

Federal Ministry of Works

Summary Report

Federal Republic of Nigeria

Pilot Survey for Disseminating SME's  
Technologies for the Inspection Technics of  
Civil Engineering Structures  
by Using Concrete Tester (CTS)

October, 2015

Japan International Cooperation Agency

Nitto Construction Inc.

## 1. BACKGROUND

According to “Nigeria’s Infrastructure: A Continental Perspective” (Africa’s Infrastructure Country Diagnostic (AICD), 2011), the road condition in Nigeria tends to be poor level comparing to the other countries categorized in ‘Resource-rich country in Sub-Sahara Africa’ and ‘Middle-income country’. This report also pointed out that there are some problems in terms of road maintenance because of lack of systematic planning for road maintenance and management and inadequate budget allocations.

In order to implement sustainable road maintenance and rehabilitation, it is required to understand road conditions properly. The database of road conditions which includes the records of constant inspection and maintenance is usually used for road management planning in Japan.

Concrete Tester (CTS) is mainly used for inspection of civil engineering structures (concrete structures), and CTS is easier and more accurate to use. The inspection results of CTS are more useful data for systematic management. Since it is possible to understand influence of aging of concrete structure by continuous inspection with CTS, it is easier to correctly analyze structure soundness by utilizing the data obtained by CTS. As the result, these obtained data and the analysis results are to be helped to design a systematic concrete structure management. Of course, enhancement of the capacity of engineers and consultants is the most important to implement appropriate road maintenance and rehabilitation through penetrating CTS as useful device for concrete structure management.

## 2. OUTLINE OF THE PILOT SURVEY FOR DISSEMINATING SME’S TECHNOLOGIES

### (1) Purpose

The Survey is mainly composed of practical training of inspection technics through demonstrating CTS. The main goal of the Survey is to establish basic database of the condition of incidental concrete structures on road in Abuja area using the data obtained by CTS, so that the recipient government can conduct systematic management for civil engineering structures in the future.

### (2) Activities

- Conduct Pre-survey of the target structures
- Formulation of an inspection plan based on the pre-survey
- Conduct practical trainings at actual inspection site based on Japanese general inspection method, and demonstration of CTS
- Evaluation of collected data by practical trainings
- Classroom learning for designing maintenance and rehabilitation plan

- Design a long term management plan including maintenance and rehabilitation with Nigerian engineers
- Providing continuous technical supports to Nigerian engineers
- Introducing other non-destructive testing method, bridge inspection truck, and other technologies

(3) Information of Product/ Technology to be Provided

CTS is a non-destructive testing equipment for estimation of concrete compressive strength. It makes the estimation more easily and accurately by measuring and analyzing obtained waveform of impact force. Besides, the CTS is able to estimate not only the compressive strength, but also detects deterioration of concrete surface, delamination, void and honeycomb near concrete surface. One of its strength is portability, and it is very easy and quick to measure. Measured data is recorded on the device, and is able to output as CSV file through a dedicated PC program for CTS on your computer.

(4) Counterpart Organization

Federal Ministry of Works

(5) Target Area and Beneficiaries

Federal Ministry of Works (FMoW)

Construction companies

Construction consulting companies

Road users in Abuja area

(6) Duration

From March 2014 to October 2015

(7) Progress Schedule

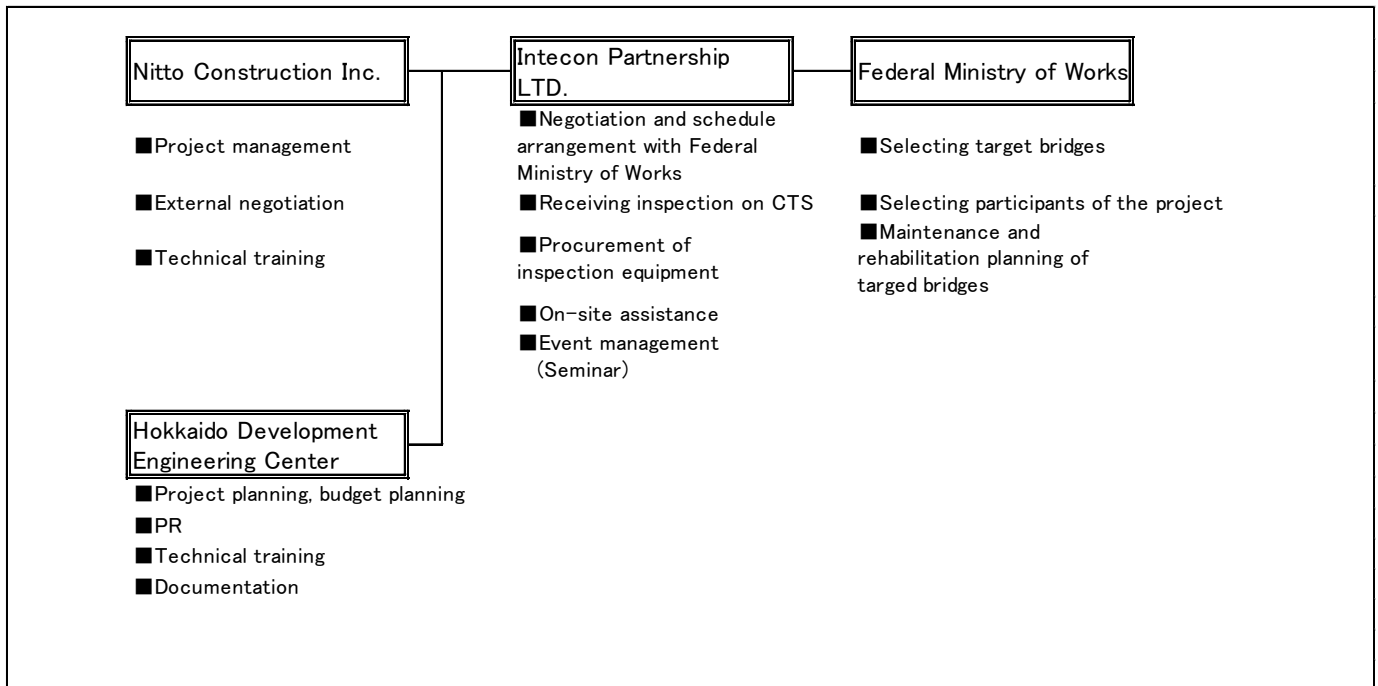
FY Item	2014											2015									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Program arrangement with local partner	□																				
Documant preparation for the meeting at Nigeria	□																				
Meeting and pre-survey	■																				
Program planning for on-site training in Nigeria	□	□																			
Editing textbook for bridge inspection	□	□	□																		
On-site training for bridge inspection				■	■																
Program planning for the training in Japan				□	□																
Selecting instructor for the training in Japan					□																
Editing textbook for the training in Japan					□	□															
Training in Japan							□														
Making a maintenance and a management plan for target bridges													□	□	□	■					
Making the progress report							□	□													
Submit the progress report to JICA								□													
Making the completion report														□	□	□	□	□	□	□	
Submit the completion report to JICA																				□	

Legend : ■ In Nigeria □ In Japan

(8) Manning Schedule

Position	Name	Company	2014												2015										Working Days Total			
			Mar	Apr	May		Jun		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		Jun	Jul	Aug	Sep	Oct	Nigeria	Japan	
Project Manager	Genki Kubo	Nitto Construction Inc.	10	6	10	1	6	15	6	7	10	6	6				2	2	3	11	6	2	2	2	2	2	37	80
Coordinator	Makoto Okamoto	Nitto Construction Inc.	10	4	9	1	6	15	6	7	10	6	5				3	3	3	11	6	2	3	3	2	2	37	80
Technical Adviser	Yusuke Konnoh	Nitto Construction Inc.	10	2	10	1	10	15	3	1	10									11	3	1					37	40
Chief Adviser	Yoshimitsu Takanishi	Hokkaido Development Engineering Center	10	6	10	1	5	15	5	5	10	5					3	3	3	11	4	4	5	6	4	2	37	80
General Affairs	Hiroshi Sato	Hokkaido Development Engineering Center	10	4	10	1	5	15	6	6	10	4					3	3	3	11	4	4	6	6	4	2	37	80
Training Planner	Yoshikazu Sato	Hokkaido Development Engineering Center	10	2	10	1	5	15	5	5	10	4							3	11	3	1					37	48
																								Nitto Subtotal	111	200		
																								DEC Subtotal	111	208		
																								Total	222	408		

### (9) Implementation System



### 3. ACHIEVEMENT OF THE SURVEY

#### (1) Outputs and Outcomes of the Survey

The Survey provided technical guidance on bridge inspection for engineers of the Federal Ministry of Works. The goal of the Survey is to have the engineers understand importance of maintenance and management for concrete structures and effectiveness of CTS for concrete inspection. The questionnaire survey has been carried out for 20 of civil engineers of the Federal Ministry of Works and 26 Nigerian private companies in order to analyze effectiveness of the Survey. As the results of the questionnaire survey all of them answered that inspection of bridges in Nigeria is necessary. Besides, those who answered that introduction of the bridge inspection works has some challenges, raised the reasons as “Lack of equipment for inspection”, “Lack of inspection skills” and “Lack of Budget”. Receiving these results, since the CTS proposed by the Survey is cheaper, easier to use than other non-destructive testing equipment, the Survey team confirmed that CTS could solve these challenges. In addition to this, the Survey team transferred the technologies on bridge inspection with CTS to the civil engineers of FMoW through providing guidance and practical trainings. Accordingly, it could be said that the purpose of the Survey certainly could contribute to the needs of FMoW.

Although appropriate inspection for bridges is important, it is more important for FMoW to make a plan on maintenance and rehabilitation based on the inspection result to reduce their administrative cost with efficient management of bridges as well as to

achieve life prolongation of bridges in Nigeria.

Additionally, most of answers showed that “Recommendation of using CTS by the FMoW” is the most effective to make CTS widely spread in Nigeria according to the questionnaire survey.

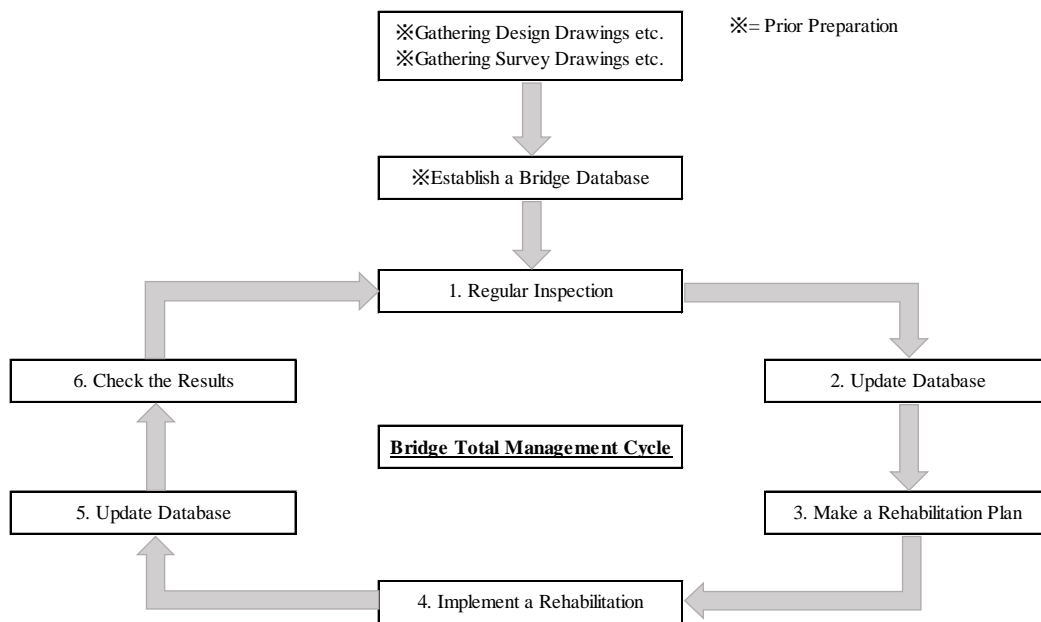
In fact, the Federal Ministry of Works made a report after the visit to Hokkaido in August, 2014. It is mentioned that more proactive bridge maintenance program should be deployed and used alongside the Bridge Management System to ensure the safe use of bridges in Nigeria. It is also mentioned that the FMoW's consultants handling Consultancy Technical Evaluation Services of bridges and other concrete structures should be requested to henceforth utilize the more technologically advanced CTS to carry out non-destructive tests in view of the advantages of CTS over Rebound Hammer and the need to have standard uniform results.

(2) Self-reliant and Continual Activities to be Conducted by Counterpart Organization

In Nigeria, most of the data required for bridge management were lost while capital relocation. Design drawings and structural calculation sheets are basic information for appropriate bridge management, and lack of these information would be an obstacle to improve bridge management system in Nigeria.

A database of bridge shall enable the FMoW to provide appropriate services such as repair or maintenance management by associating the database and inspection data using CTS.

In the future, to establish a Bridge Management Cycle as shown in following flow chart shall be beneficial for the Federal Ministry of Works to reduce management cost of bridges.



The FMoW has mentioned in the report that the Ministry/Department (Highway Design and Bridge) should encourage such training programs towards keeping the in-house engineers up-to-date with new trends in engineering. Additionally, an engineer of the FMoW, who has participated in the On-site training and the Classroom training for Bridge Asset Management, commented that they shall adopt the inspection technics including implementation of regular inspection and use of CTS in Nigeria.

The Survey conducted a comprehensive training program from the data collection to maintenance and rehabilitation planning with some bridges in Abuja as examples. It is expected that the technics shall be adapted to Nigerian circumstances so the Federal Ministry of Works shall implement a precise maintenance and management of the bridges.

#### 4. FUTURE PROSPECTS

##### (1) Impact and Effect on the Concerned Development Issues through Business

###### Development of the Product/ Technology in the Surveyed Country

As mentioned in the previous section, it is the FMoW's policy to utilize CTS to have standard uniform results on bridge inspection, and CTS may become a standard method for compressive strength measurement of concrete structures in Nigeria. In fact, CTS has already been used for Structural Assessment of concrete structures under the Ministry's project. Table 1 shows the projects that CTS has been used for the integrity test.



- Technical Evaluation of Fire Damaged Bridge along Abuja – Abaji road, FCT Abuja. (2015)
- Technical Evaluation of Fire Damaged Bridge along Ikot-Ekpene – Abak – Ekparakwa – Ette Road in Akwa Ibom State. (2015)
- Structural Assessment of Heritage mall - Cinema Area. Ibadan, Oyo state. (2015)
- Structural Integrity Audit of Costain and JDP Point Block Tower in Rainbow Town Development Project Site. Port- Harcourt (2013)
- Structural Integrity Audit of Masta Services Point Block Tower in Rainbow Town Development Project Site. Port- Harcourt (2013)
- Structural Integrity Checks for Engineering Design for Rehabilitation of Ijora-Apapa Bridge Lagos State. (2013)
- Engineering Design and Structural Assessment for the Rehabilitation of Murtala Mohammed Bridge, Kotonkarfe, Kogi State. (2012)

*Table 1: Projects that CTS has been deployed*

In addition to above, the result of the comparative analysis of CTS and Rebound Hammer, which is the most popular as non-destructive testing equipment in the world, is shown in the Table 2 as below. CTS is able to reduce about 60% of the cost of inspection comparing to the Rebound Hammer. Because the data measured by CTS can be quickly transferred to PC as CSV files, users can easily analyze the data by Microsoft Excel as mentioned above. Accordingly, CTS could contribute for reducing the cost of inspection and time of analysis, and furthermore enables users to carry out continuous measurement. Although this result is based on the average cost in Japan, it is considered that there is little difference in the necessary cost for inspection and days for analysis between Japan and Nigeria.

	CTS	Rebound Hammer	Comparative Analysis (CTS / Rebound Hammer)
Cost for Inspection	JPY155,300/130 Point	JPY382,500/130 Point	59.4%
Days for Analysis	2.5 days/130 Point	7 days/130 Point	64.3%

*Table 2: Comparative analysis between CTS and Rebound Hammer*

Note: 130 Measuring Point/Day, 25 times measurement at each Measuring Point

: Based on the Average cost in Japan

(2) Lessons Learned and Recommendation through the Survey

As mentioned above, basic information such as structural dimension of bridge, records of regular inspection are important for appropriate maintenance and management for bridges. These data should be used for developing a management plan to contribute for efficient maintenance and rehabilitation. As the result of this proactive bridge management, the service life of bridges shall be maximized. Additionally, cost of replacement of bridges shall be reduced in long-term perspective, and this would also reduce Fiscal burden of the Federal Government of Nigeria in the future.

This Survey has mainly introduced current trends in inspection and management of bridges in Japan through the classroom training and on-site training. It is expected that more proactive bridge maintenance and management program should be developed and implemented alongside the bridge management system which is arranged to suit the situation in Nigeria to ensure the safe use of bridges.

ATTACHMENT: OUTLINE OF THE SURVEY

**THE PILOT SURVEY FOR DISSEMINATING SME'S TECHNOLOGIES**  
**Inspection Technics of Civil Engineering Structures by Using Concrete Tester (CTS) in Nigeria**

**Outline of the Survey**

- Proposed by : Nitto Construction Inc., Oumu, Japan
- Counterpart Organization : Federal Ministry of Works
- Target area and Beneficiaries : Federal Ministry of Works, Construction companies, Consulting companies, Road users in Abuja Area
- Duration : March 2014 to October 2015

● **Concerned Development Issues in Nigeria** ● ← **match** → ● **Proposed Products / Technologies** ●

Road Infrastructure in Nigeria

Nigeria has been developed an extensive national road network. However, both paved and unpaved roads network are not maintained in a sustainable manner due to insufficient budget, technics, equipment and materials required for systematic road management. Therefore, it is necessary to improve maintenance and management technics of Nigerian civil engineers, and appropriate inspection equipment should be introduced to overcome above issues.

CTS-02 (Concrete Tester)

Concrete Tester is a Non-Destructive testing equipment for estimation of concrete compressive strength. It makes the estimation more easily and accurately by measuring and analyzing obtained waveform of impact force by hammering concrete surface.

**Implemented Activities in the Survey**

- This Survey is mainly composed of practical training of inspection technics of bridge with demonstrating Concrete Tester in order to deepen Nigerian civil engineers understanding on importance of inspection technics and effectiveness of Concrete Tester.



**Outputs and Outcomes of the Survey**

- Improvement of inspection technics and learning utilization method of Concrete Tester.
- Making soundness evaluation of target bridges based on the data of practical training.
- Implementing rehabilitation or making sustainable rehabilitation plan.

**Impact on the Concerned Development Issues in Nigeria**

- Concrete Tester enables proper evaluation for soundness, and also ensures the safety of concrete structures such as bridges. In addition, proactive management planning of concrete structures may reduce financial burden related to the life cycle costs.

