising contractors through GARBLT's works Reason: To improve capacity for selection of construction method and supervision utilizing construction contracted with GARBLT.
Inputs Egyptian side	No description	No description	Project Assistant Director Reason: As new head of bridge sector would be appointed.
Inputs Japanese side (3) C/P Training in Japan and/or third country	(3) C/P Training in Japan and/or third country	(3) C/P Training in Japan and/or third country	(3) C/P Training in Japan ~~and/or third country~~ Reason: only training in Japan has been planned.
Technical term	Periodic Inspection	Periodic Inspection	Condition ~~Periodic~~ Inspection Reason: To integrate terminology
Pre-conditions	Political stability	Political stability	Political stability Reason: Political stability cannot be pre-condition under the continuous instability.

PDM	Ver. 1	Ver. 2	Ver. 3
Important Assumptions	GARBLT Central Office	GARBLT Central Office	GARBLT HQ Reason: To integrate terminology. To avoid confusion with Central District Office.
Important Assumptions	No description	No description	The security circumstances are not worsened. Reason: As aggravation of security can give serious influence on the Project.
Important Assumptions and Pre-conditions	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions C/Ps allocation without any delay.	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions C/Ps allocation without any delay.	Important Assumptions The project budget allocation and necessary equipment procured by GARBLT without an major delay. Preconditions The project budget and C/Ps are allocated without any delay. Reason: To integrate into pre-conditions.

Appendix 1: Project Design Matrix(PDM) Version 1

Issued Date : / /2012

Project Period; March 2012 ～ March 2015 (3.0 years)
Target Areas; Whole regions of Egypt
Target Group: (Direct) Bridge Maintenance Engineers in GARBLT and district offices; (Indirect) users of bridges in Egypt

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
[Overall Goals] Bridges in Egypt are maintained properly.	a. GARBLT holds regular seminars/trainings for local government engineers to spread proper bridge maintenance over Egypt. b. Bridges in Egypt are managed properly based on the manuals developed in the Project	a. Records of seminars/trainings. b. . Records of inspection & repair.	
[Project Purpose] Capacity of GARBLT on bridge maintenance management is improved.	a. Bridge inspections on 20 selected bridge are carried out by GARBLT engineers properly b. Typical repair work on several target bridges s completed. c. GARBLT starts inspection on bridges other than target bridges in each district and the inspections and repair records are properly input in the BMS.	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	The responsibility of GARBLT for bridge maintenance does not change. Necessary Budget for bridge maintenance is properly secured.
[Outputs] 1. Bridge maintenance management cycle is enhanced.	a. Model action plans for improving maintenance management cycle, such as keeping/sharing drawings and technical documents, are implemented. b. More than 70% of bridge maintenance engineers of GARBLT pass achievement tests about bridge maintenance management cycle.	a. Model action plans. b. Monitoring reports on model action plan, interviews with engineers.	The C/Ps who participated in trainings conducted in the Project continues their work at the same position during the Project period. Manuals/Guidelines developed by the Project are officially approved without any major delay by GARBLT Central Office.
2. Capacity of GARBLT's engineers on bridge inspection is enhanced.	a. Bridge inspection manual is developed. b. Bridge inspections are carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The quality of the inspection by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Inspection Reports by GARBLT engineers.	
3. Capacity of GARBLT's engineers on bridge repair is enhanced.	a. Manual/guideline on bridge repair is developed. b. Bridge repair is carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	
4. Bridge Management System (BMS) is prepared.	a. BMS is developed. (Step 0; Basic System Design) (Step 1; Development of database) (Step 2; addition of the function of repair cost analysis) b. The inspection/repair results of bridges are properly recorded in BMS.	a. Manual/guideline developed in the Project. b. Data in BMS.	

<table>
<tr>
<td rowspan="2">[Activities]
1. Activities for Output 1
1-1 Review current maintenance management cycle and identify issues necessary to be improved
1-2 Propose measures to improve maintenance management cycle
1-3 Take trial actions on the proposed measures
1-4 Conduct seminars on bridge maintenance management cycle

2. Activities for Output 2
2-1 Develop Bridge Inspection Manual
2-2 Implement trainings on bridge inspection (Inventory, Routine, Periodic, Detail) with utilizing Bridge Inspection Manual
2-2-1 Implement Inventory Registration
2-2-2 Implement Routine Inspection
2-2-3 Implement Periodic Inspection
2-2-4 Implement Detail Inspection (several bridges)
2-3 Develop Bridge Inspection Manual for Aswan Bridge
2-4 Implement trainings on inspection (Inventory, Routine, Periodic) of Aswan bridge with utilizing the Inspection Manual for Aswan Bridge
2-4-1 Implement Inventory Registration
2-4-2 Implement Routine Inspection
2-4-3 Implement Periodic Inspection

3 Activities for Output 3
3-1. Develop Bridge Repair Manual/Guideline
3-2. Implement trainings through the Pilot Project for bridge repair (minor repair)

4 Activities for Output 4
4-1.Develop BMS, composed of inventory and inspection record functions. (STEP-1)
4-2.Input data (Inventory, Routine, Periodic, Detail Inspection Results)
4-3. Implement trainings with utilizing BMS.
4-4. Upgrade BMS, to deal with evaluation of bridge damage and cost estimation function for bridge repair. (STEP-2)</td>
<td colspan="2">[Inputs]</td>
<td rowspan="2">The Project budgets allocation and necessary equipment procured by GARBLT without any major delay</td>
</tr>
<tr>
<td>[Japanese side]

(1) Dispatch of Experts
Long-term Expert; Chief Adviser
Short-term Experts; Leader/Bridge Management Expert
Bridge Inspection Expert
Bridge Repair Expert
BMS Expert
Cable-Stayed Bridge Expert
Coordinator

(2) *1)Provision of Equipment
- Bridge Inspection Vehicle
- Equipment for Bridge Inspection
- Equipment and Material for Bridge Repair

(3) C/P Training in Japan and/or third country

(4) Cost Shared by Japanese side
- Project Vehicle used by Japanese Experts
- Local costs for Implementing the Activities

*1: Provision of Equipment will be determined by Japanese Experts and GARBLT after the commencement of the Project. The expected equipment and materials are shown below.
1) Rebar Detector
2) Rebound Hammer
3) Paint Thickness Meter
4) Concrete Carbonation Test (Phenolphthalein)
5) Others</td>
<td>[Egyptian side]

(1) Counterpart personnel (C/P)
Project Director
Project Manager
Project Coordinator
Counterparts (At least two fulltime persons)

(2) Facilities and Machinery
− Project Office Space at GARBLT Main Office for Japanese Experts and Local Experts including Telephone Lines, Air Conditioner, Internet Access and Secretary.
− A Lift Car for site survey

(3) Necessary Data
− Drawings and Design Calculation Reports
− Cost Data for bridge constructions/rehabilitations

(4) Necessary Arrangement
− Acquisition of the permission
− Enforcement of traffic controls

(5) Cost shared by Egyptian side
− Tax Exemption for the procurement of equipment
− Transportation Costs for the C/Ps</td>
<td>[Pre-conditions]
Political stability
C/Ps allocation without any major delay</td>
</tr>
</table>

Appendix 1: Project Design Matrix(PDM) Version 2

Issued Date : 15/July/2012

Project Period; March 2012 ～ March 2015 (3.0 years)
Target Areas; Whole regions of Egypt
Target Group: (Direct) Bridge Maintenance Engineers in GARBLT and district offices; (Indirect) users of bridges in Egypt

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
[Overall Goals] Bridges in Egypt are maintained properly.	a. GARBLT holds regular seminars/trainings for local government engineers to spread proper bridge maintenance over Egypt. b. Bridges in Egypt are managed properly based on the manuals developed in the Project	a. Records of seminars/trainings. b. . Records of inspection & repair.	
[Project Purpose] Capacity of GARBLT on bridge maintenance management is improved.	a. Bridge inspections on 20 selected bridge are carried out by GARBLT engineers properly b. Typical repair technologies are demonstrated on several target bridges. c. GARBLT starts inspection on bridges other than target bridges in each district and the inspections and repair records are properly input in the BMS.	a. Records of inspection & repair. b. Records of inspection & repair. c. Records of inspection & repair and data in BMS.	The responsibility of GARBLT for bridge maintenance does not change. Necessary Budget for bridge maintenance is properly secured.
[Outputs] 1. Bridge maintenance management cycle is enhanced.	a. Model action plans for improving maintenance management cycle, such as keeping/sharing drawings and technical documents, are implemented. b. More than 70% of bridge maintenance engineers of GARBLT pass achievement tests about bridge maintenance management cycle.	a. Model action plans. b. Monitoring reports on model action plan, interviews with engineers.	The C/Ps who participated in trainings conducted in the Project continues their work at the same position during the Project period. Manuals/Guidelines developed by the Project are officially approved without any major delay by GARBLT Central Office.
2. Capacity of GARBLT's engineers on bridge inspection is enhanced.	a. Bridge inspection manual is developed. b. Bridge inspections are carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The quality of the inspection by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Inspection Reports by GARBLT engineers.	
3. Capacity of GARBLT's engineers on bridge repair is enhanced.	a. Manual/guideline on bridge repair is developed. b. Typical bridge repair technologies are demonstrated on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The capacity of selecting of repair methods and supervising contractors by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Repair reports by GARBLT engineers.	
4. Bridge Management System (BMS) is prepared.	a. BMS is developed. (Step 0; Basic System Design) (Step 1; Development of database) (Step 2; addition of the function of repair cost analysis) b. The inspection/repair results of bridges are properly recorded in BMS.	a. Manual/guideline developed in the Project. b. Data in BMS.	

<table>
<tr>
<td rowspan="2">[Activities]
1. Activities for Output 1
1-1 Review current maintenance management cycle and identify issues necessary to be improved
1-2 Propose measures to improve maintenance management cycle
1-3 Take trial actions on the proposed measures
1-4 Conduct seminars on bridge maintenance management cycle

2. Activities for Output 2
2-1 Develop Bridge Inspection Manual
2-2 Implement trainings on bridge inspection (Inventory, Routine, Periodic, Detail) with utilizing Bridge Inspection Manual
2-2-1 Implement Inventory Registration
2-2-2 Implement Routine Inspection
2-2-3 Implement Periodic Inspection
2-2-4 Implement Detail Inspection (several bridges)
2-3 Develop Bridge Inspection Manual for Aswan Bridge
2-4 Implement trainings on inspection (Inventory, Routine, Periodic) of Aswan bridge with utilizing the Inspection Manual for Aswan Bridge
2-4-1 Implement Inventory Registration
2-4-2 Implement Routine Inspection
2-4-3 Implement Periodic Inspection

3 Activities for Output 3
3-1. Develop Bridge Repair Manual/Guideline
3-2. Implement trainings through the Pilot Works for bridge repair (minor repair only)

4 Activities for Output 4
4-1.Develop BMS, composed of inventory and inspection record functions. (STEP-1)
4-2.Input data (Inventory, Routine, Periodic, Detail Inspection Results)
4-3. Implement trainings with utilizing BMS.
4-4. Upgrade BMS, to deal with evaluation of bridge damage and cost estimation function for bridge repair. (STEP-2)</td>
<td colspan="2">[Inputs]</td>
<td rowspan="2">The Project budgets allocation and necessary equipment procured by GARBLT without any major delay</td>
</tr>
<tr>
<td>[Japanese side]

(1) Dispatch of Experts
Long-term Expert; Chief Adviser
Short-term Experts; Leader/Bridge Management Expert
Bridge Inspection Expert
Bridge Repair Expert
BMS Expert
Cable-Stayed Bridge Expert
Coordinator

(2) *1)Provision of Equipment
- Bridge Inspection Vehicle
- Equipment for Bridge Inspection
- Equipment and Material for Bridge Repair

(3) C/P Training in Japan and/or third country

(4) Cost Shared by Japanese side
- Project Vehicle used by Japanese Experts
- Local costs for Implementing the Activities

*1: Provision of Equipment will be determined by Japanese Experts and GARBLT after the commencement of the Project. The expected equipment and materials are shown below.
1) Rebar Detector
2) Rebound Hammer
3) Paint Thickness Meter
4) Concrete Carbonation Test (Phenolphthalein)
5) Others</td>
<td>[Egyptian side]

(1) Counterpart personnel (C/P)
Project Director
Project Manager
Project Coordinator
Counterparts (At least two fulltime persons)

(2) Facilities and Machinery
− Project Office Space at GARBLT Main Office for Japanese Experts and Local Experts including Telephone Lines, Air Conditioner, Internet Access and Secretary.
− A Lift Car for site survey

(3) Necessary Data
− Drawings and Design Calculation Reports
− Cost Data for bridge constructions/rehabilitations

(4) Necessary Arrangement
− Acquisition of the permission
− Enforcement of traffic controls

(5) Cost shared by Egyptian side
− Tax Exemption for the procurement of equipment
− Transportation Costs for the C/Ps</td>
<td>[Pre-conditions]
Political stability
C/Ps allocation without any major delay</td>
</tr>
</table>

Annex-2 : Project Design Matrix(PDM) Version 3 Issued Date : 9/February /2014

Project Period; March 2012 ～ March 2015 (3.0 years)
Target Areas; Whole regions of Egypt
Target Group: (Direct) Bridge Maintenance Engineers in GARBLT and district offices; (Indirect) users of bridges in Egypt

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
[Overall Goals] Bridges in Egypt are maintained properly.	a. GARBLT holds regular seminars/trainings for its engineers to spread proper bridge maintenance over Egypt. b. Bridges in Egypt are managed properly based on the manuals developed in the Project	a. Records of seminars/trainings. b. Records of inspection & repair.	
[Project Purpose] Capacity of GARBLT on bridge maintenance management is improved.	a. Bridge inspections on 20 selected bridge are carried out by GARBLT engineers properly b. Typical repair technologies are demonstrated c. GARBLT starts inspection on bridges other than target bridges in each district and the inspections and repair records are properly input in the BMS.	Records of inspection & repair and data in BMS.	The responsibility of GARBLT for bridge maintenance does not change. Necessary Budget for bridge maintenance is properly secured.
[Outputs] 1. Bridge maintenance management cycle is enhanced.	a. Model action plans for improving maintenance management cycle, such as keeping/sharing drawings and technical documents, are implemented. b. More than 70% of bridge maintenance engineers of GARBLT pass achievement tests about bridge maintenance management cycle.	a. Model action plans. b. Monitoring reports on model action plan, interviews with engineers.	The C/Ps who participated in trainings conducted in the Project continues their work at the same position during the Project period. Manuals/Guidelines developed by the Project are officially approved without any major delay by GARBLT HQ.
2. Capacity of GARBLT's engineers on bridge inspection is enhanced.	a. Bridge inspection manual is developed. b. Bridge inspections are carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The quality of the inspection by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Inspection Reports by GARBLT engineers.	
3. Capacity of GARBLT's engineers on bridge repair is enhanced.	a. Manual/guideline on bridge repair is developed. b. Typical bridge repair technologies, such as minor repair, selecting of repair methods and supervising contractors are demonstrated on concrete bridges with Japanese experts.	a. Manual developed in the Project. b. Repair reports by GARBLT engineers	
4. Bridge Management System (BMS) is prepared.	a. BMS is developed. (Step 0; Basic System Design) (Step 1; Development of database) (Step 2; addition of the function of repair cost analysis) b. The inspection/repair results of bridges are properly recorded in BMS.	a. Manual/guideline developed in the Project. b. Data in BMS.	
[Activities]	[Inputs]		

1. **Activities for Output 1** 1-1 Review current maintenance management cycle and identify issues necessary to be improved 1-2 Propose measures to improve maintenance management cycle 1-3 Take trial actions on the proposed measures 1-4 Conduct seminars on bridge maintenance management cycle **2. Activities for Output 2** 2-1 Develop Bridge Inspection Manual 2-2 Implement training on bridge inspection (Inventory, Routine, Condition, Detail) with utilizing Bridge Inspection Manual 2-2-1 Implement Inventory Registration 2-2-2 Implement Routine Inspection 2-2-3 Implement Condition Inspection 2-2-4 Implement Detail Inspection (several bridges) 2-3 Develop Bridge Inspection Manual for Aswan Bridge 2-4 Implement training on inspection (Inventory, Routine, Condition) of Aswan bridge with utilizing the Inspection Manual for Aswan Bridge 2-4-1 Implement Inventory Registration 2-4-2 Implement Routine Inspection 2-4-3 Implement Condition Inspection **3 Activities for Output 3** 3-1. Develop Bridge Repair Manual/Guideline 3-2. Implement training of minor repair 3-3 Implement trainings on selecting of repair methods and supervising contractors through GARBLT's works **4 Activities for Output 4** 4-1.Develop BMS, composed of inventory and inspection record functions. (STEP-1) 4-2.Input data (Inventory, Routine, Condition, Detail Inspection Results) 4-3. Implement training with utilizing BMS. 4-4. Upgrade BMS, to deal with evaluation of bridge damage and cost estimation function for bridge repair. (STEP-2)	[Japanese side] (1) Dispatch of Experts Long-term Expert; Chief Adviser Short-term Experts; Leader/Bridge Management Expert Bridge Inspection Expert Bridge Repair Expert BMS Expert Cable-Stayed Bridge Expert Coordinator (2) *1)Provision of Equipment - Bridge Inspection Vehicle - Equipment for Bridge Inspection - Equipment and Material for Bridge Repair (3) C/P Training in Japan (4) Cost Shared by Japanese side - Project Vehicle used by Japanese Experts - Local costs for Implementing the Activities *1): Provision of Equipment will be determined by Japanese Experts and GARBLT after the commencement of the Project. The expected equipment and materials are shown below. 1) Rebar Detector 2) Rebound Hammer 3) Paint Thickness Meter 4) Concrete Carbonation Test (Phenolphthalein) 5) Others	[Egyptian side] (1) Counterpart personnel (C/P) Project Director Project Assistant Director Project Manager Project Coordinator Counterparts (At least two fulltime persons) (2) Facilities and Machinery − Project Office Space at GARBLT Main Office for Japanese Experts and Local Experts including Telephone Lines, Air Conditioner, Internet Access and Secretary. − A Lift Car for site survey (3) Necessary Data − Drawings and Design Calculation Reports − Cost Data for bridge constructions/rehabilitations (4) Necessary Arrangement − Acquisition of the permission − Enforcement of traffic controls (5) Cost shared by Egyptian side − Tax Exemption for the procurement of equipment − Transportation Costs for the C/Ps	The security circumstances are not worsened. [Pre-conditions] The project budgets and C/Ps are allocated without any major delay.

Annex-2 : Project Design Matrix(PDM) Version 4 Issued Date : 8/February /2015

Project Period; March 2012 ～ June 2015 (39 months)
Target Areas; Whole regions of Egypt
Target Group: (Direct) Bridge Maintenance Engineers in GARBLT and district offices; (Indirect) users of bridges in Egypt

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
[Overall Goals] Bridges in Egypt are maintained properly.	a. GARBLT holds regular seminars/trainings for its engineers to spread proper bridge maintenance over Egypt. b. Bridges in Egypt are managed properly based on the manuals developed in the Project	a. Records of seminars/trainings. b. Records of inspection & repair.	
[Project Purpose] Capacity of GARBLT on bridge maintenance management is improved.	a. Bridge inspections on 20 selected bridge are carried out by GARBLT engineers properly b. Typical repair technologies are demonstrated c. GARBLT starts inspection on bridges other than target bridges in each district and the inspections and repair records are properly input in the BMS.	Records of inspection & repair and data in BMS.	The responsibility of GARBLT for bridge maintenance does not change. Necessary Budget for bridge maintenance is properly secured.
[Outputs] 1. Bridge maintenance management cycle is enhanced.	a. Model action plans for improving maintenance management cycle, such as keeping/sharing drawings and technical documents, are implemented. b. More than 70% of bridge maintenance engineers of GARBLT pass achievement tests about bridge maintenance management cycle.	a. Model action plans. b. Monitoring reports on model action plan, interviews with engineers.	The C/Ps who participated in trainings conducted in the Project continues their work at the same position during the Project period. Manuals/Guidelines developed by the Project are officially approved without any major delay by GARBLT HQ.
2. Capacity of GARBLT's engineers on bridge inspection is enhanced.	a. Bridge inspection manual is developed. b. Bridge inspections are carried out on typical three types of bridges (RC, PC and Steel) with Japanese experts. c. The quality of the inspection by GARBLT engineers on the target bridges is assured by Japanese Experts.	a. Manual developed in the Project. b. Reports of training implementation. c. Inspection Reports by GARBLT engineers.	
3. Capacity of GARBLT's engineers on bridge repair is enhanced.	a. Manual/guideline on bridge repair is developed. b. Typical bridge repair technologies, such as minor repair, selecting of repair methods and supervising contractors are demonstrated on concrete bridges with Japanese experts.	a. Manual developed in the Project. b. Repair reports by GARBLT engineers	
4. Bridge Management System (BMS) is prepared.	a. BMS is developed. (Step 0; Basic System Design) (Step 1; Development of database) (Step 2; addition of the function of repair cost analysis) b. The inspection/repair results of bridges are properly recorded in BMS.	a. Manual/guideline developed in the Project. b. Data in BMS.	

<table>
<tr><td>[Activities]
1. Activities for Output 1
1-1 Review current maintenance management cycle and identify issues necessary to be improved
1-2 Propose measures to improve maintenance management cycle
1-3 Take trial actions on the proposed measures
1-4 Conduct seminars on bridge maintenance management cycle

2. Activities for Output 2
2-1 Develop Bridge Inspection Manual
2-2 Implement training on bridge inspection (Inventory, Routine, Condition, Detail) with utilizing Bridge Inspection Manual
2-2-1 Implement Inventory Registration
2-2-2 Implement Routine Inspection
2-2-3 Implement Condition Inspection
2-2-4 Implement Detail Inspection (several bridges)
2-3 Develop Bridge Inspection Manual for Aswan Bridge
2-4 Implement training on inspection (Inventory, Routine, Condition) of Aswan bridge with utilizing the Inspection Manual for Aswan Bridge
2-4-1 Implement Inventory Registration
2-4-2 Implement Routine Inspection
2-4-3 Implement Condition Inspection

3 Activities for Output 3
3-1. Develop Bridge Repair Manual/Guideline
3-2. Implement training of minor repair
3-3 Implement trainings on selecting of repair methods and supervising contractors through GARBLT’s works

4 Activities for Output 4
4-1.Develop BMS, composed of inventory and inspection record functions. (STEP-1)
4-2.Input data (Inventory, Routine, Condition, Detail Inspection Results)
4-3. Implement training with utilizing BMS.
4-4. Upgrade BMS, to deal with evaluation of bridge damage and cost estimation function for bridge repair. (STEP-2)</td><td colspan="2">[Inputs]

[Japanese side]

(1) Dispatch of Experts
Long-term Expert; Chief Adviser
Short-term Experts; Leader/Bridge Management Expert
Bridge Inspection Expert
Bridge Repair Expert
BMS Expert
Cable-Stayed Bridge Expert
Coordinator

(2) *1)Provision of Equipment
- Bridge Inspection Vehicle
- Equipment for Bridge Inspection
- Equipment and Material for Bridge Repair

(3) C/P Training in Japan

(4) Cost Shared by Japanese side
- Project Vehicle used by Japanese Experts
- Local costs for Implementing the Activities

*1): Provision of Equipment will be determined by Japanese Experts and GARBLT after the commencement of the Project. The expected equipment and materials are shown below.
1) Rebar Detector
2) Rebound Hammer
3) Paint Thickness Meter
4) Concrete Carbonation Test (Phenolphthalein)
5) Others</td><td>[Egyptian side]

(1) Counterpart personnel (C/P)
Project Director
Project Assistant Director
Project Manager
Project Coordinator
Counterparts (At least two fulltime persons)

(2) Facilities and Machinery
− Project Office Space at GARBLT Main Office for Japanese Experts and Local Experts including Telephone Lines, Air Conditioner, Internet Access and Secretary.
− A Lift Car for site survey

(3) Necessary Data
− Drawings and Design Calculation Reports
− Cost Data for bridge constructions/rehabilitations

(4) Necessary Arrangement
− Acquisition of the permission
− Enforcement of traffic controls

(5) Cost shared by Egyptian side
− Tax Exemption for the procurement of equipment
− Transportation Costs for the C/Ps</td><td>The security circumstances are not worsened.

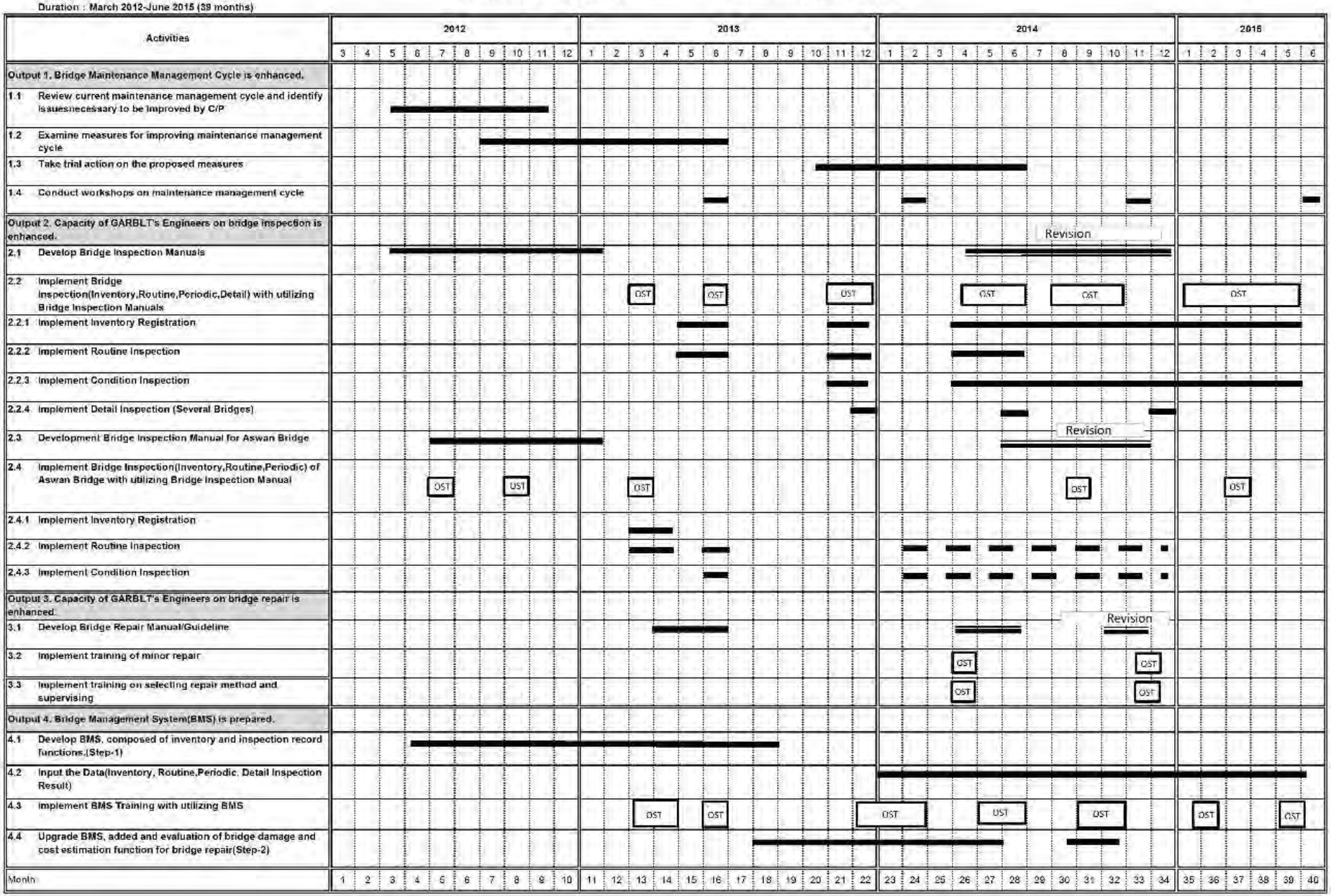
[Pre-conditions]
The project budgets and C/Ps are allocated without any major delay.</td></tr>
</table>

Target Areas: Whole regions of Egypt

Duration : March 2012-June 2015 (39 months)

Responsible Agency: GARBLT

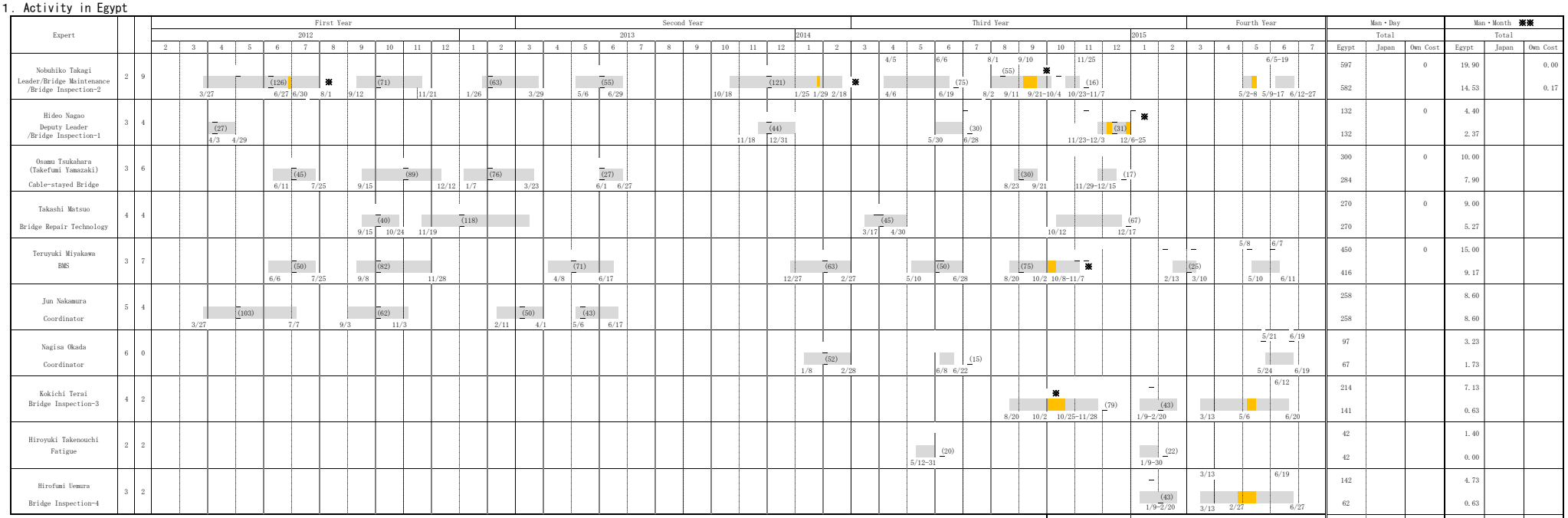
Implementing Office: GARBLT



Input of Japanese Experts

The Project for Improvement of Bridge Management Capacity in Egypt

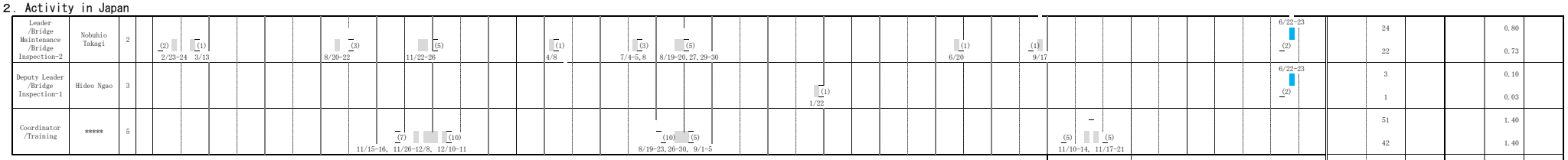
1. Activity in Egypt



Expert			Man・Day Total Egypt	Man・Day Total Japan	Man・Day Total Own Cost	Man・Month ※※ Total Egypt	Man・Month ※※ Total Japan	Man・Month ※※ Total Own Cost
Nobuhiko Takagi Leader/Bridge Maintenance /Bridge Inspection-2	2	9	597		0	19.90		0.00
			582			14.53		0.17
Hideo Nagao Deputy Leader /Bridge Inspection-1	3	4	132		0	4.40		
			132			2.37		
Osamu Tsukahara (Takefumi Yamazaki) Cable-stayed Bridge	3	6	300		0	10.00		
			284			7.90		
Takashi Matsuo Bridge Repair Technology	4	4	270		0	9.00		
			270			5.27		
Teruyuki Miyakawa BMS	3	7	450		0	15.00		
			416			9.17		
Jun Naksmura Coordinator	5	4	258			8.60		
			258			8.60		
Nagisa Okada Coordinator	6	0	97			3.23		
			67			1.73		
Kokichi Terai Bridge Inspection-3	4	2	214			7.13		
			141			0.63		
Hiroyuki Takenouchi Fatigue	2	2	42			1.40		
			42			0.00		
Hirofumi Uemura Bridge Inspection-4	3	2	142			4.73		
			62			0.63		
Total			2,502			83.40		0.00
			2,254			50.83		0.17

※ Own cost travel
※※ 30days in 1 month

2. Activity in Japan



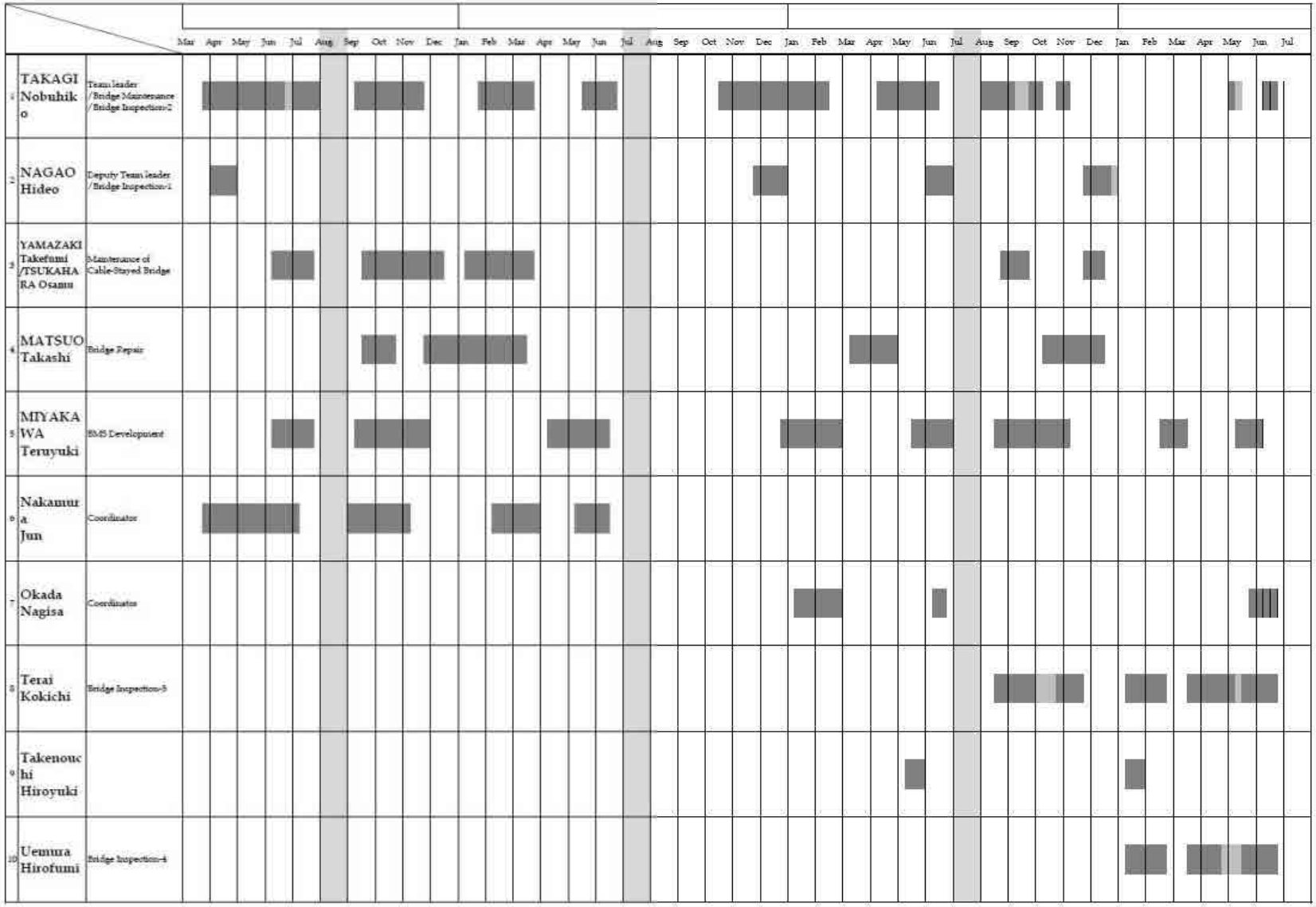
				Man・Day Total Japan	Man・Day Total Own Cost	Man・Month ※※ Total Japan	Man・Month ※※ Total Own Cost
Leader /Bridge Maintenance /Bridge Inspection-2	Nobuhio Takagi	2		24		0.80	
				22		0.73	
Deputy Leader /Bridge Inspection-1	Hideo Ngao	3		3		0.10	
				1		0.03	
Coordinator /Training	*****	5		51		1.40	
				42		1.40	
In Japan				78		2.30	
				65		2.17	

Period　　Own Cost Period

Grand Total	Egypt	Japan	Own Cost	Egypt	Japan	Own Cost
	2,502	78		83.40	2.30	
	2,254	65		50.83	2.17	
	Total			Total		0.17
	2,580			85.70		
	2,319			53.00		

Report and others: △ Implementation Plan; △ Work Plan; △ Progress Report (1st Year); △ (English Report); △ Progress Report (2nd Year); △ Mid-term Evaluation; △ (English Report); △ Terminal Evaluation; △ Final Report

JICA Experts Mobilization



5) Equipment List

Equipment to be donated

No.	Item	Basic Function	Spec.	Model	Qly	Unite Price Total Price
1	Concrete Rebound Hammer	To test concrete strength	Measurement range from 10 to 70 N/mm2. Impact energy: 2.207 Nm. Autonomy (non continuous use): more than 5 hours. Rebound values are read from a dial..	Proceq Original Schmidt Type N	2	
2	Testing Anvil for Concrete Rebound Hammer	Calibrator of the above equipment	the model suitable for the above concrete hammer	Proceq Testing anvil Type N	2	
3	Ultrasonic Tester for Concrete Crack	To measure depth of concrete cracks	Transit time range: 0.1-9999 µs Resolution: 0.1 µs Energising pulse: 125 V, 250 V, 350 V, 500 V, AUTO Tx frequency range: 125 V, 250 V, 350 V, 500 V, AUTO Transit time: Yes Pulse velocity: Yes Path length: Yes Surface velocity: Yes Crack depth: Yes Memory: > 500 readings Power supply: Mains/Battery(>20h)/USB Integrated gain stage: 1x, 10x, 100x Accessories: Standard 54kHz Transducer (Quantity: 2) , Carrying Bag	Proceq Pundit Lab	1	

No.	Item	Basic Function	Spec.	Model	Qly	Unite Price Total Price
4	Carbonation Test (Phenolphthalein)	To measure carbonation of concrete	Alkalinity Reagent System Phenolphthalein End Point 0-500mg/liter. Sufficient for 50 Tests.	ELE 433-096 *Control 58-E0063	20	
5	Half Cell (Chloride ion Penetration Tester)	To survey corrosion of reinforcement in concrete	Display: 3½ digit plus sign via 12.5 mm LCD Range/Resolution: +1999 mV / +1 mV Battery operated: giving typically 1000 hours use with low battery indication Copper sulphate reservoir for measurement/ reference electrode Container of copper sulphate (250ml) Wetting agent reservoir (125ml) Dispending sponge. Accessories: Cable reel with 80m cable, Carrying Case	Controls 58-E0065/A *James Instruments CM-4500	1	
6	Paint Thickness Meter	To measure thickness of coating on the steel surface	Typical Applications: Ferrous metals (steel and cast iron) Interchangeable Connecting Probe. Range: 0- 60 mils, 0- 1500 μm Accuracy: ±(0.05mils + 1%) 0-2 mils, ±(0.1mils + 1%) >2 mils, ±(1μm + 1%) 0-50μm, ±(2μm + 1%) >50μm Memory storage of 5000 reading in up to 100 groups. Software for charting and graphing, USB port Accessories: separate probe, precision plastic shims, protective rubber holster, couplant, 3 AAA batteries, instructions, nylon carrying case, Software for charting and graphing, USB cable	PosiTector 6000-FS3 Memory	1	

No.	Item	Basic Function	Spec.	Model	Qly	Unite Price Total Price
7	Reinforcement Detector (Magnetic Type)	To locate reinforcement in concrete	Memory: non-volatile memory for 40'000 measured values and 60 objects respectively Display: LCD with backlight option Interface: RS 232 or with Adapter for USB Port on PC Software: ProVista for downloading data and evaluation on PC Batteries: 6 x 1.5V for 45h operation; 30h with backlight on Temperature Range: -10° to +60° C	Proceq Profometer 5 Model S	1	
8	Ultrasonic Metal Thickness Gauge	To measure thickness of steel plate	Applicable for measuring thickness of metal and ceramics, and extent of corrosion on metal and ceramics Range: 0.0060-1.0000" (0.15–25.40 mm) Other ranges available with optional probes. Resolution: .0001" (0.001 mm) Display: 4 1/2 -Digit, 0.5" Backlit LCD Velocity Range: 6,500-33,000 ft./sec (1250-10000 m/sec.) Probe: 1/4", 15 MHz, actual wearface is 3/8" (9.5mm) Probe Wearface: PEEK (Polyethylethylkeytone) Cable: 4 ft. (1.2 m) waterproof cable with non-polarized, quick-disconnect connectors. Optional lengths up to 50 ft. (15 m) Accessories: gauge, probe, 4 oz. bottle of coupling fluid, 2 AA batteries, NIST Calibration Certificate and Operating Instruction Manual, carrying case	CheckLine TI-007	1	

No.	Item	Basic Function	Spec.	Model	Qly	Unite Price Total Price
10	Generator	To provide electricity to Microcore Drill	Gasoline engine type, Capacity 3000W, Automatic voltage regulator	Pump washing factories and workshops DLQ5/ GX160	1	
11	Repair Materials	To repair concrete section by shotcrete method	Bonding Material Shotcrete Material Curing Material	BASF Rheomix 140, BASF Shotpatch 10, BASF Mastercure 102	1	
12	Coating Paint	To protect steel surface	Protective Coating Paint Repair Grout materials Surface Protection Coat	Sika Zinc Rich – 2, Sikagrout – 214, SikaFerrogard – 903	10	  
13	Microcore Drill	To drill a hole in concrete structure to sample concrete material	Electric drill (Concrete Coring: 20mm×160mm), 2000W, AC220V 50/60Hz-Single Phase Drillingf guide stand, Diamond core bit 20mm×300mm, 25 anchors 8Dia. 12mm) for guide stand, Handy Pump Water Spray	WEKA Wet+Dry 3-speed Diamind Core Drill DK17	1	
14	Reinforcement Detector (Radar Type)	To locate reinforcement in concrete structure	Detective radar, Handy type, Measuring depth range: 0.5 to 30cm approx. Search Distance: 15m or more, Max. scanning rate: 40cm/s, Display: TFT color LCD (640×480 bits), Memory card capacity: 1G or more, Printer interface, Rechargeable battery: AC220 50/60Hz Single phase,	Handy Search Proceq 39000001	1	
15	BMS Server	To control BMS operation	DELL PE T110 II Intel Xeon E1220 ((3.1GHz, 4C/4T, 8M Cache, 80W, Turbo), 16 Ram LV UDIMMs) 1333MHz, , 2x1TB HDD SATA 7.2K 3.5-inch NPL , iDrac6 embedded C4 Cabled MST R1 With PERC S100	Dell PE T110 Intel Xeon E1220	1	

No.	Item	Basic Function	Spec.	Model	Qly	Unite Price Total Price
16	Photo Resize Engine	To downsize photo data to be stored in BMS	FileType: Microsoft Word（97-2013）, Microsoft Excel（97-2013）, Microsoft PowerPoint（97-2013）, JPEG, PDF, TIFF File(Not archive), ZIP, ※ZIP, Windows Standard (Windows XP、7、8.1), Win ZIP(Ver 17.5), Lhaplus (Ver 1.59), 7-ZIP(Ver 9.20) Function: Configuration, Execute status monitor, Report, Scheduling	NX PowerLite	1	

Other Equipment

No	Item	Model	Qly	Photo
1	Projector	Epson EB-925	1	
2	Video Camera	Sony Handycam HDR-XR260 with $GB SD	1	
3	Voice Recorder	Olympus VN-8110	1	
4	Copier	Toshiba e-studio 225 MY 1038+KA164	1	
5	Digital Camera	Panasonic FH2R with 4GB SD	3	
		Panasonic Lumix DMC FT4	2	
6	Laptop Computer	Dell Latitude E6420 Win Pro 7 SP1	3	
		Dell Latitude E6420 Win Pro 7 SP1	2	
7	Helmet	MSA V Guard	60	 
8	Rubber Cone	Cone 100cm	30	
9	Safety Belt	FAT	60	
10	Safety Vest	Phosphoric vest	60	
11	Handy GPS	Garmin Etrex30	4	
12	Distance Meter	Hilti PD5	4	

6) 20 bridges subjected to the inspection training.

The criteria of the particular specifications are; 1. Mainly select from standard bridge forms in Egypt, 2. Select areas where the bridges with more technical materials being stored, 3. Select bridges maintained by the office with more motivated staff.

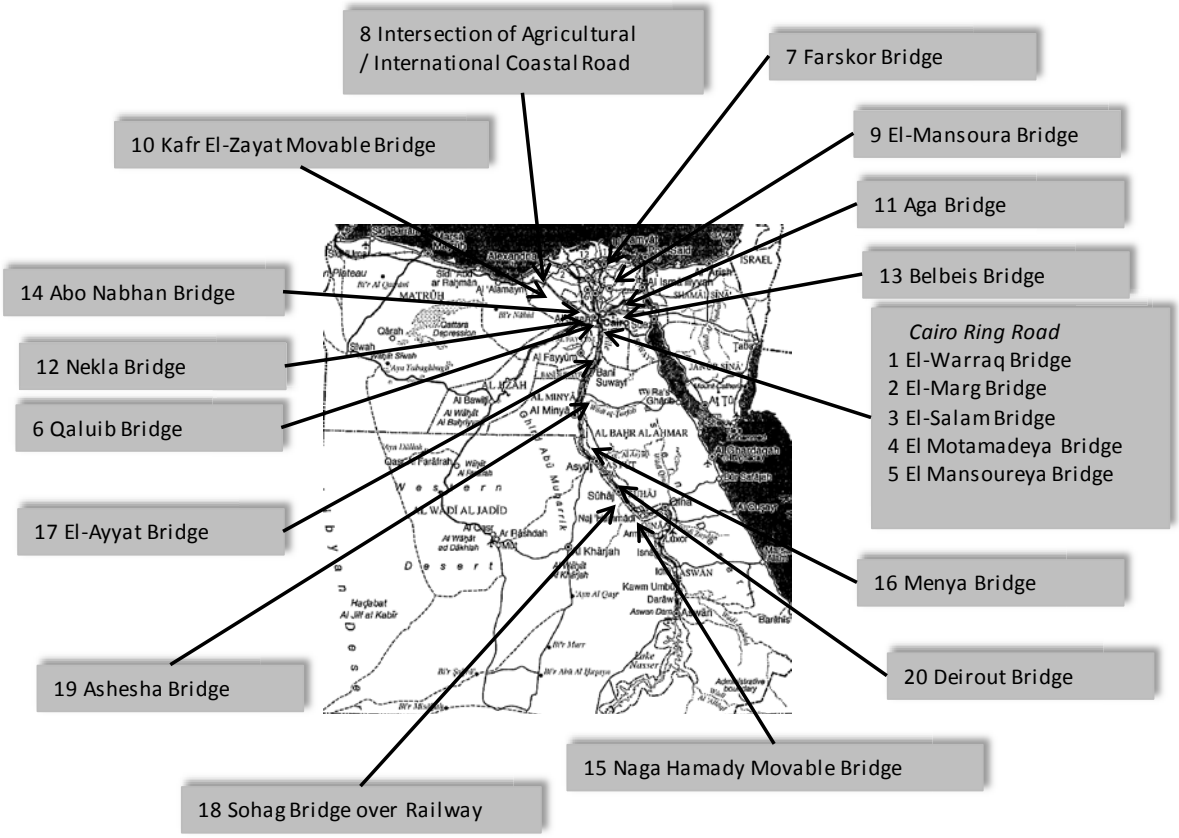
Following the discussion with GARBLT, we concluded that the selected 20 bridges meet the following criteria in general and they are appropriate.

(1) Several standard bridge forms are included.（RC girder, PC girder, Steel girder）
(2) The high level bridge is a truss bridge.
(3) Select areas where it is easy to operate (Delta, Cairo suburb)
(4) Centering around the bridges with surrounding conditions which allow easy inspection (enough space under a bridge)

20 bridges subjected to the training are described as follows.

Chart: Bridges subjected to inspection training

No.	Bridge	DO	Governarate	Inspection
1	El-Warrak	Central	Giza	2014/5/6
2	El-Marg	Central	Cairo	2014/4/17
3	El-Salam Bridge	Central	Giza	2014/11/4
4	El-Motamadeya	Central	Giza	2013/6/12
5	Masraf El-Moansoreya	Central	Giza	2013/6/12
6	Qaluib	Central	Qalyoubeya	2014/9/1
7	Farskour	Zagazig	Damietta	2014/5/13
8	Intersection of Agricultural Rd & Intl. Coastal Rd	Alexandria	Alexandria	2014/8/19
9	El-Mansoura	Zagazig	Daqahliya	2015/2/9
10	Kafr El-Zayat Movable	Tanta	Gharbeya	2014/6/3
11	Aga	Zagazig	Daqahliya	2014/5/12
12	Nekla	Central	Giza	2014/9/8
13	Belbes	Zagazig	Sharqiya	2014/5/8
14	Abo Nabhan	Zagazig	Daqahliya	2014/8/13
15	Naga Hammady	Qena	Qena	2014/5/27
16	Menya	Asyut	Menya	2015/2/16
17	El-Ayyat	Central	Giza	2014/8/6
18	Sohag	Qena	Sohag	2014/5/28
19	Ashesha	Central	Beni Suef	2014/4/29
20	Derout	Asyut	Asyut	2014/5/6



Map: Location of the bridges subjected to inspection training

M/M: 2012-03

Minutes of Presentation to GARBLT Chairman

Date and Time: 2th July, 2012 (Mon.); 14:00 to 15:00
Venue: GARBLT Conference Room
Attendance: [JICA]
Taro Azuma [Senior Representative of JICA Egypt Office]
Koichi Mizukusa [Representative of JICA Egypt Office]
Ashraf M. El-Abd [Chief Program Officer, JICA Egypt Office]
[JICA Expert Team]
Muneo Okawa (Chief Advisor),
Nobuhiko Takagi (Team Leader),
Takefumi Yamazaki (Maintenance of Cable-Stayed Bridge)
Teruyuki Miyakawa (BMS Development)
Jun Nakamura (Coordinator)
[GARBLT]
Ahmed Kamal Tolba (Chairman of GARBLT)
Ebrahim Amer (Head of Sector for Bridges)
Hala Sayed Helmy (Head of Central Department for Construction, Maintenance and Design of Bridge)
Samir ABD El Saboor (Head of Central Department for Bridge Design)
Samy Farag (Head of Central Department for Roads)
Aly Elafty Abdalla (Head of Central Department for Bridge Maintenance in Lower Egypt)
Mohamed Gouada (Head of Central Department for Bridge Maintenance in Upper Egypt)
Osama Fahmy (Head of Central Department for Bridge Construction)
Wafaa Abd El Rahman (General Manager for Electricity Bridge)
Eng. Abd El Wahab Mosleh (Full-time Counterpart)

MINUTES:

1. Welcome Greeting from GARBLT Chairman
2. Introduction of Member of JCC
   Eng. Aly Elafty Abdalla, and Mr. Takagi introduced JCC Member.
3. Speech by JICA
4. JICA Expert's Presentation
   Mr. Takagi explained outline of the Project, including background, purpose, outputs, administration and activities.
5. Approval of Work Plan
   Work Plan was approved by Team Leader of JICA Expert Team and GARBLT chairman, in witness of Senior Representative, on behalf of Representative of JICA, and head of sector of GARBLT.

Record of Discussion in Joint Coordination Committee (JCC)

- **Date** : 15/May/2013 (Wed) 10:00～11:15
- **Venue** : Conference Room @ GARBLT 1F
- **Attendance** : Refer to Annex: List of Attendees in 2nd JCC
- **Agenda**

1) Introduction of JCC members
2) Opening remarks by GARBLT Chairman
3) Greeting by JICA Egypt Office
4) Outline of the project
5) Report of the 1st year activities / plan of 2nd year activities
6) Selection of 20 bridges to be inspected
7) Bridge inspection vehicle (Type and size / procurement)
8) Discussion to improve WG activities
9) Closing Remarks by GARBLT Chairman

- **Summary of Discussion**

1. Outline of the project:

- JICA Expert Team presented the purpose, activities, expected outputs, and schedule of the project.
- JICA Expert Team requested GARBLT Chairman to add observer from MOT to JCC, which was agreed by GARBLT Chairman, JICA Long-time Expert will write an official request letter to MOT on this matter. JICA Expert Team also requested GARBLT Chairman to add Heads of two District Offices to TWG, which was affirmed to be solved by GARBLT Chairman.

2. Report of the 1st year activities/ Plan of 2nd year activities:

- JICA Expert Team presented report of the 1st year activities and plan of 2nd year activities.
- JICA Expert Team requested GARBLT Chairman to select 5 candidate engineers for the next training which would be held from 25th August to 6th September in Japan by the end of May. GARBLT Chairman agreed and requested JICA Expert Team to provide schedule and contents of lectures of the next training in advance.
- JICA Expert Team requested GARBLT Chairman for more active cooperation in the second year so that GARBLT engineers can lead the project's activities in the third year, which was agreed by GARBLT Chairman.

3. Selection of 20 bridges to be inspected:

- JICA Expert Team explained concept for selecting 20 bridges, which was agreed by GARBLT Chairman.
- GARBLT Chairman requested to include bridges over Nile to the sites for training. JICA Expert Team explained that OST on bridges over Nile could be carried out after procurement of Bridge Inspection Vehicle in 2014.

- Project Manager of GRRBLT will submit names of the 5 bridges for first OST to be carried out from May to June, 2013 to JICA Expert Team at the earliest moment.
- GARBLT chairman suggested that report of the OST shall be made after the OST not only JCC, which was agreed by JICA Expert.

4. Bridge inspection vehicle (Type and size / procurement):

- JICA Experts Team recommended an inspection vehicle of 13 /15 M class (Platform type). JICA Egypt Office explained that basic policy for procurement in Technical Cooperation Project is to provide the minimum requirements for supporting the project activities.
- GARBLT requested to consider the possibility for providing longer Inspection Vehicle (17/20 M class), and JICA Long-term Expert promised to request JICA Egypt Office about the longer vehicle.
- Type and size of Bridge Inspection Vehicle needs to be concluded after JCC.

5. Discussion to improve WG activities:

- JICA Expert Team requested that a system engineer and an infrastructure engineer should join the WG to support BMS activities, which was affirmed to be solved by GARBLT Chairman.
- JICA Expert Team explained that the main problem of the Project is shortage of maintenance engineers in GARBLT. GARBLT Chairman made comment that this matter should be discussed in detail at MOT.

6. Approval and signature of progress report:

- The JCC approved the progress report including plan for 2nd Year activities.

Nobuhiko TAKAGI
Team Leader
JICA Expert Team of the Project
for Improvement of the Bridge Management Capacity in Egypt

Ramzy Mahmound Lashine
Chairman
General Authority for Roads, Bridges and Land Transport

Muneo Okawa
Chief Advisor
JICA Expert Team of the Project
for Improvement of the Bridge Management Capacity in Egypt

Hala Helmy
Head of Central Department for Bridge Construction
General Authority for Roads, Bridges and Land Transport

Witness:

Hideki MATSUNAGA
Chief Representative
Japan International Cooperation Agency
Egypt Office

Aly Elsafty Abdalla
Head of Central Department for Bridge Maintenance in Delta
General Authority for Road, Bridge and Land Transport

Annex: List of Attendees in 2nd JCC

(GARBLT)

Name	Position
Eng. Ramzy Mahmoud Lashine	Chairman of GARBLT
Eng. Hala Helmy	Head of Central Department, Bridge Construction
Eng. Aly Elsafty Abdallah	Head of Central Department, Bridge Maintenance (Lower Egypt)
Eng. Samir Abd El Saboor	Head of Central Department, Design & Research of Bridges
Eng. Mohamed Gouada	Head of Central Department, Bridge Maintenance (Upper Egypt)
Eng. Ola	Road Engineer (On behalf of Eng. Samy Farag)

(JICA)

Name	Position
Mr. Taro Azuma	Senior Representative, JICA Egypt Office
Mr. Koichi Mizukusa	Representative, JICA Egypt Office
Dr. Ashraf M. El-Abd	Chief Program Officer, JICA Egypt Office
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Team Leader, JICA Short-term Expert
Mr. Teruyuki Miyakawa	JICA Short-term Expert
Mr. Jun Nakamura	Coordinator, JICA Short-term Expert
Mr. Saleh El-Basheer	Senior Engineer
Ms. Hana Rady	Administrative Assistant

Record of Discussion in Joint Coordination Committee (JCC)

- **Date** : 13/Feb/2014 (Thu) 10:00～12:30
- **Venue** : Conference Room @ GARBLT 1F
- **Attendance** : Refer to Annex: List of Attendees in 3rd JCC
- **Agenda**

1) Introduction of JCC members
2) Opening remarks by GARBLT Chairman
3) Opening remarks by MOT Consultant to the Minister
4) Greeting by JICA Chief Representative
5) Result of Joint Mid-Term Evaluation and Revision of PDM by Mission Member
6) Proposed Activities
7) Signing on the Minutes of Meeting by each Representative
8) Closing Remarks

- **Summary of Discussion**:

1. Result of Joint Mid-Term Evaluation and Revision of PDM

- The results of the Mid-Term Review were explained by Ms. Aoki, and recommendations were explained by Mr. Tanaka, The following recommendations were discussed and agreed on:

(1) Appointment of Assistant Project Director

- It was agreed that Eng. Hala Helmy, the Head of Project Sector would be "Assistant Project Director" to make a strategic decisions in the absence of Chairman of GARBLT.

(2) Participation of GARBLT High Rank Officers in Training in Japan

- It was requested that GARBLT high rank officers visit Japan in order to know the preventive measures of the bridge maintenance management in Japan.

- Dr. Aly Selim, the consultant to the minister understood the importance of the visit of GARBLT high rank officers to Japan.

- JICA will send an official letter to MOT to select the suitable time for the visit.

(3) Development of GARBLT Core Inspection Trainers

- GARBLT will assign core inspection trainers to be responsible for the technical transfer of experience and technologies from JICA Team to all district offices.

(4) Allocation of Personnel and Budget for BMS

- JICA Team recommended assigning at least two engineers for BMS, "System Maintenance Engineer for BMS" to maintain BMS technically, in addition to "BMS Operator" for the inputs of inspection data and utilizing information.

(5) Sharing the Acquired knowledge among GARBLT

- The engineers who have acquired technical skills and knowledge from the project shall share them among GARBLT engineers, because a separation of staff of GARBLT from time to time occurs.

- Dr. Aly Selim, the consultant to the Minister of Transport commented that 16 engineers will be employed in GARBLT soon; he also said that MOT requested from MOF to arrange a budget for new engineers not only for GARBLT but also other organizations under MOT, and now MOT is waiting for a response from MOF.

2. Proposed Activities

- Mr. Okawa Introduced a recommendation about new organization structure of Bridge Maintenance in GARBLT which includes Planning, BMS & Inspection.

- Chairman understood the recommendation of the proposed structure and he will make time to study it.

- Mr. Takagi introduced the project activities in the third year including a proposal of the project activity plan and dispatch plan of the experts.

- Mr. Takagi requested from GARBLT to submit the list of 5 candidates for the training in Japan as soon as possible.

- GARBLT and MOT understood the proposed activities and added the following comments:

(1) Since some project activities were delayed, GARBLT requested a "6 months" extension of the project in order to have sufficient time for training on using the Bridge Inspection Vehicle, in addition to BMS and sharing experience through the new inspection team to all GARBLT engineers.

- JICA Mission Team explained that the purpose of the Mid-Term review is to introduce some recommendations to meet the project targets within the period of the project, and it's now too early to take a decision regarding this matter.

(2) GARBLT made some comments about procured equipment:

1) **Rebar Detector:** GARBLT requested a new Rebar Detector (Radar Type) and now waiting for the approval from JICA.

- *JICA Team explained that the provided equipment is suitable for superstructure and there is another type suitable for substructure.*

2) **Ultrasonic Pulse Velocity Test:** GARBLT said that the results of this equipment are not accurate, GARBLT requested to replace it with more accurate equipment.

- *JICA Team will hold training in Ring Road on using this equipment again to make sure about the accuracy of the results.*

3) **Micro Drill:** GARBLT requested a bigger diameter (6 inches) since the provided one is too small.

- *JICA Team replied that the Carbonation Test doesn't need a big hole, small hole is better for Carbonation test.*

4) **Rebound hummer:** GARBLT commented that the provided one is a mechanical type not digital type.

- *JICA Team explained that the mechanical type is very simple and has the same accuracy of the digital type, also digital type can be destroyed easily.*

3. Signature of the Minutes of Meeting

- The Minutes of Meeting was approved and signed by each representative.

4. Closing Remarks

- Dr. Aly Selim, Ambassador Mahmoud Allam, and Chairman of GARBLT expressed their pleasure and gratitude to JICA, and they are looking forward to further cooperation between Japan and Egypt.

Annex: List of Attendees in 3rd JCC

(GARBLT)

Name	Position
Eng. Ramzy Mahmoud Lashine	Chairman of GARBLT
Eng. Hala Helmy	Head of Bridge Sector
Eng. Aly Elsafty Abdallah	Head of Central Department for Bridge Construction & Maintenance (District A)
Eng. Samir Abd El Saboor	Head of Central Department, Design & Research of Bridges
Eng. Osama Fahmy	Head of Central Department for Bridge Construction & Maintenance (District B)
Eng. Mohamed Goda	Head of Central Department for Bridge Construction & Maintenance (District D)
Eng. Wafaa Mubarak	General Manager of Bridge Electricity

(MOT)

Name	Position
Dr. Aly Selim	Consultant to the Minister of Transport for Roads & Bridges
Ambassador Mahmoud Allam	Advisor to the Minister of Transport for International Cooperation

(JICA)

Name	Position
JICA Mission Team	
Mr. Fusato Tanaka	Team Leader
Mr. Yusuke Tsumori	Cooperation Planning
Ms. Noriyo Aoki	Evaluation Analysis
JICA Egypt Office	
Mr. Hediki Matsunaga	Chief Representative, JICA Egypt Office
Mr. Taro Azuma	Senior Representative, JICA Egypt Office
Mr. Koichi Mizukusa	Representative, JICA Egypt Office
Dr. Ashraf M. El-Abd	Chief Program Officer, JICA Egypt Office
JICA Expert Team	
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Team Leader, JICA Short-term Expert
Mr. Teruyuki Miyakawa	BMS Specialist, JICA Short-term Expert
Ms. Hana Rady	Administrative Assistant

Record of Discussion in Joint Coordination Committee (JCC)

- **Date** **:** 06/Nov/2014 (Thu) 10:00～12:30
- **Venue** : Conference Room @ GARBLT 1F
- **Attendance** : Refer to Annex: List of Attendees in 4th JCC
- **Agenda**

1) Introduction of JCC members
2) Opening remarks by GARBLT Chairman
3) Greeting by JICA Senior Representative
4) Result of Joint Terminal Evaluation by Mission Member
5) Proposed System for Bridge Inspection and BMS
6) Proposed Activities
7) Signing on the Minutes of Meeting by each Representative
8) Closing Remarks by GARBLT

- **Summary of Discussion**:

1. Greeting by Chairman of GARBLT

- Chairman of GARBLT, Dr. Saad Elgioshy expressed the importance of the project and cooperation between JICA and GARBLT.

- Chairman said that it's very important to set standard method for inspection and feeding data to assure the quality of BMS data and outputs.

2. Result of Joint Terminal Evaluation by Mission Member

- The results of the Terminal Evaluation were explained by Mr. Minagawa, and recommendations were explained by Mr. Tanaka, The following recommendations were discussed and agreed on:

(1) Extension of the project

- Since the procurement of the bridge inspection vehicle was delayed compared with the planned schedule, extension of the project and further training of the bridge inspection using the bridge inspection vehicle is recommended.

-The period of extension is agreed to be three months.

(2) Development of Core inspection trainers

- It was recommended to develop Core Inspection trainers for planning the annual inspection plan, checking the inspection results, technical transfer to other engineers, and maintenance of the detail inspection equipment.

(3) Establishment of the organization for the operation of the BMS system

- It was recommended to establish the organization related to BMS since the engineers who are responsible for managing the budget and analyzing the inspection results are not sufficiently assigned.

3. Proposed Activities

- Mr. Takagi introduced the schedule of the project's activities and OST schedule till June 2015.

- GARBLT understood the proposed activities and added the following comments:

(1) GARBLT requested again the possibility of rearrangement of high rank officers training in Japan.
(2) Eng. Aly requested to submit the schedule of OST within 2 weeks before in order to have enough time for arrangement with district office.
(3) GARBLT confirmed the appointment of four (4) new engineers for the project.
(4) Eng. Hala Confirmed that she will assign two (2) engineers for BMS Management in January.

4. Signature of the Minutes of Meeting

- The Minutes of Meeting was approved and signed by each representative.

5. Closing Remarks

- Ambassador Mahmoud Allam, and GARBLT expressed their pleasure and gratitude to JICA, and they are looking forward to further cooperation between Japan and Egypt.

Annex: List of Attendees in 4th JCC

(GARBLT)

Name	Position
Eng. Saad Moahmed Elgioshy	Chairman of GARBLT
Eng. Hala Helmy	Head of Bridge Sector
Eng. Aly Elsafty Abdallah	Head of Central Department for Bridge Construction & Maintenance (District A)
Eng. Samir Abd El Saboor	Head of Central Department, Design & Research of Bridges
Eng. Wafaa Mubarak	General Manager of Bridge Electricity

(MOT)

Name	Position
Ambassador Mahmoud Allam	Advisor to the Minister of Transport for International Cooperation

(JICA)

Name	Position
JICA Mission Team	
Mr. Fusato Tanaka	Team Leader
Mr. Kota Wakabayashi	Planning Coordinator
Mr. Yasunori Minagawa	Evaluation Analysis
JICA Egypt Office	
Mr. Ko Goto	Senior Representative, JICA Egypt Office
Mr. Tetsushi Hayakawa	Representative, JICA Egypt Office
Dr. Ashraf M. El-Abd	Chief Program Officer, JICA Egypt Office
JICA Expert Team	
Mr. Muneo Okawa	Chief Advisor, JICA Long-term Expert
Mr. Nobuhiko Takagi	Team Leader, JICA Short-term Expert
Mr. Kokichi Terai	Bridge Inspection Specialist, JICA Short-term Expert
Mr. takashi Matsuo	Bridge Repair Specialist, JICA Short-term Expert
Mr. Teruyuki Miyakawa	BMS Specialist, JICA Short-term Expert
Ms. Hana Rady	Administrative Assistant

Record of Discussion in Joint Coordination Committee (JCC)

- **Date** : 23/June/ 2015 (Tuesday) 11:20～13:35
- **Venue** : Meeting room at GARBLT 1FL
- **Attendance** : Refer to the attached list

- **Contents:**

1. Opening Remarks and greetings by Eng. Aly Elsafty

- Eng. Aly explained that chairman went to Ministry of Transportation for urgent matter and he will come later, Eng. Aly thanked the expert team for their efforts of this project and he said the project has successfully completed its activities in Egypt and he requested two points as follow:
  - If possible continue monitoring the project results by JICA Expert Team
  - He want to discuss about Suez Canal Bridge after JCC meeting

2. Mr. Matsunaga Thanked Eng. Aly and GARBLT for their cooperation.

3. Mr. Takagi explained about Activities /Achievement of the Project

4. Chairman arrived at 11:40

Chairman thanked Japanese experts and he hope to continue cooperation with Japanese side, and he expressed his appreciation to the efforts done in improvement of both Bridge sector and Road sector.

5. Mr. Matsunaga thanked chairman and he said that the preparation for this project started on 2011 and started actually on March 2012. And he said the relationship betweek JICA and GARBLT has not ended by the end of this project.

6. Chairman of GARBLT asked about the safety of bridge inspection vehicle, and GARBLT engineers answered that it is very safe.

7. Mr. Uemura explained his presentation about Recommendation on “Future Bridge Management”

8. Chairman mentioned that GARBLT is planning to establish an organization inside GARBLT for bridge inspection

9. Manuals developed by the project were handed over, and GARBLT agree to utilize the manuals.

10. Eng. Aly mentioned that he will invite the district office engineers to H/Q for training on inspection work and get the inspection form and manuals.

11. JICA transferred GARBLT ownerships of the equipment provided by the project, and GARBLT agreed to be responsible for the future management of these equipment.

12. JICA handed over the Bridge Management System (BMS) to GARBLT and the system would be fully utilized under supervision of GARBLT.

13. Both sides agreed to hold regular discussion every 6 (six) months. GARBLT requested JICA to dispatch a Japanese expert of the project every 6 (six) months to discuss any difficulties facing the sustainability of the project and how to solve them, and JICA take note of it.

14. The minutes of meeting was approved and signed by each representative.

Annex: List of Attendees in 5th JCC

(GARBLT)

Name	Position
Eng. Adel Salah Tork	Chairman of GARBLT
Eng. Hala Helmy	Head of Bridge Sector
Eng. Aly Elsafty Abdallah	Head of Central Department for Bridge Construction & Maintenance (District A)
Eng. Wafaa Mubarak	General Manager of Bridge Electricity
Eng. Mohamed Mohsen	Bridge Engineer
Eng. Mohamed Ashry	Bridge Engineer
Ahmed Ateya	Bridge Engineer

(JICA)

Name	Position
JICA Mission Team	
Mr. Muneo Okawa	Former Chief Advisor
JICA Egypt Office	
Mr. Hideki Matsunaga	Chief Representative
Mr. Ko Goto	Senior Representative, JICA Egypt Office
Mr. Kei Ikegami	Representative, JICA Egypt Office
Dr. Ashraf M. El-Abd	Chief Program Officer, JICA Egypt Office
Ms. Mariam Yousry	Program Officer, JICA Egypt Office
JICA Expert Team	
Mr. Nobuhiko Takagi	Team Leader, JICA Short-term Expert
Mr. Hirofumi Uemura	Deputy Team Leader, JICA Short-term Expert
Mr. Jun Nakamura	Former Coordinator
Eng. Saleh Elbasheer	Senior Engineer
Ms. Hana Rady	Administrative Assistant

8) Summary of Midterm Review and Terminal Evaluation Report

Refer to the Midterm Review Report and the Terminal Evaluation Report for the details.

Item	Midterm Review Report	Terminal Evaluation Report
Survey Date	2014/2	2014/11
Achievement of the Project Purpose (Prospect)	Capacity on bridge maintenance management is improved by paying a special attention to the capacity development of GARBLT. GARBLT Technical Transfer Team shall be formed to instruct the know-how on inspections and recording of results to engineers of other districts. If the requested BMS related personnel are allocated without any delay.	Project Purpose is almost achieved except the bridge inspection by the bridge inspection vehicle. It is assumed that the training using the bridge inspection vehicle will not be sufficient if the project is ended as scheduled. Therefore, assuming that the project period is extended corresponding to the delay of delivery of an inspection vehicle, the Project Purpose is expected to be achieved by the Project completion.
Relevance	High	High
Effectiveness	Fair	Slightly High
Efficiency	Slightly Low	Fair
Impact	Fair	Fair
Sustainability	Fair	Slightly High
Recommendations	1)Appointment of Project Assistant Director 2)Participation of GARBLT High Rank Officers in Japan 3)Development of GARBLT Core Inspection Trainers 4)Allocation of Personnel and Budget for BMS System 5)Sharing the Acquired Knowledge among GARBLT	1)Extension of the Project 2)Development of GARBLT Core Inspection Trainers 3)Establishment of the organization for the operation of the BMS system

Lessons learned	1)Technical Transfer's Approach During three years, the technical transfer by the Project has to be completed. In case unexpected situation and circumstances occur, it is advisable to put priority on the planned activities. One of the examples is to attempt to choose feasible and effective method for technical transfer. According to the situation, the target area and target engineers have to be prioritized for technical transfer.	1)Additional personnel allocation An additional personnel allocation of key persons in accordance with the Project status is advisable for breaking out of straitened circumstances.


JICA