The People's Republic of Bangladesh
Public Works Department, Ministry of Housing and Public Works

PROJECT FOR CAPACITY DEVELOPMENT ON NATURAL DISASTER-RESISTANT TECHNIQUES OF CONSTRUCTION AND RETROFITTING FOR PUBLIC BUILDINGS IN THE PEOPLE'S REPUBLIC OF BANGLADESH

FINAL REPORT

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JAPAN INTERNATIONAL COOPERATION AGENCY

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Project Summary

1. Project Outline

1-1. Background

Bangladesh suffers regularly from disasters such as Cyclones, Floods, Storm Surges and Tornados including Earthquakes. To minimize damages may cause due to these disasters, public organizations need to be kept themselves prepared for adequate functioning during and after a disaster while ensuring disaster-resistant public buildings. Generally the public buildings concentrated in urban areas are vulnerable to damage caused by an earthquake. Out of 5,000 public buildings in Bangladesh, around 3,000 were constructed before 1993 when Bangladesh National Building Code (hereinafter referred to as "BNBC 1993") was enacted. These buildings have low resistant ability against earthquakes, thus, is a concern. It was learnt that under a five year project called Comprehensive Disaster Management Program (CDMP, 2009), earthquake damage estimation and building survey was carried out in 3 large cities of Bangladesh including Dhaka. According to the results, if an earthquake of M7.5 at Madhupur Fault in the Dhaka suburb occurs, the damage estimation for the Dhaka city became VIII of MMI seismic intensity scale, about 6 in the Japanese scale, and out of the total 326,000 buildings, 72,000 buildings will be damaged beyond repair. About 50% of them would be reinforced concrete and about 30 percent would be brick masonry buildings. In addition, moderately damaged buildings are estimated to be 49%. Further, if the earthquake occurs at 2:00 am, about 90 thousand people will be killed. Under such situations, maintenance of the building construction quality and improvement of the safety of the buildings are absolutely necessary for Bangladesh.

Government of Bangladesh has prepared countermeasures of seismic resistant of the buildings through formulation of national policy/plan, such as National Plan for Disaster Management (NPDM) and Standing Order on Disasters (SOD). Public Works Department (hereinafter referred to as "PWD") is one of the main organizations to promote seismic-resistant buildings. PWD has techniques/experience in Cyclone and Flood-resistant structures, while capacity of seismic-resistant design/construction are inadequate. Hence, capacity development regarding seismic-resistant techniques is an important issue for PWD.

Bangladesh experiences natural disasters, primarily floods and cyclones as usual, that have brings huge economic losses and a large number of casualties. On the other hand, regarding earthquakes, though the Dhaka

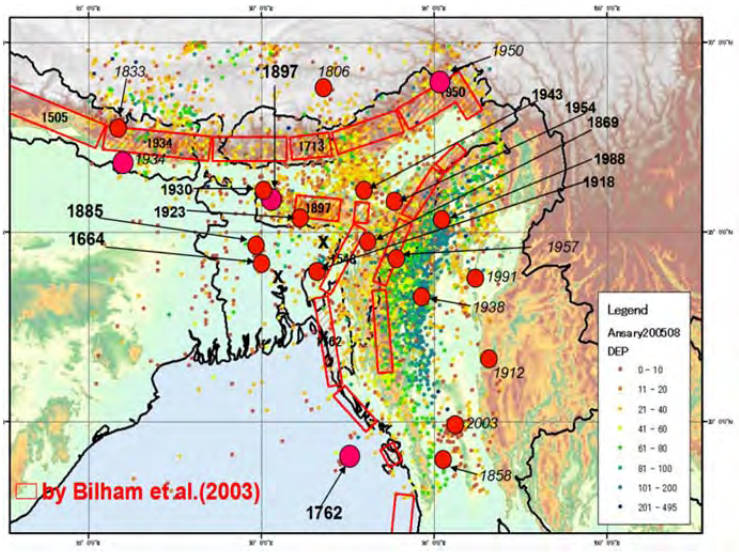

Fig. 1 Past disastrous earthquakes in and around Bangladesh

metropolitan area has not experienced any big earthquake during the last 100 years, the past records show that many large earthquakes occurred in and around Bangladesh. Among them, the 1897 Great Assam Earthquake of 8 class magnitude has caused significant damage to housing and human lives. The Nepal earthquake with a magnitude of 7.8 in April 2015 felt even in Dhaka which is located at a very far distance. It could be the warning for the people on need for earthquake countermeasures.

This project was initiated for four years starting from 2011. However, during the progress of the project, the tragic incident of Rana Plaza that occurred in 2013 awaken the consciousness of the Government of Bangladesh as well as building owners. In particular, since the garment industry is a national key industry, Ministries of Economy, Labour, Housing and Public Works, and Universities or garment industry federations have been pouring their efforts unanimously. The Government of Japanese embarked on garment industry seismic retrofitting works supported by quickly available SME loan, subject project team was entrusted for its technical assistance.

1-2. Outline of the Project

(1) Target Area: Dhaka city, Chittagong City and Sylhet City

(2) Duration: approximately 5 years from Match 2011 to January 2016

(3) Goals of the Project:

<Super Goal>

Safety of the buildings is secured by following BNBC.

<Overall Goal>

Construction and retrofitting of public buildings which are strong against natural disasters are promoted.

<Project Purpose>

The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.

(4) Outputs:

Output 1: The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed.

Output 2: The design methods for new building designing as well as retrofitting the public buildings against natural disasters are improve.

Output 3: The capacity to manage retrofitting works of the public buildings is developed.

Output 4: Quality control process is developed.

Output 5: The technologies on construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well as are disseminated to relevant engineers of other organizations.

Fig. 2 Project Area

2. Achievements of the Project

2-1. Capacity Building Activities

(1) Building Inventory

In order to explore the current state of the public buildings, and to obtain baseline data for future work operations and planning, the building inventories for three cities (Dhaka, Chittagong and Sylhet) that PWD maintains, were prepared involving Team 1. They do not include all of the buildings that PWD designed. During carrying out this work, several unknown things could be cleared such as even PWD maintaining the buildings, availability of drawings is low, and number of brick masonry buildings are decreasing, almost half.

Fig. 3 An Example of Building Inventory

(2) Vulnerability Evaluation and Preparation of Design Drawings of Existing Buildings

The strength of the overall RC Building in Bangladesh that examined by the Comprehensive Disaster Management Programme (CDMP) which was launched based on the lessons of the 2004 Large Sumatra Tsunami, is about half of the strength required by BNBC.

Under this project, vulnerability evaluation was performed on the selected existing buildings that PWD maintains. The result shows that the strength of the building is around 1/4 of those of the Japanese standards. And since the required building strength against earthquake in Dhaka is considered as around half of Japan, the current buildings in Dhaka do not comply with the value required by BNBC. One of the causes is the low concrete strength. The results of concrete strength tests carried out under this project did not reach even half of BNBC's requirement. Conventionally, such information on the strength realities of the materials for the building is very little. Therefore, this situation became a major challenge that there is no way of interpreting the effective measures.

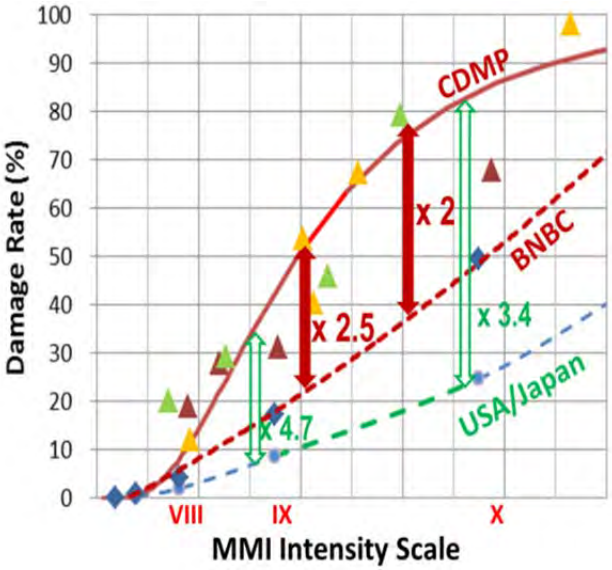

Fig. 4 Strength of RC Buildings (CDMP,

Considering this situation, trainings on seismic retrofitting design and design drawing preparation for the buildings that require seismic retrofitting were carried out.

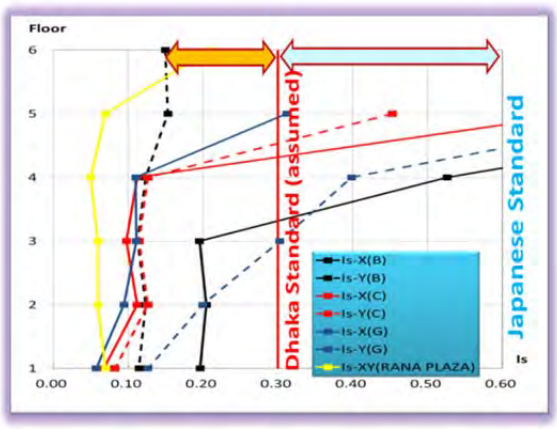

Fig. 5 An Example of Seismic Evaluation

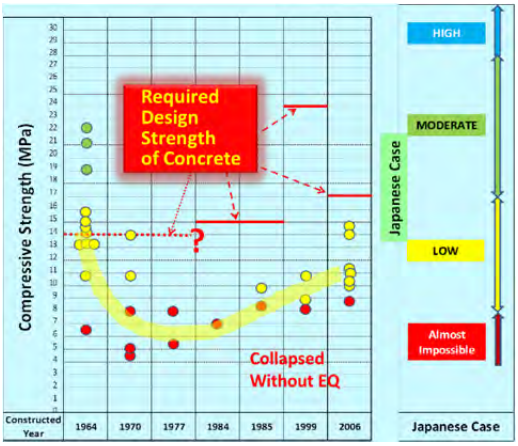

Fig. 6 An Example of Strength of Concrete in Dhaka

(3) Test Works of Seismic Retrofitting

Considering materials, cost, and the difficulty of the seismic retrofitting design and retrofitting construction, the suitable methods of seismic retrofitting for Bangladesh was studied by applying test works at the building of PWD. They are remained as a museum for the future.

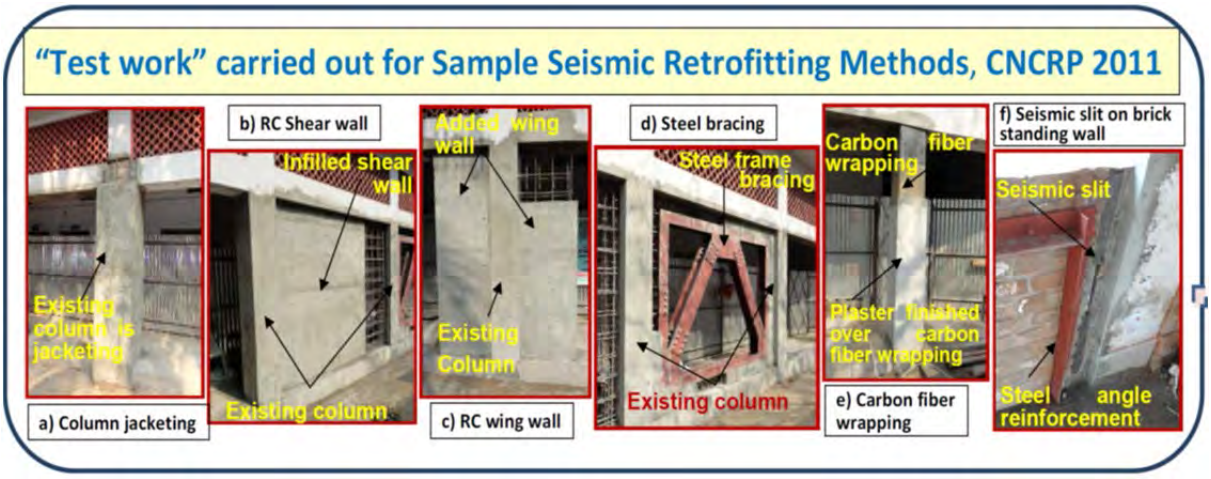

Fig. 7 The Six Types of Retrofitting Construction of the Test Works (2011)

(4) Structural Test

The actual building behavior and way of collapse during earthquakes are not known in Bangladesh. Therefore, structural tests have been conducted at the experimental facilities of BUET (Bangladesh University of Engineering and Technology) donated by JICA in the past. From these tests, results were obtained about the actual condition of the behavior of the columns and walls. Since the continuation of the basic structural tests is required, it is desirable that the work is continued under the SATREPS (Joint Research Project on Aseismic Building Technology) that has been planned.

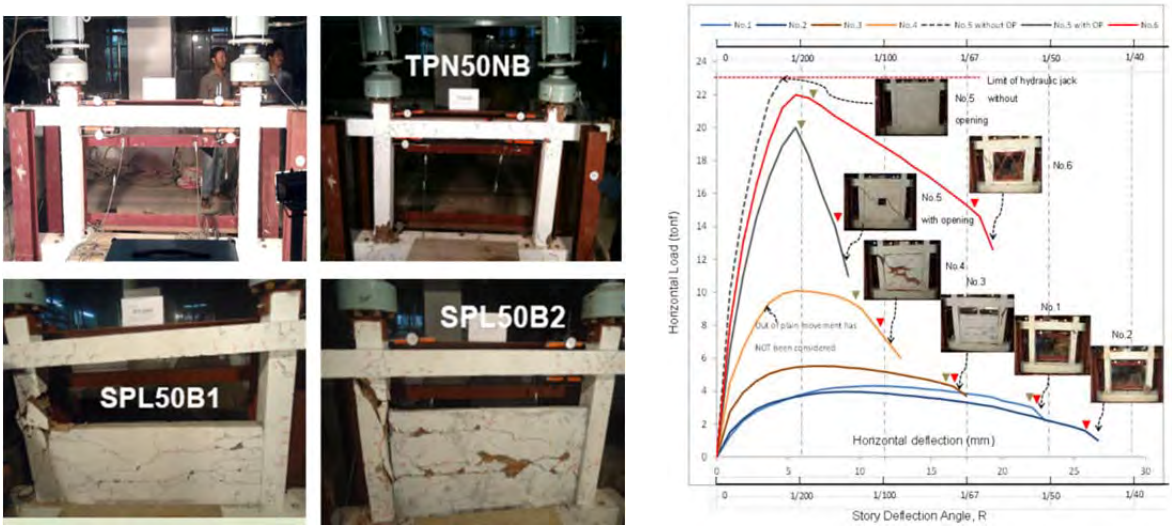

Fig. 8 Structural Test Sample

(5) Preparation of Manuals

In order to have the basic training materials for the future, the following six manual including the contents of the training have been prepared and disseminated in collaboration of the Japanese and the PWD sides. This is one of the great achievements of this project.

Seismic Evaluation Manual | **Seismic Retrofitting Design Manual** | **Retrofit Construction and Supervision Manual**

Quality Control Guidelines | **Seismic Design Manual** | **Non-Seismic Manual**

Fig. 9 The Six Manuals and Guidelines prepared in the Project

(6) Training

Apart from the lectures and consulting sessions by the Japanese experts, three training courses in Japan were organized. Also seminars/workshops and technical debate, intensive course by the invited experts from Japan (design application, liquefaction, and fire protection) aiming at the capacity building of building engineers mainly of PWD were conducted. In addition, some introductory

trainings have been organized where PWD engineers trained under this project involved as lecturers. The target participants were building engineers of PWD, universities, research institutes and private building engineers. Although the number is only around 20, it is hoped they will be the human resources as the Bangladeshi leaders or lecturers of seismic retrofitting design and construction. To deliver instructions as a lecturer is a sign of motivation of learning, which is the evidence of side effect of awareness raising. In addition, teaching materials used could be the teaching materials for future training courses.

Fig. 10 situations of trainings

(7) Pilot Project

A pilot project for retrofitting design and construction was implemented on an existing old fire station. It was an opportunity for Bangladeshi engineers to practice their knowledge that they gained from the training. The budget for the project was arranged by PWD. To overcome the challenges encountered during the implementation of the pilot project many trials and error were required which affected the construction schedule. There are still some challenges, however, they should be utilized as a lessons of learning.

Fig. 11 Pilot Project (left: before, center: after retrofitting, and right: steel bracing)

(8) Public Relation and Disaster Education

In order to improve the safety of buildings by following BNBC, not only the activities of engineers, it is important to raise awareness about disaster among the citizens. To this end, disaster education and drill activities have been carried out at schools, colony buildings and in a factory. Potentials of effects and dissemination of these activities were confirmed. It is expected that these activities have triggered the promotion of future disaster management initiatives.

On the other hand, since building permission process is an important aspect for following BNBC, suggestions and questioning with respect to verification and improvement of the application process were conducted relating to the role of RAJUK which is the authority for building permission within

Dhaka metropolitan area.

In addition, as a public relations activities, a variety of activities were undertaken and implemented. Among them preparation and dissemination of newsletters, postings on the PWD web page and JICA's Facebook page, development of disaster education activities guidebook and disaster management activities posters and brochures. Further, airing of video clips in the local television, Short Film Competition etc. were also done.

Fig. 12 Disaster Education, Evacuation Drill example (left at school, right at colony)

2-2. Support of Retrofitting Work for Ready Made Garment (RMG) Factories

Due to the collapse of Rana Plaza at the beginning of the third fiscal year, the aspects of this project have changed drastically.

(1) Incident of Rana Plaza Building

On April 24, 2013, the Rana Plaza Building of 9-story collapsed without occurrence of any earthquake, it caused a disaster of 1,135 casualties, including the staff of the garment factory. It was the typical vulnerability of the building in Bangladesh. They bare seismic design deficiencies, extension of 10th floor out of 6-storeyed design, office usage in application but actually factory use. The quality of construction was quite poor that concrete strength was less than half of the required strength of BNBC. In addition, the building permit application was faked one. The Incident Investigation Committee report by the PWD has been highly appreciated. It should be mentioned that the most of the members of the Investigation committee were trained under this project.

Fig. 13 Rana Plaza Incident

(2) Japanese Loan and Technical Support

Since the Ready Made Garment (RMG) industry has been serving as a mainstay for Bangladesh, the agencies of all over the country have embarked on measures. Also the Japanese side has launched

instantaneously support for the retrofitting work of RMG factories by SME loan. The project team was entrusted for the technical support.

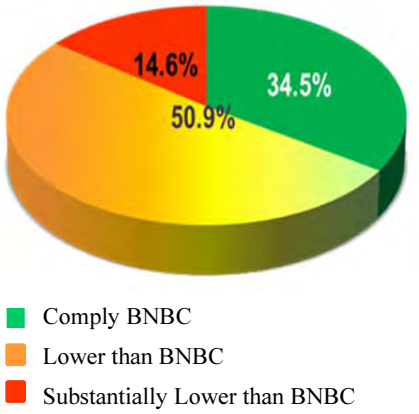

Fig. 14 Simple Evaluation Result of Applied RMG Factories

There are about 5000 RMG factories in the country, the majority of which is visually inspected prioritizing fire protection by the European and American buyers union namely ACCORD and ALLIANCE, and ILO (World Labor Organization). Around one third of the inspected factories need renovation measures. DIFE (Department of Inspection for Factories and Establishments under the Ministry of Labour and Employment) has issued a shutdown instruction to dozens of factories which are of very poor conditions. However, further support is not considered by these organizations.

On the other hand, JICA has signed MOU with the associations of garment industry, knitwear industry (BGMEA, BKMEA respectively), Bangladesh Bank, and PWD. Through this scheme, approximately 200 applicants were accepted but reduced to 55 after a document check. The results of a simple evaluation on 55 factories showed that 2/3 did not follow BNBC, 15% were found to be far below BNBC requirement.

The one selected factory among applied RMG factories got credit limit from the bank after building survey and seismic evaluation. The first retrofitting construction work was started in February 2015 after the retrofitting design, and it was completed after about one year. There are still some ongoing activities.

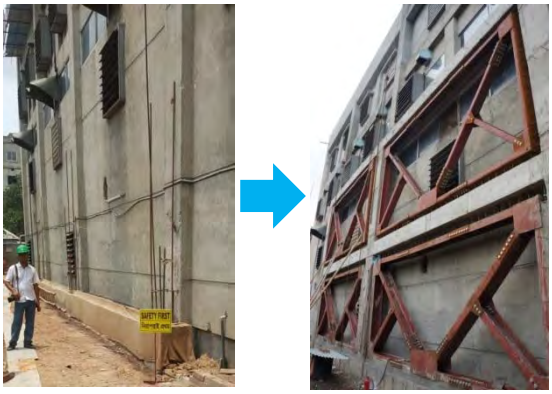

Fig. 15 First Retrofitting Work at RMG Factory by Japanese Loan

3. Issues and Recommendations

The main issues, challenges and recommendations through this project are as follows.

3- 1. Capacity Development, Human Resource Development

The project goal is the capacity development of PWD building engineers. After almost five year efforts, certain outcome has been achieved, and some human resources developed who can play the leading role for future. However, since not all counterpart engineers can stand alone, there is a need for further efforts. Also, assuming a huge number of vulnerable buildings in Bangladesh, it is very difficult to handle these numbers only by PWD engineers. It is necessary to train other organizations' engineers to accomplish the job. It should be noted that, there is a Training Academy operates by PWD

but there are many issues such as insufficient budget, shortage of lecturers, and curriculum need to be solved. Therefore, there is a requirement for development of an overall plan of training.

3- 2. Manuals and Building Code

Under this project, following the BNBC, the six manuals and guidelines were prepared. They are effective as practical supplements for BNBC execution. On the other hand, BNBC, enacted in 1993, revised in 2006, actually enforced in 2009, has a reality that it is not complied as it should be at the time of construction in the past. Considering the realization of safety enhancement of the buildings against the disasters, by any means, it should be the top priority to enforce the compliance of BNBC as early as possible in the whole country.

(1) Revision of BNBC

The revisions made on the old versions were approved by the committee in 2014, and in 2015 all editing works were also finished, but an official order still pending which is hindering the enforcement. In addition, in the revised version, although the terms of seismic design is given importance than ever, there is no specific description with respect to seismic evaluation and seismic retrofitting. Therefore, regarding seismic evaluation, seismic retrofitting, as well as construction supervision, it is hoped that the manuals prepared under this project can be very advantageous.

(2) Dissemination/Enforcenment System

As described in SOD, dissemination of BNBC is the responsibility of MoHPW. BNBC 2006 proposed BBRA (Bangladesh Building Regulatory Authority) as the monitoring organization for BNBC enforcement. However, as of now it has not been realized. More effective endeavors of MoHPW are essential.

3-3. External Situations

(1) Other JICA Projects

In addition to this technical cooperation project, there are few JICA funded on-going projects, namely Urban Building Safety Projects (UBSP), a hospital-related building project and the joint research project (SATREPS). Since there are many relevant activities, it is recommended that sharing of experience gained from this project is done properly so that positive impacts are achieved in other projects.

(2) Seismic Retrofitting Construction of RMG factories

The Japanese Embassy and JICA decided to provide a loan for seismic retrofitting of RMG factories and acted promptly after Rana Plaza incident. This project team provided all necessary technical supports for that RMG project. Retrofitting construction work was started in 2015, and completed over a period of one year. During this work, in order to take advantage of the results of training and manuals, it is believed that further knowledge have been piled up with local contractors and designers. This is one of the major achievements of the project. It is assumed that more works of this kind will continue on other candidate RMG factories resulting continuation of this project.

(3) Related to RMG Industry

Regarding around 5000 RMG factories across the country, the three organizations such as ILO, ASCCORD and ALLIANCE conducted preliminary inspection. They publicized the results that one third of factories were unsafe. However, the focus of the inspection was mainly on the fire protection due to the 2012 garment factory fire accident that caused over 100 death. Among the inspected factories, about 30 factories were given shutdown notice by DIFE for their poor conditions. However, these organizations do not go for further activities. And they delegated the responsibilities to the factory owner side. Further, they recommended to perform a Detailed Engineering Assessment (DEA) by owners' expenses. ILO has called for forming an unified guidelines of DEA, but technically there are many problems.

Fig. 16 Fire Accident at Tazreen company, 2012

3-4. Evaluation and Recommendations

(1) Evaluation of the Project

For project evaluation purposes, baseline and end-line surveys were carried out by the project team. Every year, interviews were taken and interpreted. Comparison of the results show that the counterparts have improved their technical capabilities substantially.

In addition, JICA also carried out their own evaluations at the middle and end of the project. There were five categories in terms of relevance, effectiveness, efficiency, impact and sustainability in the evaluation method, and it was concluded that there was a great effect. In future, human resource development not only of PWD is expected and the sustainability of the project has been encouraged.

(2) Recommendations

In this project, the following recommendations are made:

1) To form and to execute the program focusing on human resource development on seismic Technology
2) To utilize and to revise the manuals
3) To succeed and to develop the technical experiences and lessons during design, construction and supervision
4) To establish technical aspects and system on seismic retrofitting for public buildings in PWD
5) To continue the project

Contents

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＜Separate Manual & Guidelines＞

List of Abbreviations

Abbreviation	Official Name	Abbreviation	Official Name
ACCORD	The Accord on Fire and Building Safety in Bangladesh	IAB	Institute of Architects Bangladesh
ACE	Additional Chief Engineer	ICC	International Code Council
ACI	American Concrete Institute	IEB	Institute of Engineers Bangladesh
ADB	Asian Development Bank	ILO	International Labor Organization
ADPC	Asian Disaster Preparedness Center	ISO	Seismic Demand Index of Structure
AE	Assistant Engineer	JPY	Japanese Yen
ALLIANCE	The ALLIANCE for Bangladesh Workers Safety, Inc.	JBDPA	The Japan Building Disaster Prevention Association
AIJ	Architectural Institute of Japan	JCC	Joint Coordinating Committee
AO	Authorized Officer	JET	JICA Expert Team
ASCE	American Society of Civil Engineers	JICA	Japan International Cooperation Agency
ASE	Advanced Simplified Evaluation	LGED	Local Government Engineering Department
BB	Bangladesh Bank	M	Magnitude
BC	Brick in cement mortal with concrete floor building	M/M	Minutes of Meeting
BCA	Building Construction Act	MMI	Modified Mercalli (Seismic) Intensity
BCC	Building Construction Committee	MoDMR	Ministry of Disaster Management and Relief
BCJ	The Building Center of Japan	MoE	Ministry of Education
BCR	Building Construction Rules	MoF	Ministry of Finance
BDT	Bangladesh Taka	MoH	Ministry of Health
BF	Brick in cement mortal with flexible roof building	MoHA	Ministry of Home Affairs
BGMEA	Bangladesh Garment Manufacturers' Export Association	MoHPW	Ministry of Housing and Public Works
BKMEA	Bangladesh Knitwear Manufacturers' Export Association	MoLE	Ministry of Labour and Employment
BNBC	Bangladesh National Building Code	MoP	Ministry of Planning
BO	Building Official	MoPH	Ministry of Public Health
BRA (BBRA)	Bangladesh Building Regulatory Authority	MOU	Memorandum of Understanding
BUET	Bangladesh University of Engineering and Technology	NPDM	National Plan for Disaster Management
CA	Chief Architect	NTAP	National Tripartite Action Plan
CDMP	Comprehensive Disaster Management Programme	OJT	On the Job Training
CE	Chief Engineer	PDM	Project Design Matrix
CNCRP	Project for Capacity Development on natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings	PGA	Peak Ground Acceleration
C/P	Counterpart	PO	Plan of Operation
D/D	Detail Design	PWD	Public Works Department
DCC	Dhaka City Corporation	RAJUK	Rajdhani Unnayan Kartipakha
DD	Detail Design	RC	Reinforced Concrete
DDM	Department of Disaster Management	R/D	Record of Discussions
DEA	Digital Engineering Assessment	RMG	Readymade Garments
DIFE	Department for Inspection of Factories and Establishments	SDE	Sub-divisional Engineer
DOA	Department of Architect	SE	Superintendent Engineer
EC	European Commission	SEAOC	Structural Engineers Association of California
EE	Executive Engineer	SME	Small and Medium Scale Enterprises
EED:	Education Engineering Department under Ministry of Education	SOD	Standing Order on Disasters
ERD	Economic Relations Division	Tk	Bangladesh Taka
FEMA	Federal Emergency Management Agency	TRP	Technical Review Panel
Fc	Concrete (Compressive) Strength	UAP	University of Asian Pacific
FSCD	Fire Service and Civil Defense	UBSP	Urban Building Safety Project
FSPDSME	Financial Sector Project for the Development of SME	UNDP	United Nation Development Program
FY	Fiscal Year	USA	United States of America
GIS	Geographical Information System	USD	United State Dollar
GOB	Government of Bangladesh	VAT	Value Added Tax
HBRI	House Building Research Institute	WB	World Bank

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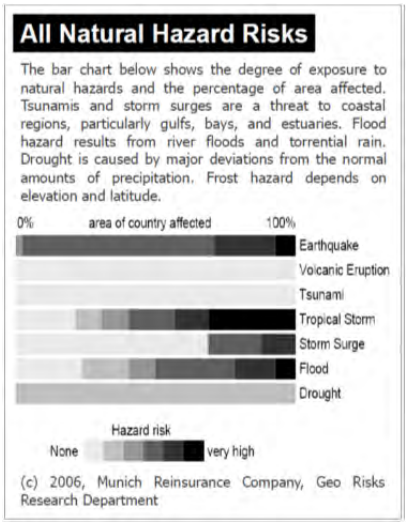
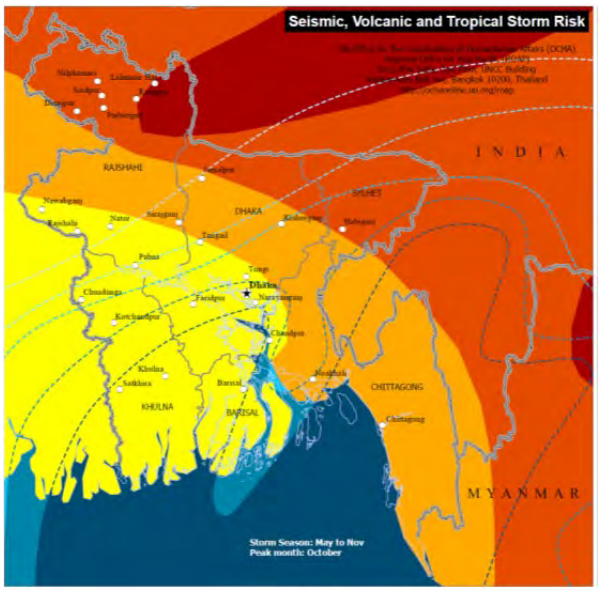
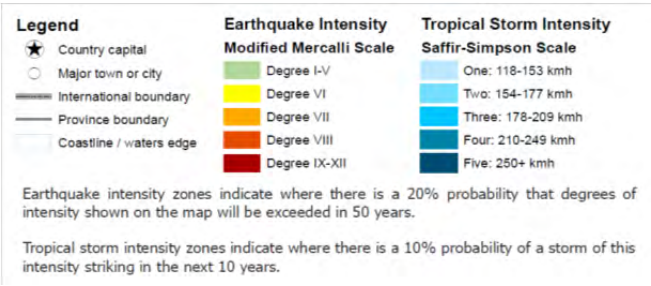
Chapter.1 Project Outline

1.1 Background

Bangladesh is suffered by Cyclone, Flood, Storm Surge and Tornado with high frequency as well as Earthquake disasters as shown in Figure 1.1.1. To minimize damages due to a natural disaster, public organizations need to preserve adequate function at a time of and after it, and public buildings having disaster-resistant shall be ensured. The public buildings concentrated in urban area are vulnerable to damage by an earthquake. Around 3,000 public buildings out of 5,000 buildings were constructed before 1993 when Bangladesh National Building Code (hereinafter referred to as "BNBC 1993") was enacted or in a time without a standard, low resistant ability of the buildings against earthquake, thus, is a concern.







[Source: OCHA, 9 March 2007]

Figure 1.1.1 Natural hazard Risks in Bangladesh

1.2 Circumstances

Government of Bangladesh has taken various steps to adopt countermeasures against natural disasters through formulation of policies/plans such as; National Plan for Disaster Management (NPDM) and Standing Order on Disasters (SOD). Public Works Department (hereinafter referred to

as “PWD”) is one of the main organizations to promote seismic-resistant buildings. PWD has techniques/experience in designing cyclone and flood-resistant structures, while capacity of seismic-resistant design/construction is inadequate. Hence, capacity development regarding seismic-resistant techniques is an important issue for PWD.

On consideration of the above, Government of Bangladesh requested Government of Japan for technical assistance to develop capacity of PWD engineers. JICA carried out a detailed preparatory survey in July 2010 and concluded the project scheme in the Minutes of Meeting (M/M). Record of Discussions (R/D) was signed in December 2010.

1.3 Project Purpose

<Super Goal>

Safety of the buildings is secured by following BNBC.

<Overall Goal>

Construction and retrofitting of public buildings which are strong against natural disasters are promoted.

<Project Purpose>

The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.

1.4 Project Area

Dhaka City, Sylhet City, Chittagong City in Bangladesh (refer to Figure 1.4.1)

Figure 1.4.1 Project Area

1.5 Basic Concept of the Project

1.5.1 Issues

Considering the problems to be resolved for the construction and retrofitting of the public buildings in Bangladesh, the following 5 items are pointed out as key issues.

(1) Current Conditions of the Public Buildings

(2) Capacity Development for Seismic Resistant Building

(3) Development of Quality Control for Design / Construction of the New and Existing Buildings

(4) Development of Appropriate Retrofitting Techniques for Bangladesh

(5) Preparation of Practical Manual of Seismic Resistant Construction and Retrofitting

In light of the above issues, the overall goals are set and presented in Table1.5.1.

Table 1.5.1 Setting of the Overall Goals

Issues \ Overall Goal	1. Implementation of retrofitting	2. Issuance of license	3. Incorporation for BNBC
(1) Current Conditions of the Public Buildings	○		
(2) Capacity Development for Seismic Resistant Building	○	○	○
(3) Development of Quality Control for Design / Construction of the New and Existing Buildings	○	○	
(4) Development of Appropriate Retrofitting Techniques for Bangladesh	○	○	○
(5) Preparation of Practical Manual of Seismic Resistant Construction and Retrofitting	○		○

<Overall Goals>

1. Construction and retrofitting of public buildings which are strong against natural disasters are promoted.

The progress of the above mentioned five items are as follows:

(1) Current Conditions of the Public Buildings

It is said that more than 5,000 public buildings across the country are managed by PWD (C/P of this project). However, since sufficient material is not available for identification of them, the systematic planning for retrofitting program cannot be formed currently. Thus, for advancing the disaster management measures of public buildings, construction of building database was an urgent issue in this project.

Under abovementioned context, in this project, a building inventory for Dhaka city in collaboration with C/P was conducted to construct a database. During the third and fourth year of

the project, it is expected to construct the building inventories and databases for Sylhet and Chittagong cities.

By the way, the building database revealed the current situation of Dhaka that almost 50% of the buildings are composed of RC (reinforced concrete) frame and the rest are composed of brick masonry. Also that most of the RC structure of them are with the RC frame unreinforced brick wall. Furthermore, it was found that the use of RC frame is in increasing trend in recent years.

The results of the test works, the vulnerability assessment and the structure tests that have been carried out during the first year and the second year of the project, showed several important information. The existing RC buildings in Dhaka built especially before 2,000 are likely to use brick chips as aggregate in concrete. Also many of them showed extremely low-strength concrete (13.5N/mm^2 or below) through the concrete core sample tests.

Further, some combination of extreme low-strength concrete and round steel main reinforcement are popular in existing RC buildings, as well as waist wall and partition wall are made of brick wall.

Because of differences in construction type and method between Japanese and Bangladesh, when applying Japanese seismic evaluation procedure, such differences should be taking into consideration. Therefore, in order to contribute grasping earthquake resistance nature and vulnerability of existing RC buildings, the structural tests were performed utilizing the existing laboratory equipment in the second and third years.

Since it was said to be the first time in Bangladesh, the structure tests of the RC skeleton provided not only experimental results but also lessons and challenges for tests.

By taking advantage of the experience of these , to continue the experiment structure , including seismic retrofitting , and strive to collect data on the improvement and seismic assessment of existing RC structures in the third year.

(2) Capacity Development for Seismic Resistant Building

The engineers of C/P plays a main role in design, construction and management of public buildings in Bangladesh. C/P has the experience and knowledge to natural disasters such as cyclones tornado , flood , storm surge, etc. affecting a frequent experiences. However, the experience with earthquake disaster is less since there is no major damage to the earthquake about recent 100 years.

In addition, many public buildings that C/P is manageing, were built before 1993 when the building standards (BNBC) was enacted for the first time in Bangladesh. It was suggested due to the property investigation of existing buildings during the second year that reinforcement amount and concrete strength are low, shear rebar is thin. Thus the follwoings are pointed out that they are just supporting its own weight only, and possibility without study on the deformation in the horizontal direction. As large number of such buildings constructed prior to 1993are supposed to exist, it is hard to say that the resistance to disasters in Bangladesh building is high. Since the first year, especially, as we have tried to capacity building related to

seismic design and construction management with focus on seismic retrofitting of existing buildunbgs and earthquake-resistant design of new construction.

(3) Development of Quality Control for Design / Construction of New and Existing Buildings

In the design and construction of new buildings, quality control including construction management is not built as a system nor working. Even for public buildings, they are likely to be constructed under the discretion of the individual management techniques.

In addition, as the case is rare for the renovation/retrofitting design and construction of the existing building so far, there is less construction management experience. In terms of the future, in order to go through the renovation/retrofitting and construction works, it becomes necessary challenge to construct the rules of the quality control.

In this project, a checklist of design and construction management of new construction was created at the beginning, to build a process of quality control of them. Both to raise awareness and to ensure quality for a certain level of BNBC have been tried, with respect to the design and construction management of new construction.

As for the renovation/retrofitting design and construction, the two manuals namely design and construction work management for retrofitting were formed. In addition, the checklist of design and construction management of seismic retrofitting was also to be prepared.

(4) Development of Appropriate Retrofitting Techniques for Bangladesh

Technology development for retrofitting has not been implemented in the C/P. Further the processes such as theoretical learning and test works and are also not taken in enough. While securing performance to be required, the development of retrofitting techniques under the local condition of are necessary such as availability of the materials, the development of construction techniques in consideration of the difficulty of method, cost, construction period, etc.

During this project, in order to grasp difficulty such as acquisition and construction method of the material, current status, the followings were conducted that the test works, a pilot project, in some cases handling the practical samples. It was expected to seek the retrofitting technique suitable for Bangladesh in consideration of the current situation.

(5) Preparation of Practical Manual of Seismic Resistant Construction and Retrofitting

During the renovation design and construction of existing buildings and design of new construction, though there is BNBC, it is said to be as an issue that the practical manuals applicable to the design engineers along with are missing. Provisions of the earthquake resistance standards and others are included in the National Bangladesh Building Code (BNBC2006), but the manuals to understand the concepts and methods by design engineers during seismic resistant design, and the design engineers can properly operate seismic design is required. The practical manuals are also lacking in the field of quality control and retrofitting design and construction.

From the issues described above, the following four manuals and one guidelines were created in this project.

1) Seismic Vulnerability Assessment (Seismic Evaluation) Manual
2) Design Manual for New Construction
3) Design Manual for Retrofitting
4) Retrofitting Work Management Manual
5) Quality Control Checklist and Guidelines

1.5.2 Basic Policy of Technical Aspects

Following 4 items were the basic policy of technical aspects for the capacity development.

(1) Capacity development focusing on seismic measures against natural disasters

(2) Technology transfer with respect to the concept and the methodology for design of new buildings and retrofitting design of existing buildings

(3) Development of construction techniques for retrofitting based on test works to meet circumstances in Bangladesh

(4) Preparation of technical manuals

(1) Capacity development focusing on seismic measures against natural disasters

Seismic load is larger than the wind load in general when limited to medium to low-rise RC buildings which is the target structural type of the project. When earthquake resistance is secured for the main members of the columns, beams, etc., wind resistant is also ensured.

PWD, C/P of the project, is an institution of building engineer representing Bangladesh, has experience and knowledge relatively about the response and countermeasures against the natural disasters such as cyclone, tornado, flood, storm surge, etc. so far, but experience of the earthquake disaster is less. Serious damage has been brought about in the Assam earthquake of 1897, but has not been hit by a major earthquake disaster since then, the occurrence of a coming large earthquake disaster following is a concern. For this reason, technical capabilities development related to seismic was required. Therefore, in this project, and to help you focused on the response to the earthquake of public buildings, and can respond to other natural disasters.

(2) Technology transfer with respect to the concept and the methodology for design of new buildings and retrofitting design of existing buildings

Technology transfer was done with respect to the concept and methodology for design of new buildings, vulnerability assessment and retrofitting design of existing buildings. Standardization of the target of seismic performance was required to coordinate. Consistency among seismic loads, strength of frames and ductility of frames were ensured in the related fields as shown in following Table1.5.2.

Table 1.5.2 Concept of Seismic Design and Evaluation

	Seismic (horizontal seismic capacity) design of new buildings	Seismic evaluation and retrofitting design of existing buildings	Time history response analysis (reference only)
Seismic loads, seismic index (for response, design)	Elastic response value is given as given design condition	Seismic index is calculated from strength index and ductility index, and is judged against seismic demand index	Dynamic ground motion is provided as given condition
Strength of frames	Required strength is calculated and is designed (judged)	Strength index (shear force coefficient) for frames is calculated	Strength (load-deflection curve) is estimated
Ductility of frames	Expected ductility is calculated	Ductility index of frames is calculated	Storey deflection angle (response) is judged

The setting of Seismic Demand Index for the seismic evaluation of existing buildings was examined with C/P and relevant organizations taking into consideration of seismic loads suggested in BNBC 1993. A review revealed that Index value of BNBC 1993 is smaller than the value in Japan standards and there is a big regional difference compared with Japan. The details will be discussed with concerned professionals including C/P based on new BNBC to be enacted.

For the comprehensive seismic measures for the buildings including non-structural members such as external brick walls will be incorporated in the design and retrofitting. The policy and extent of retrofitting design of major equipment for building services were discussed with C/P after the investigation of construction circumstances in Bangladesh.

(3) Development of construction techniques for retrofitting based on test works to meet circumstances in Bangladesh

Technical supports were provided to C/P to carry out the test works for construction techniques of retrofitting after the review of theoretical aspects of construction techniques.

Practical construction techniques for retrofitting was developed by C/P and JET jointly incorporating available materials and construction circumstances in Bangladesh. The test works such as RC jacketing for columns and installing RC walls to increase strength and ductility of existing frames were supervised by C/P with the support by JET.

(4) Preparation of technical manuals

Following technical manuals were prepared as shown in Table 1.5.3.

Table 1.5.3 Outline of Technical Manuals

Name of Technical Manual / Guidelines	Outline
1. Vulnerability Assessment (Seismic Evaluation) Manual	Gradually revised by applying manuals to existing public buildings in Dhaka, Sylhet and Chittagong. Note: Design Manual for new construction was compiled in the 2nd Year.
2. Design Manual for New Construction	
3. Design Manual for Retrofitting	
4. Retrofitting Works Management Manual	Gradually revised incorporating the results of the test works
5.. Quality Control Checklist and Guidelines	Gradually revised incorporating monitoring results of quality control for 2 pilot projects carried out by C/P

C/P and JET together will prepared the draft of technical manuals / guidelines as mentioned above. The completeness of them was ensured following repeated revisions and applications.

1.5.3 Basic Policy of Operational Aspects

Following 5 items are the basic policy of operational aspects to ensure smooth and effective activities.

(1) Setting of effective working team

(2) Effective technology transfer through on the job training (OJT)

(3) Coordination with other organizations having similar projects

(4) Setting of work plan depending on capacity of C/P and project progress

(5) Enlightenment, publication and dissemination

(1) Setting of effective working team

Through the subjective activities of this project with supporting activities by the JICA Expert Team (JET), in order to complete the project objectives, participants of C/P were divided into 5 working teams from WT-1 to WT-5, corresponding to the outcomes as shown in Table 1.5.4. By this grouping, it could be confirmed on a regular basis, the problems to be solved and progress of the project results for each outcome.

For the smooth operation, it was necessary to share fully the content of the activities, the goals of the project, and the results among JET and C/P. Therefore, PDM (Project Design Matrix) and PO (Plan of Operation) were mutually understood by every member.

In addition, during the period when JET member was absent, the local engineers were utilized to sustain continuous implementation of activities.

Table 1.5.4 Working Team Member

		C/P Member								JET Member							
		1st Year		2nd Year		3rd Year		4th Year (Plan)		1st Year		2nd Year		3rd Year		4th Year(Plan)	
Project manager	Scope of the main works	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
Project Manager Group	Project Management	1	Md. Abdul Malek Sikder	1	Md. Abdul Malek Sikder	1	Md. Abdul Malek Sikder	1	Md. Abdul Malek Sikder	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO
		2	Md. Mafizur Rahman	2	Md. Mafizur Rahman	2	Md. Mafizur Rahman	2	Md. Mafizur Rahman	2	Mr. Ryo MIYAZAKI						
												2	Mr. Jun MATSUO	2	Mr. Jun MATSUO	2	Mr. Jun MATSUO
												3	Mr. Masaaki AIZAWA	3	Mr. Masaaki AIZAWA	3	Mr. Masaaki AIZAWA
Working Team	Scope of the main works	1st Year		2nd Year		3rd Year		4th Year (Plan)		1st Year		2nd Year		3rd Year		4th Year	
		No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
1	Management of GIS Database	★1	Mr. Ali Newaj	★1	Mr. Ali Newaj	★1	Mr. Ali Newaj	★1	Mr. Ali Newaj	1	Dr. Koichi HASEGAWA	1	Dr. Koichi HASEGAWA	1	Dr. Koichi HASEGAWA	1	Dr. Koichi HASEGAWA
		2	Mr. Akhsanul Islam	2	Mr. Akhsanul Islam												
		3	Muhammad Mostafijun Rahman	3	Muhammad Mostafijun Rahman	2	Muhammad Mostafijun Rahman	2	Muhammad Mostafijun Rahman								
		4	Ms. Humaera Binte Reza Membere	4	Ms. Humaera Binte Reza Membere												
				5	Ms. Rafia Begum	3	Ms. Rafia Begum	3	Ms. Rafia Begum								
				6	Mr. A.K.M Sajadur Rahman	4	Mr. A.K.M Sajadur Rahman	4	Mr. A.K.M Sajadur Rahman								
2	・Evaluation of Existing Buildings ・Seismic Design for New Buildings ・Seismic Design for Existing Buildings	★1	Md. Rafiqul Islam	★1	Md. Rafiqul Islam	★1	Md. Rafiqul Islam	★1	Md. Rafiqul Islam	1	Mr. Akira INOUE	1	Mr. Akira INOUE	1	Mr. Akira INOUE	1	Mr. Akira INOUE
		2	Mr. Anup Kumar Halder	2	Mr. Anup Kumar Halder	2	Mr. Anup Kumar Halder	2	Mr. Anup Kumar Halder	2	Mr. Osamu MIYOSHI	2	Mr. Osamu MIYOSHI	2	Mr. Osamu MIYOSHI	2	Mr. Osamu MIYOSHI
		3	Md. Emdadul Huq	3	Md. Emdadul Huq	3	Md. Emdadul Huq	3	Md. Emdadul Huq	3	Mr. Yosuke NAKAJIMA'	3	Mr. Yosuke NAKAJIMA'	3	Mr. Yosuke NAKAJIMA'	3	Mr. Yosuke NAKAJIMA'
		4	Md. Mominur Rahman	4	Md. Mominur Rahman	4	Md. Mominur Rahman	4	Md. Mominur Rahman			4	Pro. Nozomu YOSHIDA				
		5	Md. Jahidul Islam Khan	5	Md. Jahidul Islam Khan	5	Md. Jahidul Islam Khan	5	Md. Jahidul Islam Khan					4	Pro. Taiki SAITO		
				6	Mr. Moniruzzaman Moni	6	Mr. Moniruzzaman Moni	6	Mr. Moniruzzaman Moni							5	****
						7	Mr. Ahmed Abdullah Noor	7	Mr. Ahmed Abdullah Noor								
						8	Mr. SK. Toufiqur Rahman	8	Mr. SK. Toufiqur Rahman								
3	Construction Management	★1	Mr. Sohel Rahman	★1	Mr. Sohel Rahman	★1	Mr. Sohel Rahman	★1	Mr. Sohel Rahman	1	Mr. Hiroshi OOHIRA	1	Mr. Takeshi TAKESHITA	1	Mr. Seiichi HORIKOSHI	1	Mr. Seiichi HORIKOSHI
		2	Md. Shafiul Islam	2	Md. Shafiul Islam	2	Md. Shafiul Islam	2	Md. Shafiul Islam		Mr. Takeshi TAKESHITA		Mr. Seiichi HORIKOSHI	1	Mr. Kazuna KOIZUMI	1	Mr. Kazuna KOIZUMI
		3	Md. Shamsul Islam	3	Md. Shamsul Islam	3	Md. Shamsul Islam	3	Md. Shamsul Islam								
		4	Mr. Zahid Hasan Khan	4	Mr. Zahid Hasan Khan	4	Mr. Zahid Hasan Khan	4	Mr. Zahid Hasan Khan								
				5	Ms. Nur-E-Kawonine	5	Ms. Nur-E-Kawonine	5	Ms. Nur-E-Kawonine								
				6	Mr. ASM Shahriar Jahan	6	Mr. ASM Shahriar Jahan	6	Mr. ASM Shahriar Jahan								
4	Quality Control	★1	Mr. Ziaul Hafiz	★1	Mr. Ziaul Hafiz	★1	Mr. Ziaul Hafiz	★1	Mr. Ziaul Hafiz	1	Mr. Masayuki TAKAZAWA	1	Mr. Yukio KATAYANAGI	1	Mr. Yukio KATAYANAGI	1	Mr. Yukio KATAYANAGI
		2	Md. K.M Mostafa Hasan	2	Md. K.M Mostafa Hasan	2	Md. K.M Mostafa Hasan	2	Md. K.M Mostafa Hasan								
		3	Kazi Md. Firoze Hassan	3	Kazi Md. Firoze Hassan	3	Kazi Md. Firoze Hassan	3	Kazi Md. Firoze Hassan								
		4	Mr. Abdullah Mohammod Zubair	4	Mr. Abdullah Mohammod Zubair	4	Mr. Abdullah Mohammod Zubair	4	Mr. Abdullah Mohammod Zubair								
5	Project Publicity Plan of Training Dissemination and Enlightenment	★1	Mr. Sardar Mainul Islam	★1	Mr. Sardar Mainul Islam	★1	Mr. Sardar Mainul Islam	★1	Mr. Sardar Mainul Islam	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO	1	Mr. Fumio KANEKO
		2	Md. Morshed Hossain	2	Md. Morshed Hossain									2	Dr. Mahbub REZA	2	Dr. Mahbub REZA
		3	Mr. Mohammad Abul Kalam Azad	3	Mr. Mohammad Abul Kalam Azad									3	Ms. Yuko NAKAGAWA	3	Ms. Yuko NAKAGAWA
						2	Md. Mohiuddin Jahangir	2	Md. Mohiuddin Jahangir						Ms. Eriko KOBAYASHI		Ms. Eriko KOBAYASHI
						3	Mr. Rashed Ahsan	3	Mr. Rashed Ahsan					4	Mr. Tetsuya SUZUKI	4	Mr. Tetsuya SUZUKI
						4	Mr. Mahmudul Hasan	4	Mr. Mahmudul Hasan								

★1 : Team Leader
: Replacement or additional members in 2nd year from 1st year
: Replacement or additional members in 3rd year from 2nd year
: Replacement or additional members in 4th year from 3rd year

(2) Effective technology transfer through on the job training (OJT)

In order to confirm the understanding of C/P side, BL (baseline survey) during 1st year, and both the domestic trainings and CA (capacity assessment survey) after the 2nd year were conducted. Also, CA was implemented in 4th year.

For the domestic trainings, where C/P trains to Bangladesh engineers, simultaneously it was the opportunity to teach what C/P members have studied in the project. Therefore the trainers should experience that they could not teach well except they understand deeply. This was one of the purpose of the domestic trainings.

C/P and JET jointly prepared curriculum and syllabus of OJT to effectively achieve the outputs through an objectives management.

Table 1.5.5 Summary of the Training Program in Bangladesh

Technical Field	Year	Lecturer	Trainee
· Seismic design of new construction buildings · Vulnerability assessment and retrofitting design of existing buildings	2nd Year to 4th Year	C/P and JET	· Structural engineers of PWD · Structural engineer of other organizations
· Construction management of retrofitting works · Quality control	3rd Year to 4th Year		· Construction management engineer of PWD (Dhaka, Sylhet, Chittagong)

(3) Coordination with other organizations having similar projects

Disaster prevention projects by other donors have been carried out in Bangladesh, such as CDMP (Comprehensive Disaster Management Program) phase I (2003–2009) and phase II (2010–2014) assisted by UNDP / EC organized by Ministry of Food and Disaster Management. C/P and JET will have collaboration from other related projects and share information to avoid duplication of work.

Related major projects currently in progress in Bangladesh are;

1) CDMP II Comprehensive Disaster Management Program II (UNDP/EC, Ministry of Disaster Management and Relief) :
   - Earthquake Damage Estimation, Disaster Management Planning Design at 6 cities (Mymensingh, Bogra, Tangail, Rangpur, Dinajpur, Rajshahi)
   - Retrofitting design
2) Bangladesh Urban Earthquake Resilience Project (World Bank):
   - Attempt of BNBC compliance activities, study of training and qualification system of construction engineers, monitor private building retrofitting experiment

(4) Setting of work plan depending on capacity of C/P and project progress

CA (Capacity Assessment Survey) of PWD was done as the baseline survey when the project was started.

CA is performed at the first dispatch at the every fiscal year to monitor the capacity development of the CNCRP members. Combined with the progress of the project and the CA results, the development of work plan such as a revise of PDM and recombination of activities that can be combined have been conducted.

(5) Enlightenment, publication and dissemination

PWD engineers as C/P are expected to learn earthquake resistant techniques for the public buildings through this Project. The technical transfer has been going well during the three years so far. The skill and knowledge should be disseminated to engineers as well as decision makers in PWD and other organizations so that other public buildings and ordinary buildings could be retrofitted in due course time. Sustainable dissemination of the seismic design and construction

techniques and understanding of necessity of the retrofitting will contribute to promote of the disaster management plan in Bangladesh.

Future, in Bangladesh, in order to approach even a little to the environment to be able to be considered, this project will examine the continuity of dissemination of the technique together with C/P, by placing experts of public relations, enlightenment and dissemination,

1) Formulation of a dissemination plan for sustainable training

It is desirable that C/P arranges / organizes lecturers to spread the sustainable / constructive training scheme. Existing training system in Japan and / or surrounding counties of Bangladesh (i.e. Nepal) will be taken into consideration to formulate the training scheme in Bangladesh. These issues are to be recommended.

2) Publication of the project contents in PWD's homepage

To stimulate visualization of the project outputs to relevant engineers, periodic information transmission (project information, purpose and progress etc.) using PWD website will be useful. In addition, C/P and JET will examine the possibility of preparing pamphlet explaining the necessity of retrofitting to the engineers, politician, administrators and citizens as well.

3) Enlightenment using seminar

A seminar will be organized once a year to disseminate the progress and activities of the Project to the relevant personnel / organizations. Interactive seminar that exchanges candid opinions between Bangladesh and Japan sides will be planned in order to establish the outputs of the Project steadily. The poster session, a good reputation in 2nd year, will be planned. If circumstances allow, the seminar will be opened to the public.

The results of the Project will be presented in an international seminar to be held in the 4th Year. In this seminar guests will be invited from neighboring countries of India, Myanmar, Bhutan, Nepal, Indonesia, etc., and activities related to retrofitting will be shared among the participants.

4) Retrofitting consultation system and qualification system

In order to spread earthquake resistance concept to the general public, the measures will be recommended to C/P. For example, such as is provided with a seismic counseling unit in PWD, by the cooperation of building engineers of each city and PWD engineers. In the unit, the expertized engineers can provide the consultation of earthquake resistance construction method responding to the questions from general public. To realize the activities, the public relations activities to the general public of the project itself will be tried, such as the development of dialogue and leaflet of this project with the general public by the Q & A of the WEB site etc.

In addition, since more than 5,000 public buildings exist under the control of PWD, the lack of technical personnel of seismic evaluations and retrofitting/renovation design and construction management is concerned.

In the future, it is necessary to try the level up overall by implementing the training of building officials in each city. However, as there are many budget and institutional issues, these activities must be developmental and sustainable. For this reason, it is one of the most effective ways that realizing the qualification system with providing an incentive to qualified personnel such as the graduates of domestic trainings and checklist users for construction management. In this regard, the appropriate measures will be considered with and around C/P, and try to recommend the qualification system in the future.

Chapter.2 Activity contents and achievements

2.1 Evaluation of project

2.1.1 Capacity Assessment

In order to measure the impacts of the project implementation, a baseline survey (hereinafter referred to as "1st Survey") was carried out in June 2011. Applying the similar method, progress of capacity building in terms of "individual", "organizational" and the "institutional" was also assessed in June 2012 (hereinafter referred to as" 2nd Survey") and in July 2013 (hereinafter referred to as "3rd Survey), as well as in July 2014 (hereinafter referred to as "4th Survey).

(1) Individual Aspect

1) Target Persons

The CNCRP has five working teams. The target persons were all team members. However, during the course of the project activity some changes have taken place in the CNCRP organization. It was learnt that 13 members of a total of 20 have been belonging to PWD continuously since the 1st Survey, 7 members have left the organization. On the other hand 4 new members at the time of 2nd Survey and 2 members at the time of 3rd Survey joined the teams which made the existing total number as 19.

Table 2.1.1 Number of C/Ps to be Assessed

	Concerned Activity	1st Survey (2011)	2nd Survey (2012)	3rd Survey (2013)	4th Survey (2014)	Remarks
WT1	Vulnerability assessment, Preparation of roadmap for retrofitting	1-A	1-A	1-A	1-A	Continuously participated
		1-B	1-B			
		1-C	1-C			
		1-D				
			1-E	1-E	1-E	Joined at 2nd Survey
			1-F	1-F	1-F	Joined at 2nd Survey
				1-G		
WT2	Designing (planning) for retrofitting	2-A	2-A	2-A	2-A	Continuously participated
		2-B	2-B	2-B	2-B	Continuously participated
		2-C	2-C	2-C	2-C	Continuously participated
		2-D	2-D	2-D	2-D	Continuously participated
		2-E	2-E	2-E		
			2-F	2-F	2-F	Joined at 2nd Survey
				2-G	2-G	Joined at 3rd Survey
				2-H		
WT3	Implementation of retrofitting works	3-A	3-A	3-A	3-A	Continuously participated
		3-B	3-B	3-B	3-B	Continuously participated
		3-C	3-C	3-C	3-C	Continuously participated
		3-D	3-D	3-D		
			3-E	3-E	3-E	Joined at 2nd Survey
			3-F	3-F		
WT4	Quality control	4-A	4-A	4-A	4-A	Continuously participated
		4-B	4-B	4-B	4-B	Continuously participated
		4-C	4-C	4-C	4-C	Continuously participated

	Concerned Activity	1st Survey (2011)	2nd Survey (2012)	3rd Survey (2013)	4th Survey (2014)	Remarks
		4-D	4-D	4-D	4-D	Continuously participated
WT5	Conduct of seminar/ workshop	5-A	5-A	5-A	5-A	Continuously participated
		5-B	5-B			
		5-C	5-C			
				5-D	5-D	Joined at 3rd Survey
				5-E		
		20 members	24 members	25 members	19 members	

*WT: Working Team, as of July 2014

2) Assessment Items and Methods

Survey items were the same as were in 1st Survey. The aspects of were selected with the idea that there will be capacity building through the implementation of the project from the viewpoints of "skill", "knowledge" and so on, which have the reference of five "Outputs" of PDM. Beside, an extra aspect of "attitudes" towards CNCRP was added in the survey items. Therefore there were a total of six aspects in the survey as shown in the table below.

For each survey aspect, a quantitative evaluation was made. For example, "1" means the lowest negative rating scale, and "5" means the highest positive rating scale.

Table 2.1.2 Assessment Items from "Individual" Aspect

View point	Survey Items
'Knowledge' and 'Skill'	i) The PDM Output 1-related items
	ii) The PDM Output 2-related items
	iii) The PDM Output 3-related items
	iv) The PDM Output 4-related items
	v) The PDM Output 5-related items
"Attitude"	vi) Survey items for the "awareness" aspect

First a questionnaire describing the survey items, index (items for detailed investigation) was distributed to all C/Ps. Then they were requested to do a self-evaluation using the rating scale of 1 to 5. They were also asked not only to evaluate the items related to their team but also related to other teams.

After the self-evaluation, JET conducted individual interviews with the C/Ps to crosscheck the self-assessment. If it was found that the ratings done by the CPs and the experts were not the same, then with the agreement of the C/Ps, evaluation made by JET treated as the final survey results.

3) Survey Results

The evaluation was made separately, such as, a) for target 13 members who participated in all of 1st, 2nd, 3rd and 4th Surveys, b) for target 4 members who participated in 2nd, 3rd and 4th Surveys and c) for target 2 members who participated only in 3rd and 4th Surveys.

a) 13 members, who participated in all of 1st , 2nd,3rd and 4th Surveys,

The average of evaluation points are shown in the table below.

Table 2.1.3 Average rating scale and degree of variability based on 1st Survey

	1st Survey (June 2011)		2nd Survey (June 2012)		3rd Survey (July 2013)		4th Survey (July 2014)	
	All C/Ps	Related team	All C/Ps	Related team	All C/Ps	Related team	All C/Ps	Related team
Output1	1.12	1.08	1.48 (132%)	1.50 (138%)	1.77 (158%)	1.67 (154%)	2.01 (180%)	2.00 (185%)
Output2	1.28	1.50	1.57 (123%)	2.13 (142%)	1.86 (145%)	2.23 (148%)	2.30 (180%)	2.78 (185%)
Output 3	1.53	1.63	1.97 (129%)	2.38 (146%)	2.40 (157%)	2.63 (162%)	2.88 (189%)	3.50 (215%)
Output 4	1.19	1.09	1.51 (127%)	1.57 (144%)	1.75 (147%)	1.77 (163%)	2.32 (195%)	2.48 (227%)
Output 5	1.28	1.44	1.53 (120%)	1.61 (112%)	2.02 (158%)	2.33 (162%)	2.55 (199%)	2.83 (196%)
Attitude	4.00	-	4.18 (105%)	-	4.12 (103%)	-	4.54 (113%)	-

Upper：average rating scale

Lower: Degree of Variability based on 1st Survey

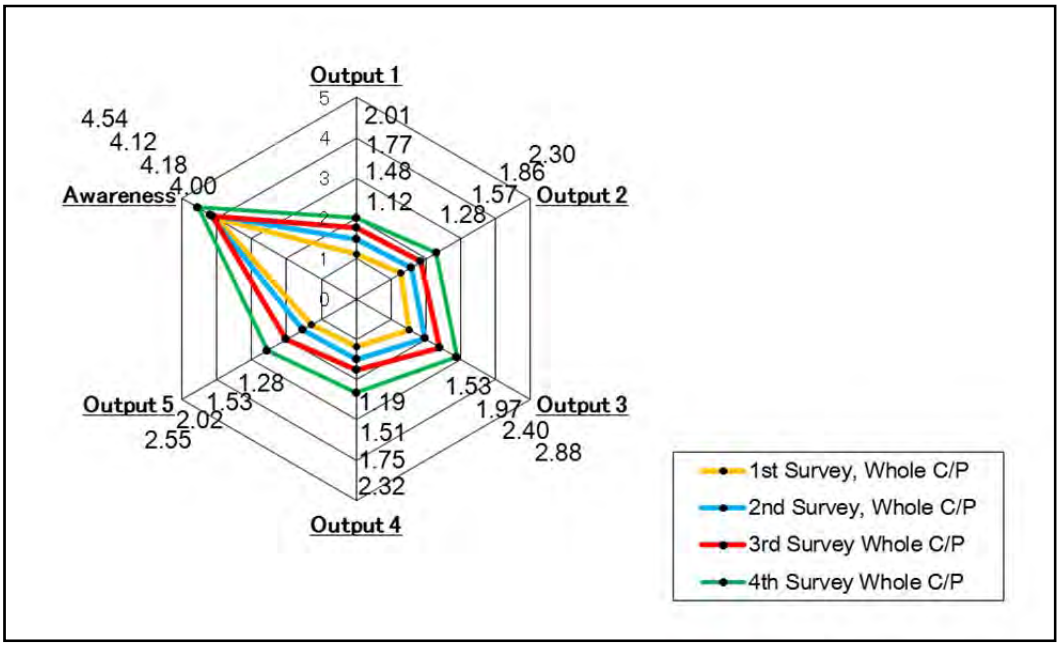


Figure 2.1.1 Assessment Results of "Individual" Aspect (1)

(Average Scale of Every Aspect, 13 members who participated in all of 1st, 2nd, 3rd and 4th Surveys)

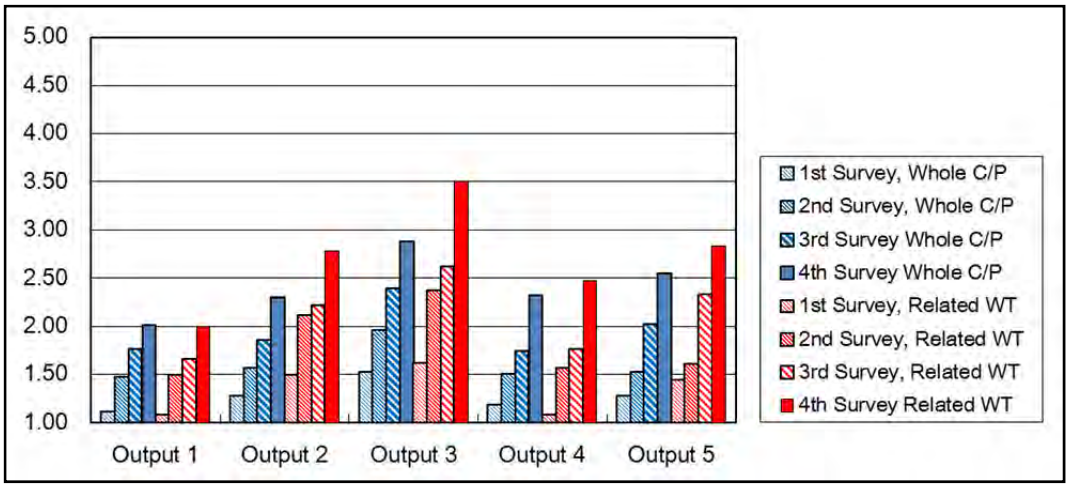


Figure 2.1.2 Result of the "Individual" Aspect (1)

(Average Scale of Every Aspect, 13 members who participated in 1st, 2nd, 3rd and 4th Surveys)

b) 4 members, who participated in 2nd, 3rd and 4th Surveys

The average of evaluation points are shown in the table below.

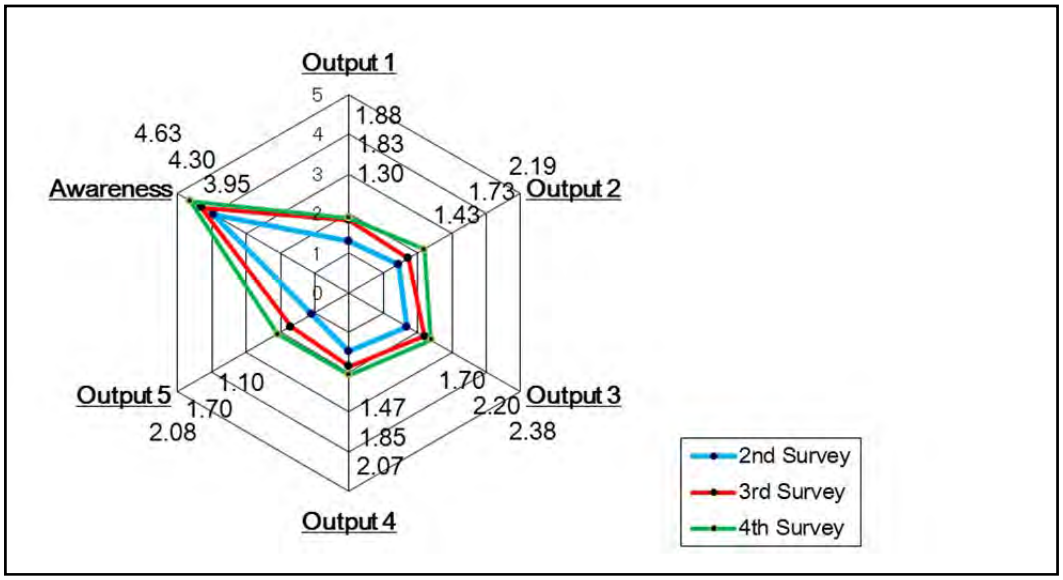


Figure 2.1.3 Assessment Results of "Individual" Aspect (2)

(Average Scale of Every Aspect, 4 members who participated in 2nd, 3rd and 4th Surveys)

c) 2 members, who participated only in 3rd and 4th Surveys

The average of evaluation points are shown in the table below.

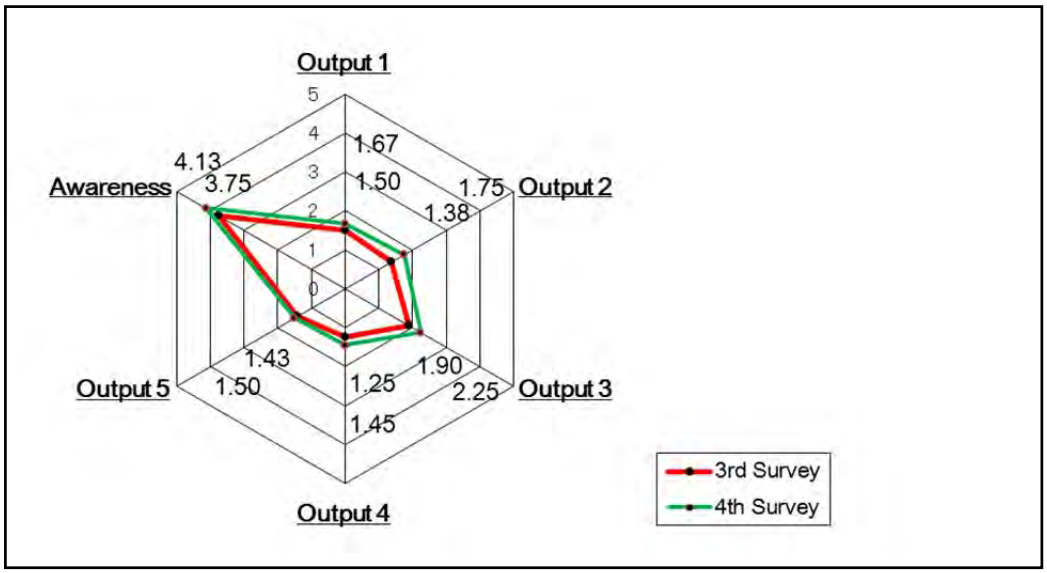


Figure 2.1.4 Assessment Results of "Individual" Aspect (3)

(Average Scale of Every Aspect, 2 members who participated only in 3rd and 4th Surveys)

The table below shows a summary of 1st, 2nd, 3rd and 4th Survey results of each outcome. Some comments made by the working team members are also presented. It could be found that some progresses in both the "comments" and "attitudes" have been made.

Table 2.1.4 Assessment Results from "Individual" Aspect (2): Summary

	Summary	
Output-1	1st Survey	- All C/Ps have never used any GIS software (e.g. ArcView) for practical works, only one C/P has learned GIS software operation in a training program. - All the members except 1 member (5%) do not have experience in any work related to building vulnerability assessment.
	2nd Survey	- 10 members (42%) have learned how to use the GIS software. Two of them are new members - 15 members (63%) have learned how to carry out vulnerability assessment. Three of them are new members.
	3rd Survey	- 14 members (56%) have learned how to use the GIS software. - 21 members (84%) have learned how to carry out vulnerability assessment.
	4th Survey	- 15 members (79%) have learned how to use the GIS software. - 18 members (95%) have learned how to carry out vulnerability assessment.

Output-2	1st Survey	- All C/Ps have no experience in development of methods for designing/retrofitting the buildings against natural disasters and no experience in preparation of design manuals for designing/ retrofitting the buildings against natural disasters.
	2nd Survey	- 7 members (29%) have learned how to develop methods for designing/retrofitting the buildings against natural disasters. And two of them are new members. - 7 members (29%) have learned how to prepare the design manuals for designing/retrofitting the buildings against natural disasters. And one of them is a new member.
	3rd Survey	- 12 members (48%) have learned how to develop methods for designing/retrofitting the buildings against natural disasters. - 8 members (32%) have learned how to prepare the design manuals for designing/retrofitting the buildings against natural disasters.
	4th Survey	- 11 members (58%) have learned how to develop methods for designing/retrofitting the buildings against natural disasters. - 9 members (47%) have learned how to prepare the design manuals for designing/retrofitting the buildings against natural disasters.
Output-3	1st Survey	- 16 members (80%) had experience in material test. - All the members do not have experience in preparation of manual for retrofitting work.
	2nd Survey	- 20 members (83%) have learned how to carry out material tests. And four of them are new members. - 8 members (33%) have learned how to prepare the materials for tests. And four of them are new members.
	3rd Survey	- 24 members (96%) have learned how to carry out material tests. - 12 members (48%) have experience in preparation of manual for retrofitting work
	4th Survey	- 18 members (95%) have learned how to carry out material tests. - 13 members (68%) have experience in preparation of manual for retrofitting work
Output-4	1st Survey	- 9 members (45%) have done further study on quality control system. - There are no checklists for ensuring quality during designing (planning) for retrofitting as well as retrofitting work, and guidelines for ensuring quality during designing (planning) for retrofitting as well as retrofitting work. The C/Ps have never developed such checklists or guidelines.
	2nd Survey	- 14 members (58%) have learned how to control quality. And 4 of them are new members. - 5 members (21%) have learned how to make a checklist for retrofitting design. And two of them are new members. - 7 members (29%) have learned how to make a checklist for retrofitting works. And two of them are new members.
	3rd Survey	- 19 members (76%) have learned how to control quality. - 11 members (44%) have learned how to make a checklist for retrofitting

		design. - 12 members (48%) have learned how to make a checklist for retrofitting works.
	4th Survey	- 18 members (95%) have learned how to control quality. - 11 members (58%) have learned how to make a checklist for retrofitting design. - 12 members (63%) have learned how to make a checklist for retrofitting works.
Output-5	1st Survey	- 5 members (25%) have experience in giving lectures on designing (planning) of the buildings against natural disasters. - No lectures on retrofitting work have been given to the members. All the members have never given such lectures.
	2nd Survey	- 14 members (58%) have learned how to arrange workshops or lectures. And two of them are new members. - 6 members (25%) have learned how to deliver lectures regarding retrofitting works.
	3rd Survey	- 20 members (80%) have learned how to arrange workshops or lectures. - 10 members (40%) have learned how to deliver lectures regarding retrofitting works.
	4th Survey	- 18 members (95%) have learned how to arrange workshops or lectures. - 12 members (63%) have learned how to deliver lectures regarding retrofitting works.
Attitude	1st Survey	- All assessment items have been relatively highly rated. In other words, the members' awareness level about the project at the beginning stage was high. It can be said that the most members have much interest in the project.
	2nd Survey	- I became a member with my own wish because I am interested in CNCRP. - I would like to continue my involvement in this project as I did in 1st year because I want to develop my capacity in new technologies such as retrofitting. - I feel that my skill has been enhanced through CNCRP. - In relation to retrofitting technology I feel that my ability has been greatly improved. I attended lectures organized by the members of other teams, however, still it was difficult for me to understand their activities as a team. - I am interested in the activities of dissemination or the lectures to spread the information or knowledge to other persons/organizations. - My strong desire is to acquire knowledge and techniques regarding retrofitting works. I would like to master the technology through CNCRP.
	3rd Survey	- I have understood the importance of the project because I have observed actual example in Japan. - I am trying to develop myself to conduct lecture. - I have recognized the necessity of project after Rana plaza accident. This project seems essential not only in Bangladesh but whole developing country.
	4th Survey	- I feel that my skill has been enhanced through CNCRP. - On- site lecture has helped me understood principal process how to control

		construction quality. - I am interested in the activities of dissemination or the lectures to enhance the information and/or knowledge to other persons/organizations. - Unfortunately, I have been not eager to join the project except the activity which concerns my team strongly. - I would like to continue my involvement in this project in case the project will be continued.

4) Conclusions

13 members out of 20 members have been belonging to PWD continuously since the time of 1st Survey. For "skill" and "knowledge", the results related to each evaluation item, has risen 85% or over when compared with 1st Survey. As the result, the average rating scale of 13 members related to the all outputs is more than "2" as shown in the table above. It was learnt that the members have acquired additional knowledge and skills through the project.

At the time of 2nd Survey, average rating scale of related team was higher than those of all C/Ps. To encourage other team members, the project has tried to arrange more opportunities such as small seminars, group discussions so that progress of each team can be shared. However, average rating scale of related team was higher than those of C/Ps except WT1 at the time of 4th Survey. It can be considered that unwillingness for learning the items/subjects other than the concerned WT and/or their subjects have been still low.

Besides, in the view of individual rating scale, it was observed that rating scale for output 5 of C/P who was not belong to WT5 have risen, as well as that the rating scale for output 4 of C/P who did not belong to WT4 have risen. Some C/P seems to have learned not only the items which concern his WT but also other project items.

Average rating scale of 4 members who joined the project at the time of 2nd Survey is higher than those of 2 members who joined the project at the time of 3rd Survey. And, average rating scale of 13 members who joined the project continuously since the time of 1st Survey is higher than those of 4 members who joined the project at the time of 2nd Survey. Considering the above results, continuous involvement in the project for a long term is essential to enhance the capacity development.

The absolute evaluation point indicates that the "attitudes" have been very high. Expectations and interests of C/Ps in this project have been very high throughout the project. Besides, many C/Ps are interested in the activities of dissemination of lectures, information and knowledge to other persons/organizations. In the future, C/P can be expected to realize the above so that design and/or retrofitting capacity will be disseminated not only to public but also private sector in Bangladesh.

In addition, regarding the number of items to assess the capacity building, there is much difference such as, Output 1 has 6 related items, Output 2 has 8 related items, Output 3 has 2 related items, Output 4 has 11 related items and Output 5 has 6 related items. In order to equalize the

assessment conditions, the number of items for each output should be equal so that the effect of project implementation can be measured properly.

(2) Organizational Aspect

1) Target Organization, Assessment Items and Method

The target organization is PWD, i.e. the C/P organization assigned to the project. Through the project term, PWD is expected to be strengthened in the areas of management (staff, coordination etc.), financial status, maintenance of equipment, and intellectual resources.

The data of 1st, 2nd, 3rd and 4th Survey will be used for monitoring the capacity of PWD from the view point of organizational aspect. The target areas and their indicators are listed below.

Table 2.1.5 Assessment Items for "Organizational" Aspect

Points of view	Survey Items
PWD's management	PWD's staff
	Coordination
	Concern of the PWD's top officials in the Project activities
PWD's Financial Status	Financial status
PWD's Equipment and Maintenance	Equipment and maintenance
PWD's intellectual resources, such as roadmap/retrofitting plan, design manuals for retrofitting works, Checklist for quality control and so on	Intellectual resources

2) Survey results

Survey results are shown in the table below.

Table 2.1.6 Assessment Results of "Organizational" Aspect: Summary

Areas	Summary	
PWD's staff	1st Survey	- 667 Class 1 staff - No staff who works for retrofitting designing (planning) or supervising/ management of the retrofitting work
	2nd Survey	- The circumstances of staff are the same as 1st Survey - Actual class 1 posts supposed to be 823. - It is expected that the staff of PWD will increase in near future.
	3rd Survey	- 829 actual Class 1 staff (additional 162 Class 1 staff) - 32 staff who work for designing (planning) of the new building. (additional 6 staff) - 24 staff is belonging to the training academy focusing on lecture conduction
	4th Survey	- 834 actual Class 1 staff (additional 5 Class 1 staff) - 3 officers of different level are assigned for supervising the pilot retrofitting project.
Coordination and Cooperation among Relevant Organizations	1st Survey	- The Coordination and Cooperation among Relevant Organizations are there.
	2nd Survey	- The Coordination and Cooperation among relevant organizations have been strengthened.
	3rd Survey	- The Coordination and Cooperation among relevant organizations have been strengthened.
	4th Survey	- The Coordination and Cooperation among relevant organizations have been strengthened.
Concern of	1st	- Less interest in issuance of official license to the engineers who will complete

the PWD's high officials in the Project activities	Survey	training programme introduced by the project.
	2nd Survey	- It is still the same as 1st Survey
	3rd Survey	- It is still the same as 1st Survey
	4th Survey	- It is still the same as 1st Survey
Financial Status	1st Survey	- No expenditure for retrofitting works was confirmed
	2nd Survey	- Same as 1st Survey
	3rd Survey	- Same as 1st Survey. - Income and/or expenses of PWD are increased.
	4th Survey	- Expenditure for retrofitting works was done - Income and/or expenses of PWD are increased.
Equipment and Maintenance	1st Survey	- No vehicle for carrying out testing operation is available. 15 items of equipment for material testing are in the stock of PWD testing laboratory。
	2nd Survey	- 1 vehicle is now available for carrying out testing operation. - 92 equipment (for 37 items) are stocked with their repairing records.
	3rd Survey	- Same as 2nd Survey
	4th Survey	- 94 equipment (for 37 items) are stocked with their repairing records.
Intellectual Resources	1st Survey	- No building inventory data - No roadmap for retrofitting (Retrofitting plan) - No design manual for retrofitting the buildings against natural disasters - No manuals for retrofitting works - No checklists for quality control - No training materials for the project activities to be disseminated to other engineers
	2nd Survey	- PWD has Building Inventories, of total 2020 buildings. - No roadmap for retrofitting (Retrofitting plan) - No design manual for retrofitting the buildings against natural disasters - Draft guidelines for retrofitting works have been prepared - Draft check list for quality control has been prepared. - No training materials for the project activities to be disseminated to other engineers。
	3rd Survey	- Vulnerability assessments (seismic evaluation) have been executed for 3 buildings. - Draft design manual for designing new building against natural disasters was established. - Draft manual for retrofitting works is almost completed. - Draft guidelines for quality control for new building has been prepared. - Training material for retrofitting design has been prepared.
	4th Survey	- Building inventory (in Dhaka: 2,193, in Sylhet: 251) have been prepared. - Vulnerability assessments (seismic evaluation) have been done for 4 buildings. - Draft design manual for designing new building against natural disasters has been submitted to Editorial Advisory Board. - Design Document for pilot project has been prepared. - Training material for quality control has been prepared.

3) Conclusions

The working team members have performed the vulnerability assessment (seismic evaluation), prepared draft design manuals, draft guidelines for the construction supervision and so on. Due to the project activities, the management of "intellectual resources" and "equipment and maintenance" have been improved. Besides, the "PWD's staff" and "Financial Status" have been strengthened.

Evaluation related to "organizational aspect" is expected to be improved continuously throughout the implementation of the project.

(3) Institutional Aspect

1) Assessment Items and Methods

The survey was focused on legal and institutional matters related to CNCRP. It is assumed that someone from PWD would know better about the institutional aspects of Bangladesh, therefore, one C/P of CNCRP was selected for this purpose.

A questionnaire containing survey items and indicators was given to that C/P. First an assessment was made by him. Later JET made the actual evaluation by interviewing the selected C/P.

Table 2.1.7 Assessment Items for "Institutional" Aspect"

View points	Survey Item
Legal system at National Level	How do the related laws/acts or national plans/ policies state retrofitting?
Institution	Statements of the PDM's overall goal
	Public awareness about retrofitting

2) Survey Results

Summary of the results are shown in the table below.

Table 2.1.8 Assessment Results from "Institutional" Aspect: Summary

Viewpoint	Summary	
Are there any laws/acts or national plans/ policies related to retrofitting?	1st Survey	- Action Agenda 5.3.1.7 states: "Develop and implement retrofitting programs for vulnerable critical infrastructure" - SOD: 4.2.13.1 states the followings: ・ To observe BNBC ・ To prepare the manual for building assessment as well as design of the buildings against earthquakes ・ To make a list of vulnerable structures and update the list periodically ・ To disseminate technical information related to earthquake and tsunami to engineers ・ To support in retrofitting of the buildings
	2nd Survey	- Same as 1st Survey
	3rd Survey	- Same as 1st Survey
	4th Survey	- Same as 1st Survey
Statements of the PDM's overall goal	1st Survey	- No institutions on retrofitting of the public buildings including government buildings, hospitals, fire stations, schools, shelters, etc. have been established, yet. - No institutions on the issuance of license to the engineers who will complete training programme introduced by the Project have been established, yet. - No manuals prepared through the Project have been incorporated

		into BNBC, yet.
	2nd Survey	- Same as 1st Survey
	3rd Survey	- Same as 1st Survey Part of draft manuals has been prepared. However, those are not incorporated into BNBC
	4th Survey	- Same as 1st Survey
Public awareness about retrofitting	1st Survey	- No institutions on promotion of public awareness activities on retrofitting of the existing buildings have been established, yet.
	2nd Survey	- Same as 1st Survey
	3rd Survey	- Same as 1st Survey
	4th Survey	- Same as 1st Survey

3) Conclusions

Regarding the institutional aspects, all of the survey items have not been changed from 1st Survey. Some time is necessary if any effective improvement is expected through CNCRP. Therefore, a long-time observation is recommended.

2.2 Construction circumstances

2.2.1 Understanding of building circumstances

2-1 Building Circumstances

Building structural types, materials, structural design, design and jurisdiction for public buildings, approval and construction of private buildings, building disaster are outlined below as building circumstances of Bangladesh.

1) Outline

The structures of existing buildings in Bangladesh are mainly reinforced concrete (RC) and brick masonry. Old buildings are mainly brick masonry type. Recently, RC buildings are found to be common in order to provide more column span length and higher number of stories. There are some buildings with steel structure but it is not common. It is an usual case that RC frame structure constituting of beam, column and floor slab, provision of brick wall as partition and non-structural external wall. There are some buildings with flat slab RC structures.


(a) (b) (c)

Photo 2.2.1 Buildings under construction in Dhaka

2) Materials for RC structure

The specifications of materials are described in Chapter 2 (Materials), Part 5 (Building materials) of Bangladesh National Building Code (BNBC 1993).

a) Structural Concrete:

The specifications of structural concrete are, f'c = 19, 21, 22, 25 N/mm^2 (~30N/mm^2). Good quality aggregates are produced in Sylhet, a city located in northern part of Bangladesh. Brick chips are used as coarse aggregate for some old buildings. Mixing at site is usual. In addition to the use of brick chips, poor construction management such as use of less cement and access water during mixing at sites cause low strength concrete (not more than 13.5N/mm^2). The use of ready-made mixture by a plant is very limited.

b) Re-inforcing bar:

The specification is based on BNBC or ASTM A615. Materials that are not of prescribed specifications can also be found in the market easily.

Small diameter (D13 and less): 40grade, fy=276 N/mm^2

Large diameter (D16 and more): 60grade, fy=415 N/mm^2

The most common Re-bars found in the market are made in Bangladesh or imported from India. Plain bars are used in many old buildings. It is usual to transport re-bar in folded condition from 12m to 6m which hampers the quality.

c) Formwork and scaffolding

Production of timber is not sufficient in Bangladesh. Steel made formwork and steel scaffolding (partially bamboo scaffolding) are generally used.

3) Structural design

a) Application of Seismic Code to buildings

Before 1971: Since British age, use of brick masonry has been the common practice in construction industry. RC buildings were rare. Non-ductile RC frames are common.

After 1971: Structural design by PWD was started. Standards suggested in ACI (American Concrete Institute) was followed. Seismic zoning was not specified.

BNBC1993 and after: During this period, seismic zoning referred in UBC (Uniform Building Code) was taken into consideration. More than half of the buildings designed by PWD before 1992 are of brick masonry, but after 1993, RC structure became very common and its share became 90% and rest 10% were of masonry. No details about ductile could be known.

After 2001 Gujarat earthquake: Within a transitional period of several years, almost all buildings became RC type structures. In general, for detail design guidelines of ACI are followed .

2006 and after: BNBC1993 became mandatory and applied also for private buildings.

2015 and after: new BNBC 2015 is under preparation.

b) Earthquake resistant design

Structural design of RC buildings including seismic design is done based on limit state design including load factor by applying American structural calculation software. Seismic design load is described in Section 2-5, Part 6 of BNBC 1993. Member details are calculated based on BNBC 1993, ACI 318-92, and design of floor slab and foundation are done separately. Main software used are presented below.

'STAAD Pro', (General structural analysis software, Bentley Inc.)

'ETABS' , (Building structural design software、Computers and Structures Inc.)

'SAP2000',(General structural analysis software, Computers and Structures Inc.)

BNBC 2015 recommended pushover and time-history analyses depending on size and usage of a building.

4) Public buildings

a) Design organization and jurisdiction of public buildings (data as of 2011)

(1) **PWD (**Public Works Department)

Structural design and construction management of major public buildings are done by PWD (more than 30 structural design engineers are engaged for this purpose). Approximately 600 graduate engineers and approximately 1,200 diploma engineers are involved in construction management of public buildings.

Design and construction management of government buildings belonging to larger districts are done by PWD through the cooperation of related Governmental bodies.

Big hospitals with more than 100 beds are handled by PWD. All fire and police stations are also under PWD. Key Point Installations (KPI) such as official residence for the President, Prime Minister, TV and Radio station buildings are also taken care of by PWD.

(2) **DoA** (Department of Architecture)

DoA's functions are planning and performing architectural design. Chief Architect of Department of Architecture (DoA) is the Chief Authorized Officer for Government Buildings. The public buildings are approved by his signature on drawings.

(3) **EED**（Educational Engineering Department）

Design and construction management of Secondary schools, Colleges, Public Universities,

Madrashas, and Polytechnic institutes are the functions of EED. Prior to 1986, these functions used to be taken care of by PWD.

(4) **LGED**（Local Government Engineering Department）

Design and construction management of Primary schools are done by LGED.

(5) **CMMU**（Construction Management & Maintenance Unit under Ministry of Health）

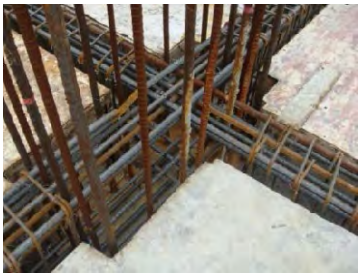
Hospitals with less than 100 beds and clinics are taken care of by CMMU.

(a) Top of rebar of cast in-situ piling

(b)Grade beam

(c) Folded re-bar with 12 m length

(d) Metal formwork and scaffolding



(e) Re-bar arrangement at beam column joint

Photo 2.2.2　Construction of public building (RC 6 storied)

5) Private buildings

Outline of building approval by RAJUK and quality control of private buildings are described below (based on a survey carried out in February, 2012).

a) Building inspection for approval by RAJUK

There are three Divisions in RAJUK, Planning (Master plan, Town planning)、Development of areas, and Development control (Building permission). The Development control division handles building inspection and approval.

b) Related codes and regulations

Rules and regulations related to Building permission are, “Rules for Construction, Development, Conservation and Demolition of Dhaka City 2008”. Prior to these rules, Building Construction Act 1952 was used. The covered area is shown in Town Improvement Act 195?..

BNBC 1993, which emphasized the minimum requirement for building safety, was re-stated in

2006 version and became mandatory.

c) Number of building application

Total number of applications for building approval in Dhaka is roughly 5,000 per year according to recent three years, and 15 to 20% of the applications are not approved by the reason of violating "Rules for building construction 2008". Data on structural types could not be collected, however it is assumed that more than 90% are RC buildings, and less than 5% are brick masonry.

d) Application documents and contents of inspection

Specialized project;

After 2008, buildings satisfying following conditions are called as "Specialized project".

(Residential building with a total floor area of 7,500m2 and above, commercial building with a total floor area of 5,000m^2 and above, residential buildings with 40 units and above, buildings located within the radius of 250m of a historical building). Total number of buildings under specialized project is roughly 200 per year.

At first "Land use clearance (compatibility to Master plan)" issued by Town planning section of RAJUK is submitted, and Special project permit is issued by Special project approval committee of RAJUK after verifying Conceptual design drawings.

Next step is to get a building permit by submitting architectural drawings. Submission of structural design drawing is not required. The process needs coordination and approval from at least 9 organizations. The organizations are CAAB (Civil aviation), DESA/DESCO (Electric), Titas (Gas), FSCD (Fire service and civil Defence), DWASA (Water/sewage), DOE (Environment), DCC (City Corporation), DTCB (Transportation) and DMP (Police). Application documents require the signatures of an Architect of IAB (Institute of Architects in Bangladesh), a Registered Architect of RAJUK, and an Engineer of IEB (Institute of Engineers in Bangladesh). Submission of structural design drawings and structural calculation sheets are not required even as of 2008 and after.

General buildings;

Other than the buildings under specialized project category, general architectural drawings with signature of an Architect and Land use certificate issued by Town planning section of RAJUK are required for general buildings. Approval by the 8 committees namely, committees responsible for architectural planning, evacuation, fire protection, sanitary, mechanical and electrical, and others are required since 2008 and after. PWD engineers and architects from DOA are involved in these Committees. Structural design drawings and calculation sheets are not required for the approval. Before 2007, only general architectural drawings with a signature of an architect and an application form were required.

e) Inspection during construction

Main task of RAJUK is to check the building size including the deviation of floors and change in usage during construction. Construction organization (including project manager, site engineer, and

technical staff) at a site is required to submit the construction plan to RAJUK 15 days before the commencement of site work. Site inspection related to construction quality by RAJUK can't be carried out due to lack of manpower. Supervision by a consultant or engineer during the construction stage is not mandatory. Checking of building occupation system by RAJUK exists but practically it is not applied, in other words the system is not working well.

(a) (b) (c)

(d) (e) (f)

(a), (b), (c) Temporally stocked folded re-bar, aggregate and sand, (d), (e) Mixing by volume, (f) Bamboo support (wearing safety helmets is not common)

Photo 2.2.3 Construction of private building in Dhaka

6) Building disaster

a) Collapse of building by gravity

Collapse of buildings only due to gravity load and without external horizontal load such as earthquake occurs in Bangladesh. The collapse of Rana plaza in Savar city occurred on 24 April 2013. The building was a RC frame structure. This terrible incident killed 1,135 persons and more than 1,800 were injured. Original building was designed for 6 storey with one basement. The collapse occurred during the illegal vertical extension of 3 more stories. According to the survey after the collapse, it was reported that the use of low quality materials, poor workmanship, faulty structural design drawings, lack of proper supervision were the causes of collapse.

Following three incidents are reported before the Rana plaza incident.

11 April 2005: Spectrum garment factory in Savar, 9 storied, number of death 64.

25 February 2006: Phoenix group building at Tejgaon, 5 storied, number of death 21

1 June 2010: A residential building, 5 storied, number of death 25

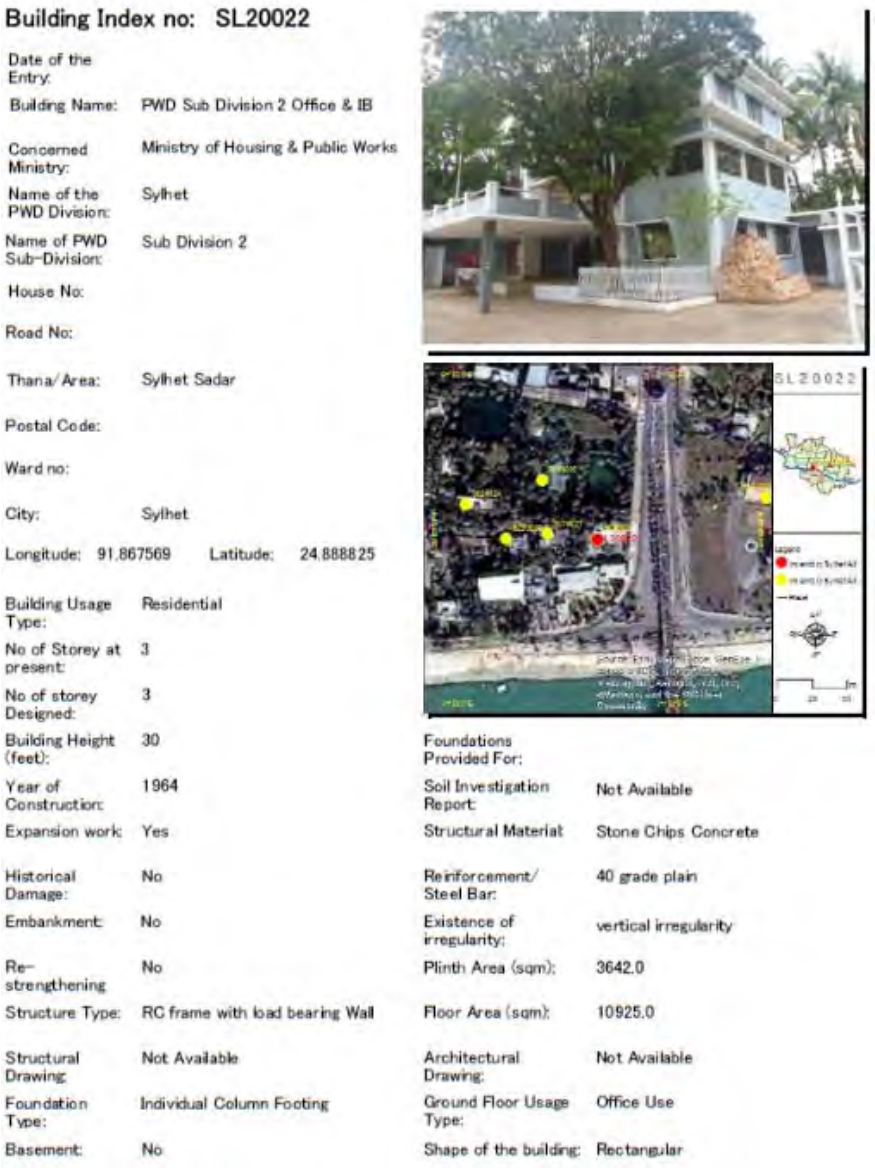
b) Fire accidents

Many existing buildings don't satisfy the fire regulations such as presence of fire escape staircase, fire compartment, fire door, fire detection and alarm systems, and fire extinguishers. Many fire accidents occur by electrical short circuits and other reasons. Recent major fire incident is devastating fire at Tazreen Fashion Co. on November 2012, which killed 111 persons. The number of fire accidents are increasing recently according to FSCD.

2.2.2 Building Inventory

1) Preparation of Inventory

An inventory consisting of 2,756 buildings from three cities, namely Dhaka (2194), Sylhet (252) and Chittagong (523) was prepared. It should be mentioned that all these buildings are government buildings and maintained by PWD. In the database of Dhaka, sorting of basic information of the building management status was performed., for instance construction age, ratio of RC and non RC buildings, vulnerability classification etc. All these information will be used for future planning including the road mapping. However, issues related to data quality and maintenance still remain. The database for Sylhet and Chittagong have been established fundamentally by both headquarter and subdivisions of PWD themselves. An example of inventory sheet is shown in Figure 2.2.1.



Building Index no: SL20022

Date of the Entry:			
Building Name:	PWD Sub Division 2 Office & IB		
Concerned Ministry:	Ministry of Housing & Public Works		
Name of the PWD Division:	Sylhet		
Name of PWD Sub-Division:	Sub Division 2		
House No:			
Road No:			
Thana/Area:	Sylhet Sadar		
Postal Code:			
Ward no:			
City:	Sylhet		
Longitude: 91.867569	Latitude: 24.888825		
Building Usage Type:	Residential	Foundations Provided For:	
No of Storey at present:	3		
No of storey Designed:	3		
Building Height (feet):	30		
Year of Construction:	1964	Soil Investigation Report:	Not Available
Expansion work:	Yes	Structural Material:	Stone Chips Concrete
Historical Damage:	No	Reinforcement/ Steel Bar:	40 grade plain
Embankment:	No	Existence of irregularity:	vertical irregularity
Re-strengthening	No	Plinth Area (sqm):	3642.0
Structure Type:	RC frame with load bearing Wall	Floor Area (sqm):	10925.0
Structural Drawing:	Not Available	Architectural Drawing:	Not Available
Foundation Type:	Individual Column Footing	Ground Floor Usage Type:	Office Use
Basement:	No	Shape of the building:	Rectangular

Figure 2.2.1 Sample of Building database in Sylhet

2) Qualities of the building database

The building inventory is an important tool in order to grasp the current situations and also for preparing future plan for building seismic resistance. From this point of view, a fundamental but important database was established. However, the qualities of data are still poor, for example, in case of floor area, there are two types of units such as meter and feet can be found. Which makes the average area uncertain. This irregularity has been pointed out to the CPs, but corrective measure is very slow.

In future, it is necessary to update the system to revise smoothly and check the data quality by PWD side.

3) Maintenance and management

The building inventory which was prepared could be termed as a draft version. Further development of the procedure and system is necessary to maintain the data. For this future maintenance of database, PWD and its sub-divisions should take the responsibility. It is necessary to establish a good collaboration between PWD HQ and sub divisions. In this regard, periodical seminars targeting subdivision engineers should be organized so that collaborative relationship can be further strengthened.

Though PWD is sometimes facing difficulty to collect subdivision engineers from other divisions, it is necessary to search the possibility to develop cooperative relationship and collect them from nearby subdivisions first.

4) Classification of the buildings using building inventory.

Using the building inventory database, CNCRP tried to classify the public buildings for the preparation of a roadmap.

a) Building Importance

In Japan, there is a Law for Promotion of Renovation for Earthquake-Resistant Structure. According to this law, the building which accommodates many unspecified businesses such as hotels, theaters and department stores shall be retrofitted against the earthquakes when vulnerable. As for public structures, schools, hospitals and evacuation shelter will be the target. Applying this law to the database established by PWD, the targets of public buildings can be shown in the following table. It is suggested that Bangladesh should also make laws for promoting retrofitting enterprise and decide the rule of the important building.

Table 2.2.1 Target buildings in the database by PWD if Japanese law is applied

Buildings	Condition of Japanese law	Number in database
a) Schools (primary, junior, high Schools)	Stories: More than 2 stories Total floor area : More than 2,000m^2	15
b) Hospitals	Stories: More than 3 stories Total floor area :More than 5,000m^2	20
c) Evacuation shelter*	Local government decides	Unknown (in case of Dhaka)

*) Evacuation shelter shall be decided by Bangladesh law.

b) Highly vulnerable building (RC frame)

The concrete strength is an important factor regarding the RC frame structure building vulnerability. It has the tendency to become weaker in relation with the construction years, shown in Figure 2.2.2. Though the number of data is limited, concrete strength varies with years. They are not always weaker when older years, and the economic situation might relate. During 1970's were the weakest, but both before and after that period found to be stronger. . Roughly speaking, the tendency is the latter number is weaker.

i) After 2005

ii) Before 1965

iii) From 1985 to 2005

iv) From 1970 to 1985

Regarding the lateral force, generally the higher building needs more lateral deformation performance. Because of masonry wall in fill, general RC framed buildings in Bangladesh have not so large deformation performance. Namely higher buildings are risky. In general, it is suggested that the building height should be as follows;

i) Lowe than 3 stores

ii) From 4 to 6 stories

iii) Higher than 7 stories

Based on Table 2.2.2, 8 buildings have high vulnerability, constructed in 70's and higher than 7 stories.

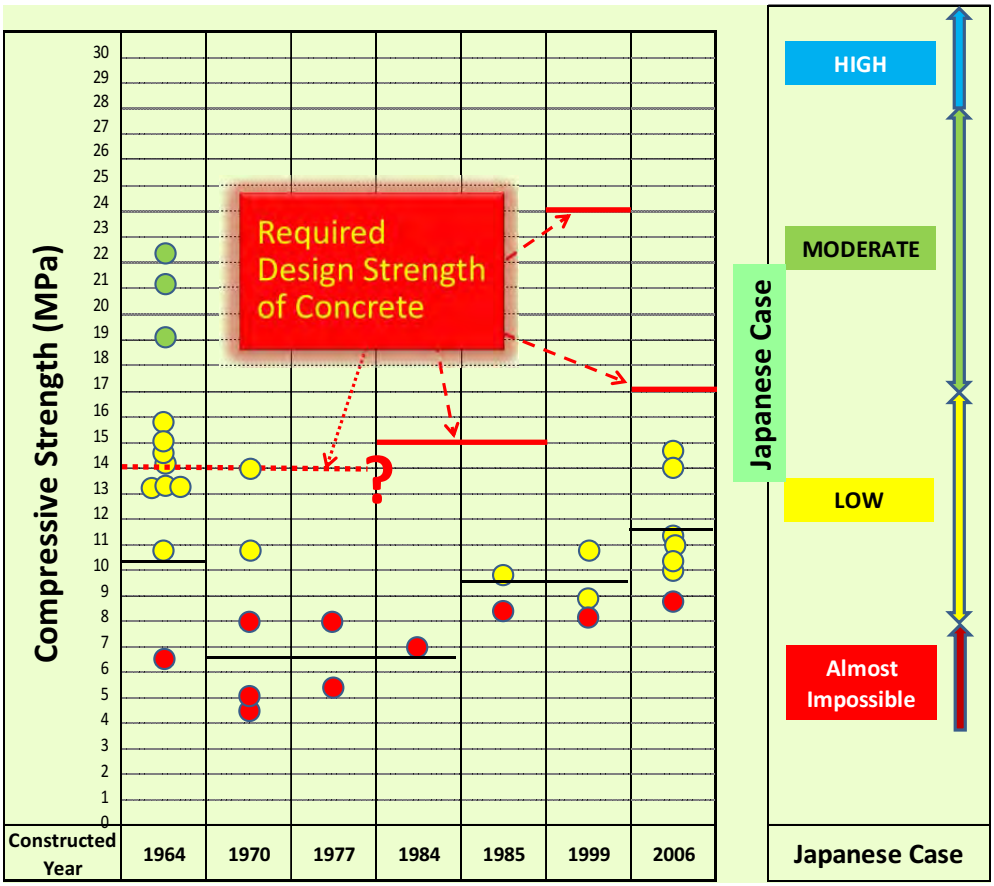


Figure 2.2.2 Concrete strength per age (CNCRP)

Table 2.2.2 Matrix between building heights and building age (RC frame)

Construction age	Lower than 3 stories	4-6 stories	Higher than 7 stories
After 2005	3	54	11
Before 1965	96	47	8
1985-2005	67	435	34
1970-1984	86	155	8

2.3 **Preparation of Seismic Design Manual for New Building**

2.3.1 Background

Since CNCRP aims at the technology transfer of seismic evaluation and retrofitting design of existing buildings, the preparation of seismic design manual for new buildings initially was not included in the scope, and as a matter of fact, appropriate documentation has not been developed for seismic design following the building code in Bangladesh. According to the strong demand by PWD side, the preparation of the “Seismic Design Manual for New RC Buildings" was included in the scope of work.

In Bangladesh, although structural engineers are educated and trained in colleges or universities, however, professional and technical engineers do not receive education and training on building structures. This is probably due to the curriculum of the civil engineering in western world where it focuses mainly on infrastructure, which is also followed in Bangladesh. Therefore, the current seismic design manuals related to civil engineering and building construction in Bangladesh are rich in civil engineering with knowledge of earthquake generation mechanism and geology. On the other hand, threats of earthquakes has become a concern and necessity of proper seismic design is strongly felt. It is assumed that the application of seismic design as an actual technique has not been realized yet. Therefore, the demand of a manual preparation focusing seismic design of new buildings is assumed to be very essential.

2.3.2 Comparison with BNBC1993 and Other Regulations

The current Bangladesh National Building Code BNBC1993 (or BNBC2006) adopts the contents after the United States Building Code UBC-93 (Uniform Building Code-1993). However, in the near future, when BNBC-2015 will be enacted, the seismic design method will basically be in accordance with International Building Code IBC-2006. In addition, the seismic design method of IBC-2006 recommends to follow the United States Standard ASCE7-05, which is "Minimum Design Loads for Building and Other Structures" by American Society of Civil Engineers.

The new Bangladesh Building Code BNBC-2015 has such background. In order to prepare the "Seismic Design Manual for New RC Building", at first the comparison of the seismic design methods of other countries, such as UBC-93, ASCE7-05 was made. The comparison results are shown in the following table. Though the detail information are not presented, BNBC-2015 is based on IBC-06 and ASCE 7-05, but there are several points which are not clear on the specific provisions.

Table 2.3.1 Comparison between BNBC1993 and IBC-06 for Seismic Analysis and Design (structural elements)

Sl. no.	BNBC1993	IBC-06
1	BNBC itself contain provisions for seismic load calculation.	IBC refer ASCE 7-05 for seismic load calculation.
2	BNBC has seismic zoning map based on PGA to select ground acceleration.	IBC provide 0.2 sec and 1.0 sec spectral acceleration map based on Maximum Considered Earthquake (MCE).
3	The return period for PGA is about 225 years.	The return period for MCE is almost 2475 years.
4	Importance factor for structure providing essential facilities is 1.25.	Importance factor for Structure providing essential facilities is 1.5.
5	Sub-soil has been classified into 4 categories.	Sub-soil has been classified into 6 categories.
6	Response modification co-efficient for structural system (R) is higher than IBC.	Response modification co-efficient (R) is lower than BNBC.
7	BNBC provide stress level earthquake load.	IBC provide strength level earthquake load.
8	Base share is distributed in triangular pattern throughout the height of building with a concentric load at top.	Base shear is distributed in complex (triangular + parabolic) patter throughout the building height without any concentric load at top.
9	No consideration for redundant or non-redundant lateral force resisting system.	A redundancy factor (ρ) has been incorporated to promote redundant lateral farce resisting system.
10	The amount and use of vertical component of ground motion in load combination is not clearly defined in BNBC. Moreover it is defined in dynamic response only.	Effect for vertical component of earthquake is considered for Seismic Design Category (SDC) D, E and F.
11	No lower limit for calculated base shear.	Minimum design base shear has to be calculated to overcome uncertainty of response of long period building.
12	Allowable story drift is checked at elastic level.	Deflection amplification factor (C_d) has been introduced to consider inelastic range of deflection.
13	Structural design & detailing are categorized according to only seismic zone (i.e. ground acceleration).	Structural design and detailing are categorized according to ground acceleration, occupancy type, site class and building height.
14	Structural design and detailing are liberal than IBC.	Structural design and detailing are more elaborate and stringent than BNBC.
15	In load combination over load factors are higher than IBC.	In load combination over load factors are lower than BNBC.

Table 2.3.2 Comparison between BNBC1993 and IBC-06 for Seismic Analysis and Design (Composition and Non-structural Members)

Sl. no.	BNBC1993	IBC-06
1	Importance coefficient for essential and hazardous facilities is 1.5. For other structure it is 1.0	In IBC it is same as BNBC.
2	Calculation of seismic lateral force is simpler.	Calculation seismic design force is more complicated than BNBC.
3	No effect of vertical position of component during calculation of seismic force. Total seismic lateral force for component located at or below ground level may be taken as two-third.	Vertical position component with respect to building height has significant effect on calculation of lateral force.
4	No guidelines are available for relative seismic displacement of two connection points of single component.	There is guidelines for relative seismic displacement of two connection points of single component.
5	No guidelines for anchorage of non-structural element.	There is specific guidelines for anchorage of non-structural element.
6	No guidelines for architectural, mechanical and electrical component. But horizontal force coefficient (C') control total lateral seismic force for piping, ducting and conduit system.	There is separate guidelines for architectural, mechanical and electrical component.

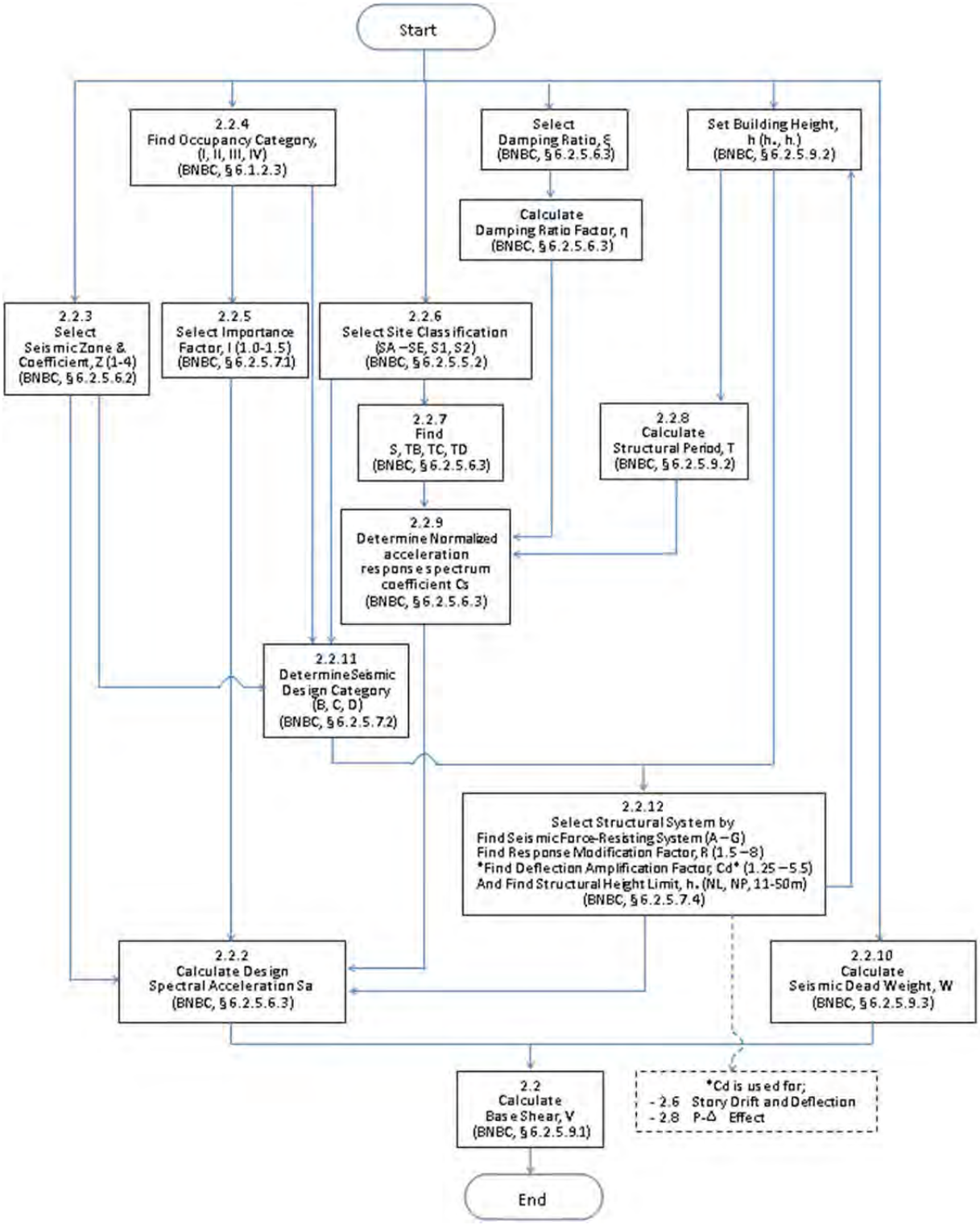
2.3.3 Composition Overview of Seismic Deign Manual for New RC Building

This seismic design manual is consisted of a Main Manual with Appendix and a Sub-Manual with its Appendix. Overall structure is presented in the table of contents below.

As for the main part of the manual, in consultation with PWD, initially the chapter of the basic description of the seismic design was included in the first half, with the idea that, after learning the basic knowledge, the chapter of the commentary of the seismic provisions of the BNBC-2015 was decided to be followed. However, later, following the advice from the editorial advisory board of Japanese side, the description of the seismic provisions of the main BNBC-2015 was put in the first half, and then the technical commentary for seismic design was followed. In other words, an easy-to-use content was considered so that the Bangladeshi design engineers can perform the actual design comfortably. Thus, it was decided to include the provisions of explanation while emphasising on the difference between BNBC-2015 and BNBC-1993 (see main chapter 2). For example, according to the needs of PWD, at the beginning of Chapter 2 of the Main Manual a flow diagram of a seismic load calculation is included and it is followed by a description of flow of the calculation (see Figure 2.3.1).

Table 2.3.3 Table of Contents of Seismic Design Manual for New Buildings

	Main-Manual		Sub-Manual	
Chapter	1	General	1	Overview of Japanese Provision for Earthquake Analysis & Design
	2	Earthquake Provisions According to New-BNBC		
	3	Example Based on New BNBC	2	Example of Horizontal Load Carrying Capacity Based on Japanese Earthquake Provision
	4	Seismic Response of RC Frame Structure		
	5	Earthquake Load and its Impact on Structure	3	Response & Limit Capacity Calculation As Per Japanese Earthquake Provision
	6	Detailing of Reinforcement	4	Example of Response & Limit Capacity Calculation Based on Japanese Earthquake Provision
AppendIx	A	Foundation Design in Seismic Zone	I	Pile Foundation Design in Liquefiable Soil
	B	Unreinforced Masonry Infill Structure	II	Architect License in Japan
	C	Pushover Analysis of Reinforced Concrete Structure	III	Calculation Documents in Japan
	D	Failure Mode with Pictures	IV	Live Loads and Load Combination



Note :(a) BNBC – Bangladesh National Building Code (BNBC)-Upcoming Edition
(b) Section numbers are shown on the top of textbox

Figure 2.3.1 Flow of Base Shear Calculation

Also, instead of adding a detailed description of the seismic provisions, for a better understanding the seismic design method according to BNBC-2015, a design example of "Dhaka Medical College

Hospital" (building scale: reinforced concrete six-story, building area: 690m2, floor area: 4140m2), which has been designed and built actually in accordance with BNBC-2015 (see Chapter 3 of Main Manual) is included. In particular, in order to understand the provisions of the seismic design, it is important to know the basic concepts of building response and seismic loads caused by an earthquake. Therefore, two chapters (see Chapter 4 and Chapter 5 of Main Manual) for this purpose are provided. In addition, since the contents of design must be reflected during construction correctly and accurately, the important points about the reinforcement of rebar are mentioned (see Chapter 6 of Main Manual).

The components of Main Manual are as above. Further, Appendixes of Main Manual and Sub-Manual are elaborated (See Table 2.3.1).

First, in the Appendix of Main Manual, in order to understand the design method of pile for the liquefaction of the ground during the earthquake, the design provisions and design example of the pile in Japan (Appendix-A) are included. At present there is no provision in BNBC-2015, which is considered as an important issue. In addition, "Masonry in Fill" (Appendix-B) and "Pushover Analysis" (Appendix-C) are included in the Appendix

The reasons for inclusion of the "Masonry in Fill" part is described below. In Bangladesh, in relation to construction industry, a big change in the future is not likely where framework of buildings even using RC (Reinforced Concrete), unreinforced brick is frequently used in inner and outer walls. Though BNBC-2015 has the provision of reinforced concrete (RC) frame with brick wall structure (Confined Masonry Structure), it has no provisions for brick walls incorporated into RC beam-column framework (URM-Infill: **U**n-**R**einforced **M**asonry Infill). The seismic design methods in BNBC-2015 are defined ignoring the strength and rigidity of these unreinforced brick walls. If strength and rigidity of the unreinforced brick walls are ignored during seismic design, the buildings become very dangerous due to the following three reasons. Firstly, damage due to rapid change in stiffness in the vertical direction (1st Soft Story: floor store or parking lot in 1st floor) is considered. Second, there is a risk of collapse due to a twist of the building caused by the uneven distribution of the planar wall (generally the building is extremely vulnerable to flat twist moment). Third, if the unreinforced brick wall with an opening such as a window between a spandrel wall and hanging wall, pillars will have stress concentration by shear force during earthquakes that can result brittle destruction. In the chapter of "Masonry in Fill" of Appendix-B, a truss substitution method is introduced as one method to take into account the unreinforced brick walls in seismic design.

The "Pushover Analysis" is added as a separate chapter considering the following reason. Although in BNBC-2015 it is possible to design to withstand against expected seismic forces, Pushover Analysis can be a means to grasp the final shape of building collapse which BNBC-2015 did not mention. According to Pushover Analysis, the final strength of each building layer and the final amount of building deformation can be confirmed, the ultimate strength of existing and new buildings can be grasped. It is an interesting issue that in the United States, Pushover Analysis is popularly performed for seismic evaluation of existing buildings.

In Sub-Manual, an emphasis is given on to introduce the current seismic design method in Japan (Chapters 1 through 4 of Sub-Manual). In addition, in order to understand the composition of Calculation Sheets widely adopted in Japan as official document, the table of Calculation Sheets for the general buildings is introduced in Appendix-III. In near future, it is expected that a legal system for the building administration to be developed in Bangladesh. As a reference of such cases, the outlines of Japanese building inspection system and a variety of building design qualification system are introduced in Appendix-II of Sub-Manual.

2.3.4 Utilization of Seismic Design Manual for New RC Building

In future, in order to design and construct sound buildings with earthquake resistance by Bangladeshi structural engineers while utilizing this "Seismic Design Manual for New RC Building", the following three points are recommended.

1) For the basic plan of building construction, the optimal design should be achieved by repeating studies with Architects and Mechanical & Electrical Engineers using a sufficient period of time. The basic design is a key part, structural plan at this stage is also important. Structural designers and Architects and Mechanical & Electrical Engineers must have good mutual understanding about seismic design. Since these engineers should have a basic knowledge of seismic design, it is necessary to prepare a basic manual of seismic design methods targeting these engineers. It is desirable to prepare it immediately, because the idea was emitted from PWD side.

2) It is not recommended to trust computer blindly as well as to design relying fully on computer programs. It is desirable to return always to the basics, understanding the principles, and checking whether there is no error. These should be conducted repeatedly to aim optimal design.

3) It is essential for structural engineers to confirm whether the idea, design and concept are realized as the originals at the stage of construction by their own presence.

It is highly expected to achieve the above. And, it is hoped that this manual is to be used continuously, further additions and modifications are added as necessary.

2.3.5 Additional Comments

A large Mw7.8earthquake on April 25, 2015 occurred in Nepal approximately 80km west from Kathmandu. It killed around 9 thousand people and nearly wounded 20,000. In October 8, 2005, a major earthquake hit the norther Pakistan which caused the death of 70,000 people and affected more than three million. In both earthquakes, substantial damages occurred in brick wall buildings. Even though the brick buildings, they were constructed only by piling up adobe and baked bricks of mud mortar resulting very weak structures vulnerable against earthquakes.

It is easy to distinguish from the buildings' structure, such as cement mortar or Confined Masonry Structures. In the case of Confined Masonry Structure, there are provisions of seismic design in

BNBC-2015. However, for unreinforced brick walls, BNBC2015 has no seismic provisions. As it can be seen in earthquake damage photos (see photos No. D-13 and D-14 in Appendix-D of Main Manual), there are many cases out-of-plane collapse of the outer wall. Urgent measures are required for this type of damage from the point of view of disaster mitigation. Immediate reinforcement method for the out-of-plane collapse of the outer wall must be a simple and less expensive method.

Finally, three reference materials are introduced as follows.

1) Reinforced masonry construction method for new buildings (see Appendix B-21 of Main Manual)

2) An increased beating method of reinforced concrete wall to existing building ("Seismic Evaluation and Rehabilitation for Building", US Army Corps of Engineers TI-809-15, November 1999, Page Reference D4-35 ~ D4-37)

3) A PP (polypropylene) band mesh method for the existing building (Kimiro Megur: Damage to general houses due to 2005 Northern Pakistan earthquake and proposal of convenient and low-cost seismic reinforcement method , Natural disaster science, J.JSNDS 25-3, 2006, pp. 381-392)

2.4 **Fragility Evaluation (Seismic Evaluation)**

2.4.1 Fragility of Buildings

Classification of the fragility of the Bangladesh buildings was done as a fundamental material for establishing a roadmap. Design drawings and data of structural calculations of existing buildings were collected, their contents were analyzed, the differences in the seismic performance of the buildings were determined, and classification of their fragility from the results was scheduled. Figure 2.4.1 and Figure 2.4.2 show the status of retention of drawings (architectural and structural) of the existing buildings from the inventory data of this project.

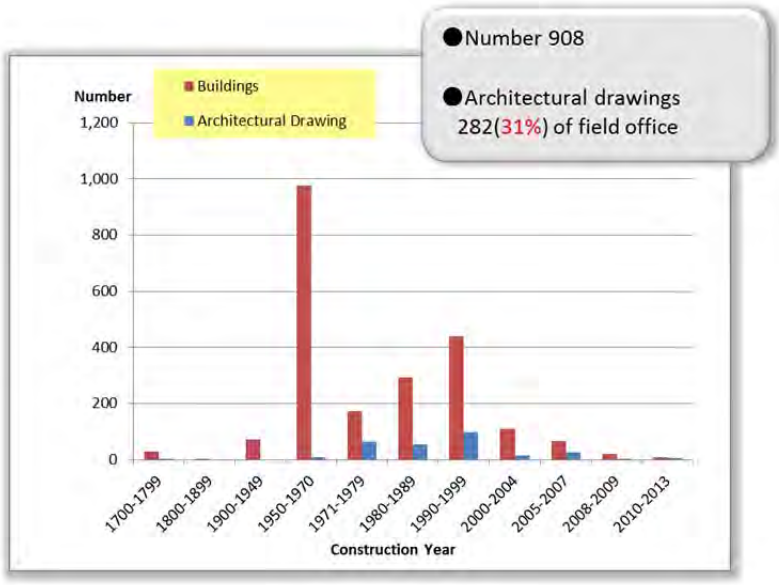


Figure 2.4.1 Number of existing reinforced concrete buildings and number of buildings for which drawings (architectural drawings) were available (percentage retained)

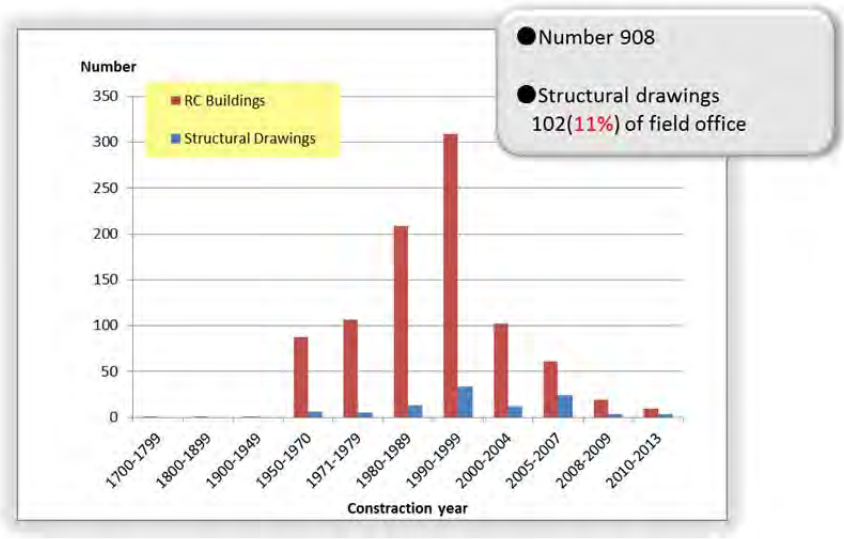


Figure 2.4.2 Number of existing reinforced concrete buildings and number of buildings for which drawings (structural drawings) were available (percentage retained)

As shown in the figures, the percentage retained is extremely low. Also, it is evident that there is no practice of retaining the data of structural calculations produced in the structural design process, so it is not possible to carry out classification based on design drawings.

Therefore, fragility classification was carried out from the seismic design in the year of design, the materials used, and the reinforcement methods and based on discussions with the counterparts. The results are shown in Figure 2.4.3 below. The results are divided into 4 broad classifications according to age.

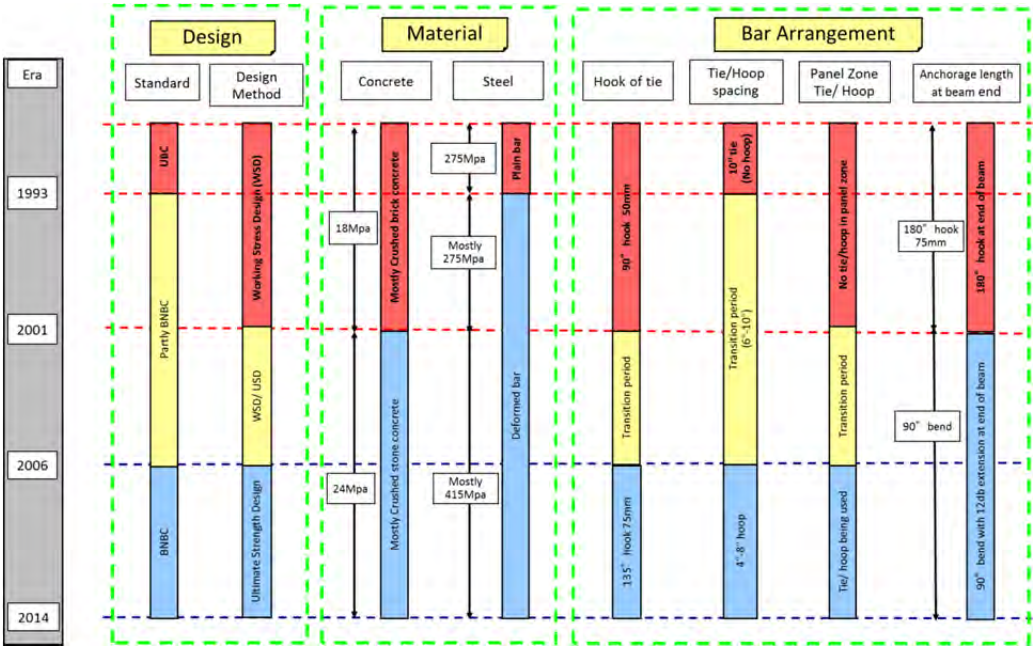


Figure 2.4.3 Fragility classification according to age

2.4.2 Fragility Evaluation (Seismic Evaluation)

Meetings with counterparts were organized to study the evaluation methods of the seismic performance of existing buildings used in Japan and the United States. Participants practiced the evaluations using Japanese standards (including diagnosis of one building in accordance with ASCE (American Society of Civil Engineers) 31-03). Also, at the same time site surveys of buildings (structures) were carried out, to determine the features and status in terms of structure and construction.

The issues in terms of structure and construction of the buildings obtained from the survey are summarized in the following Figure 2.4.4.

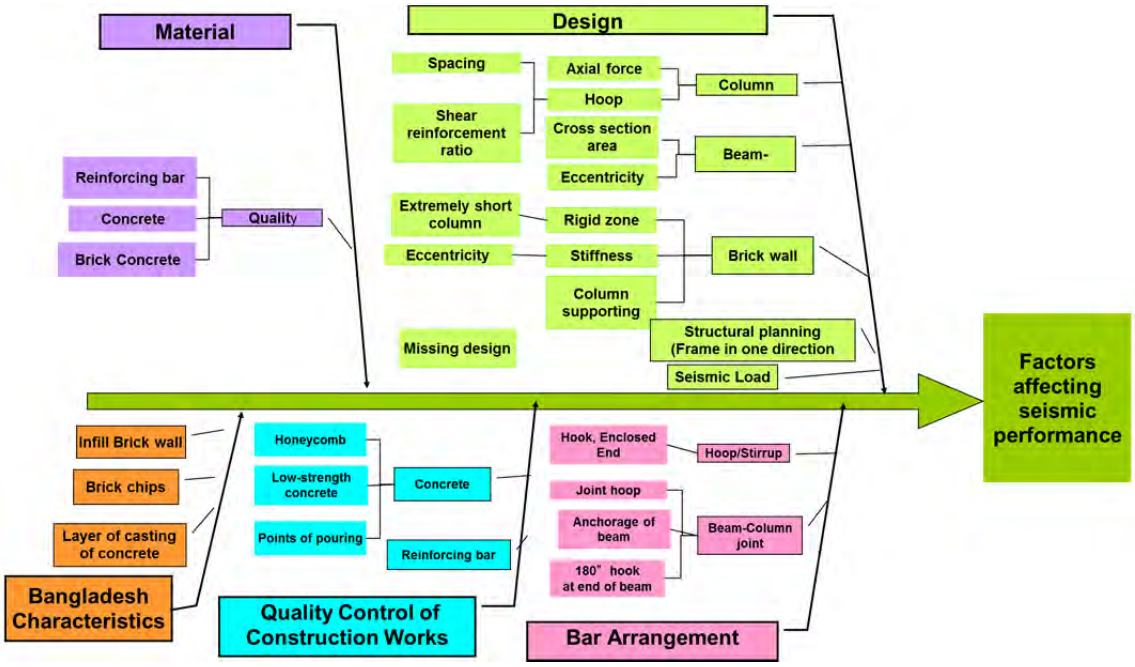


Figure 2.4.4 Issues of buildings in terms of structure and construction

Of the above issues, one of the most structurally important points is the low-strength concrete caused by the low-grade quality of construction. Figure 2.4.5 shows the result of concrete strength tests that were performed using the concrete cores sampled from actual buildings, compared with the design strength. Most buildings show lower strength than the design strength. In addition, most of the concrete has low-strength concrete of approximately 10N/mm^2 (MPa) or lower. Under such construction conditions, buildings will become structurally problematic even if the structural design is proper. As a matter of fact, in the buildings which underwent a seismic evaluation, it was found that as a result of the influence of this low-strength concrete, there was a tendency for the axial force on the first floor columns to increase, and the margin of safety to the horizontal force (seismic force) to be small.

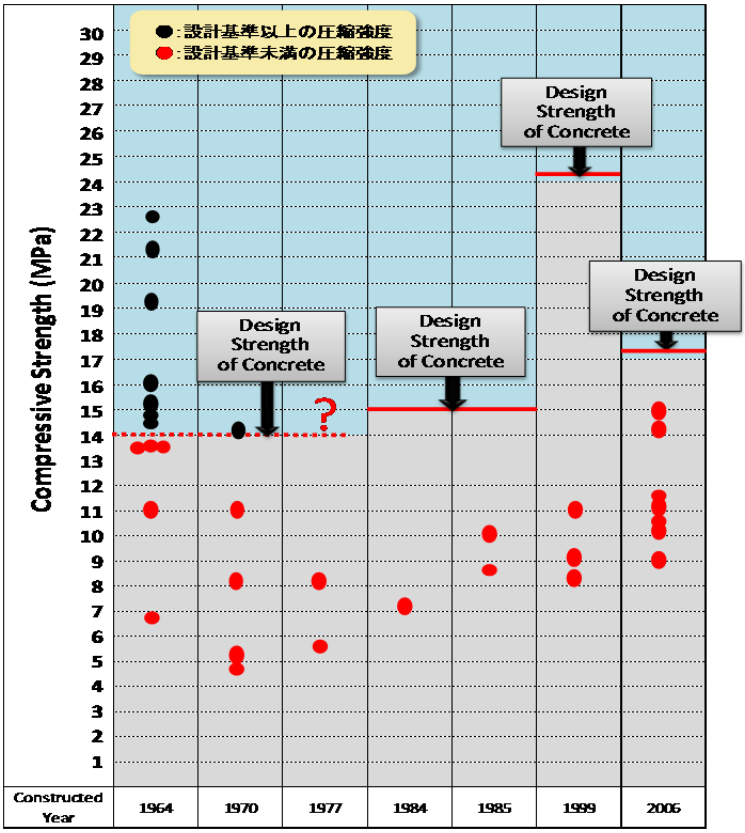


Figure 2.4.5 Concrete design standard strength and actual strength

As a result of the differences in structural features between Japan and Bangladesh, the Japanese fragility evaluation (seismic evaluation) standard was planned to be used as it is, and it was necessary to apply the contents of the standards to Bangladeshi buildings. The detail of the applications are shown in the following Fig. 2.4.6.

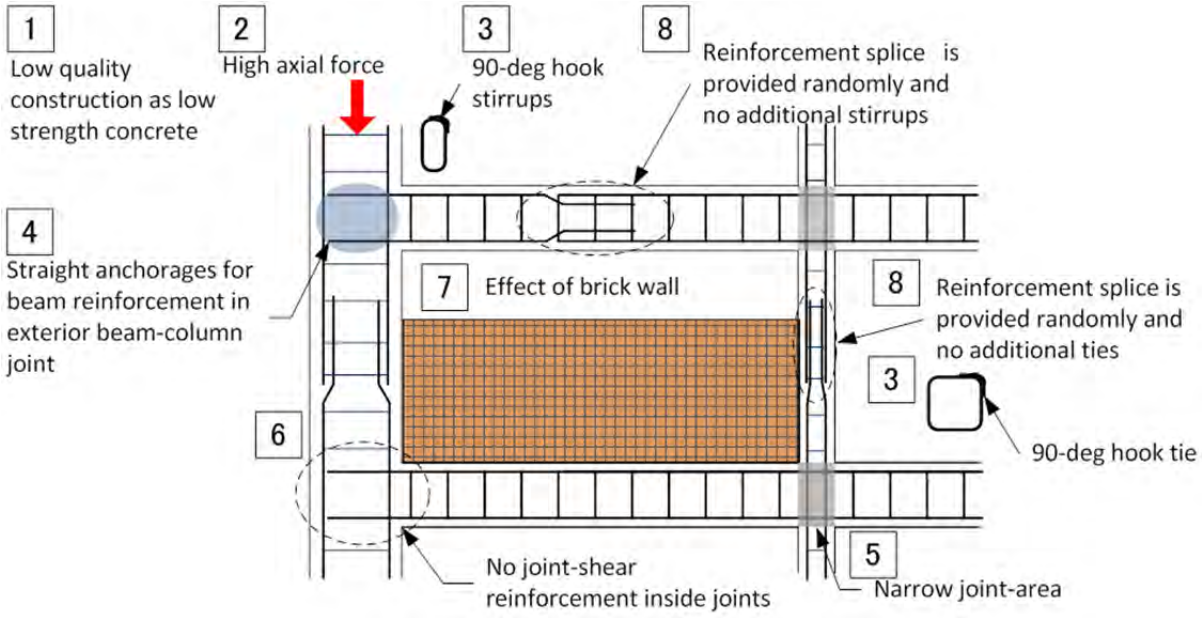


Figure 2.4.6 Issues related to application of Japanese fragility evaluation (seismic evaluation)

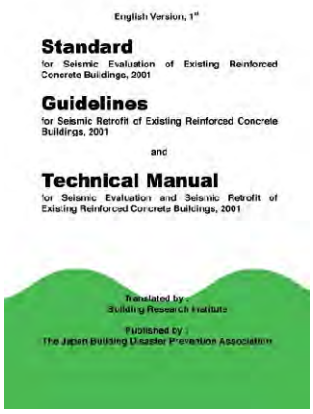
2.4.3 Fragility Evaluation (Seismic Evaluation) Manual

Also, in FY 2012 and 2013 structural tests were carried out in order to resolve these problems (for details refer to section 2.5 retrofit design).

From FY 2014, editorial boards for manuals were established both in Bangladesh and Japan for editing the contents of the manuals, and discussions were carried out.

The current manual reflects the instructions and advice of the editorial boards, and the final contents are being confirmed and the final structure is being accepted by the Bangladeshi side.

The Seismic Evaluation Manual will take the final structure consisting of three volumes, namely, (1) Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001, 1st English Version, (2) Manual for Seismic Evaluation of Existing Reinforced Concrete Buildings, (3) Commentary on Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001 (see the following illustration). Currently the Japanese seismic evaluation commentary is being translated as the commentary in (3), as necessary for evaluation in Bangladesh.



(1) Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001, 1st English Version

(2) Manual for Seismic Evaluation of Existing Reinforced Concrete Buildings

(3) Commentary on Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001

* Number (1) is published by the Japan Building Disaster Prevention Association

Figure 2.4.7 Structure of the Seismic evaluation Manual

At the present stage, methods of seismic evaluation have not been established for all problems that exist in Bangladeshi buildings. The system for carrying out fragility evaluation (seismic evaluation) has only just begun. The remaining important issues in the differences between the Bangladeshi and Japanese versions of fragility evaluation (seismic evaluation) that have been determined to date are shown in the following Table 2.4.1.

Table 2.4.1 Remaining important issues and differences between the Bangladeshi and Japanese versions of fragility evaluation (seismic evaluation)

Bangladesh Seismic Evaluation Manual (First Edition)		Issues and items for study
Principles	Adoption of the basis of Japanese seismic evaluation standards	
	2nd level screening method is applied, which is suitable and practical for buildings.	The effect of main beam reinforcement anchorage or beam to column connections on the failure mode
	Seismic demand index of structure $I_{S0} = 0.8 \cdot 2/3 \cdot Z \cdot I \cdot C_S$	Validation of seismic demand index of structure
	The Bangladesh design standard (BNBC-15) is 80%	
	Structure seismic index $I_S = E_0 \cdot S_D \cdot T$	
	Change the setting of the strength index *C*, the ductility index *F*, the shape index S_D, and the time index *T* in accordance with the actual circumstances of Bangladeshi buildings	
	Cumulative strength index $C_{TU} \cdot S_D \geq 0.4 \cdot 2/3 \cdot Z \cdot I \cdot C_S$	
Scope of application	Reinforced concrete structures (flat slab structures are outside the scope)	Adaptation to concrete using brick chips
	6 stories or lower, concrete strength 9.0 N/mm^2 or higher	Lower limit value of concrete strength
	Non-structural members are outside the scope of application (to be examined in accordance with BNBC-15)	Flat slabs to be considered (request from Bangladeshi side)
Site surveys	Detailed survey recommended (the same level of survey as in Japan when drawings are not available)	Diameter of cores (mainly taken from columns 50 mm) Number of cores taken (concrete pouring 3 times/floor) Construction quality
	* Problems of loss of existing drawings, and their accuracy	Methods of verification of anchorage of main beam reinforcement
		Methods of verification of the presence of shear reinforcements at beam -column joints
Calculation of E_0	Adoption of strength equation and ductility equation (same as Japan)	Ductility equation not necessary (second-class prime elements) Effective strength factor
	Member ultimate strength evaluation Basically adopt the Japanese evaluation equation (adoption of lower coefficients taking into consideration the actual situation)	Adaptation to concrete using brick chips Validation of adaptation of evaluation equation
	Reduction in column flexural strength •Combination of low strength concrete (less than 13.5 N/mm^2) plus plane-bar 20% reduction •If the anchorage of the main beam reinforcement is insufficient (external end columns only) beam width 250 mm about 50%, otherwise 25% reduction The minimum values in the above 2 items to be taken as reduction coefficients.	Effect of lap joints apart Study of these effects
	Reduction in column shear strength • In the case of low strength concrete (less than 13.5 N/mm^2), take $k_r = 0.244 + 0.056\sigma_B$ into consideration •In the case of 90° hooks, evaluation of the resistance as a multiple of the pitch (as ductility evaluation)	The effect of the form of deformation during bending yield of 90° hooks

	Ductility index evaluation Adoption of the same evaluation equation as in Japan •Adoption of deformation angle of 1/150 as it is during standard flexural yield •Plasticity ratio based on the same shear decided by flexure/shear margin of safety	Investigation of evaluation equation Study of ductility capacity (plasticity ratio) from structural standards such as ACI, etc.
	Upper limit on flexural ultimate deformation Set upper limit values for the following items, and among them set minimum values with the upper limit •Axial force ratio (set in accordance with axial force ratio, low strength concrete, hoop reinforcement pitch, hook shape) •Shear stress (no change) •Main tension reinforcement ratio (change to $p_t > 1.3\%$) •Shear reinforcement spacing (no change) •Clear height (classified as RC walls, brick walls. No change for RC walls. For brick walls set in accordance with low strength and shear reinforcement ratio) •Beam-column joints (add conditions. If not examined low strength 1/124, otherwise 1/100) •Insufficient anchorage of external end beam main reinforcement (add conditions. If not examined low strength 1/124, otherwise 1/100 Likewise for beam to column connections)	Validity of setting of upper limit for each ultimate deformation
	Effect of brick walls Not taken into consideration. However the effect is taken into consideration only for short columns due to the effect of standing walls, etc. (deformation upper limit) (the height of standing walls is taken into consideration as it is as the stiffness region)	Strength and stiffness of infill brick walls Evaluation of construction status (mortar, strain) Evaluation of out-of-plane collapse / strength survey methods Method of investigating pilotis
Irregularity index	The same as Japan. However investigation of eccentricity ratio and stiffness ratio are also added in accordance with BNBC (brick walls are not taken into consideration)	Confirmation of the differences in shape indices for plan and elevation in Japanese standards and BNBC, etc. Effect of brick walls
Time index	Japanese first level adopted. However, matters related to age to be changed for status of corrosion of reinforcement and carbonation of concrete, because visual inspection of reinforcement is implemented.	
Others	No items for evaluation of foundations Effect when there are no underground beams	It is necessary to diagnose foundations

2.4.4 Fragility evaluation (seismic evaluation) examples

A list of buildings on which actual fragility evaluation (seismic evaluation) was carried out under this project is given in Table 2.4.2.

Table 2.4.2 List of buildings on which actual fragility evaluation (seismic evaluation) was carried out

Building Name	A	B	C	D
Usage	OFFICE	HOSPITAL	HOSPITAL	HOSPITAL
Structural Type	Reinforced concrete	Reinforced concrete	Reinforced concrete	Reinforced concrete
Frame Type	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame
Above Ground story	5	5	5	6
Eaves High(m)	15	24.7	18	-
Year of design	1985	1984	1999	In planning
Aggregate	Brick	Brick	Brick	-
Photo				
Building Name	**E**	**F**	**G**	**F**
Usage	Garment factory	Garment factory	HOSPITAL	HOSPITAL
Structural Type	Reinforced concrete	Reinforced concrete	Reinforced concrete	Reinforced concrete
Frame Type	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame
Above Ground story	4	6	5	5
Eaves High(m)	15.2	19.3	22.5	18.3
Year of design	2002	2003	1964	1964
Aggregate	Brick	Brick	Stone	Stone
Photo				

The low rate of retention of drawings is referred to Section 2.4.1 above. This is huge concern for fragility evaluation (seismic evaluation), since without drawings it is not possible to carry out detailed fragility evaluation (seismic evaluation). Therefore in the 3rd year, some exercises for preparation of as-built drawings of existing buildings based on the site surveys were done for buildings located in Sylhet G and F.

Figure 2.4.8 Report on preparation of as-built drawings for 2 buildings in Sylhet

Also, in this project a general purpose seismic evaluation spreadsheet and a spreadsheet to determine a preliminary estimate of the amount of retrofit were prepared using MS Excel for the

contents of the evaluation of the Seismic Evaluation Manual. The objectives in preparing the spreadsheets were to encourage spreading the use of seismic evaluation in the future, and to improve evaluation efficiency by reducing the time required.

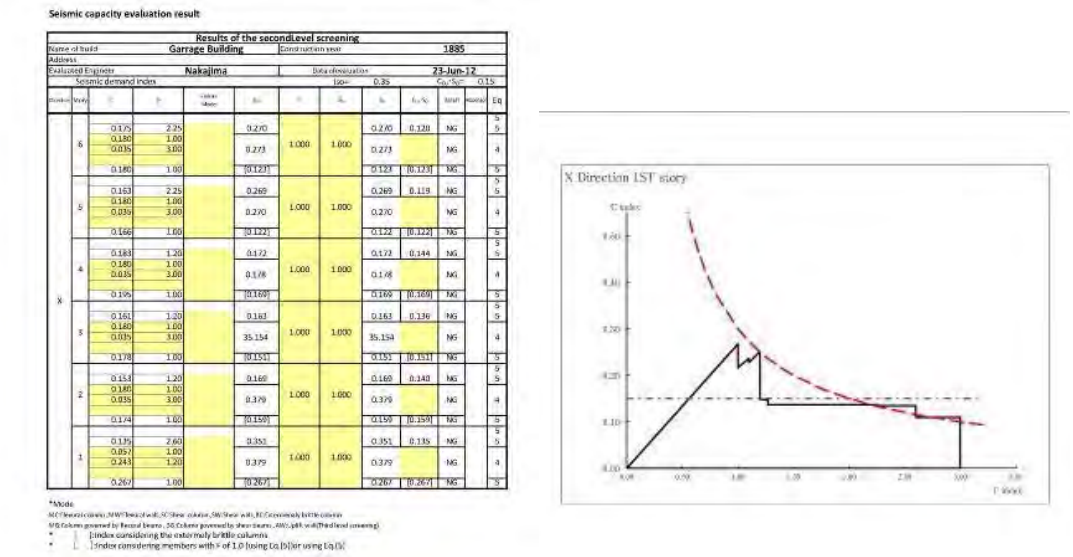


Figure 2.4.9 Example of spreadsheet output

2.5 **Retrofit Design**

1） Retrofit design documents

a) General

Manual for Seismic Assessment of existing RC Buildings developed under CNCRP and BNBC were applied for the structural assessment and for Retrofit design, Manual for Retrofit Design was followed. Retrofit design documents consist of retrofit design drawings (specifications are included in the drawings), structural calculation sheet, and bill of quantity. At the beginning, retrofit design covered only structural retrofit, later during the 4th year of the project when RMG project was included within CNCRP, fire protection and electrical design were also incorporated.

Retrofit design of two RMG factories were performed. For further detail please consult with Chapter 8 of Retrofit design document. RMG Factory No. 1 is located in Ashulia, it is a 4 storey RC structure building. Factory No. 2 is located in Narayanganj, it is a 6 storey RC structure building.

Schedule of Retrofit design drawing for RMG factory No. 1 is shown in Figure 2.5.1.

CONTENTS FOR RETROFITTING DRAWING.

S. NO.	CONTENTS	S. NO.	CONTENTS
S-01.	CONTENT SHEET	S-19	DETAILS OF TYPICAL STEEL FRAME BRACING-2 (1ST FLOOR LEVEL)
S-02	RETROFITTING LAYOUT PLAN (GROUND FLOOR)	S-20	EXCAVATION DETAILS
S-03.	RETROFITTING LAYOUT PLAN (1ST FLOOR)	S-21	TYPICAL DETAILS OF SHEAR WALL TYPE-1
S-04.	DEMOLISH LAYOUT PLAN (ROOF PLAN)	S-22	TYPICAL DETAILS OF SHEAR WALL TYPE-2
S-05.	SLAB REINFORCEMENT PLAN (ROOF)	S-23	COLUMN DETAILS OF STAIR-1
S-06.	BEAM DETAILS-1 (ROOF)	S-24	FOUNDATION DETAILS OF STAIR-1
S-07.	BEAM DETAILS-2 (ROOF)	S-25	GB & FB DETAILS OF STAIR-1
S-08	RETROFITTING SECTION: G-G	S-26	DETAILS OF STAIR-1
S-09	RETROFITTING SECTION: C-C	S-27	FOUNDATION DETAILS OF STAIR-2
S-10	RETROFITTING SECTION: 01-01	S-28	DETAILS OF STAIR-2
S-11	RETROFITTING SECTION: 06-06		
S-12	RETROFITTING DETAILS (SECTION G-G)		
S-13	RETROFITTING DETAILS (SECTION C-C)		
S-14	RETROFITTING DETAILS (SECTION 1-1)		
S-15	RETROFITTING DETAILS (SECTION 5-5)		
S-16	RETROFITTING DETAILS (SECTION 6-6)		
S-17	DETAILS OF TYPICAL STEEL FRAME BRACING		
S-18	DETAILS OF TYPICAL STEEL FRAME BRACING-1 (GROUND FLOOR LEVEL)		

Figure 2.5.1 Schedule of Retrofit design drawing (Structure) for RMG factory No. 1

It is noted that framing elevation drawings are provided for retrofit design.

Index of summary of structural assessment, retrofit design (structural calculation documents) for RMG factory No. 1 is shown in Figure 2.5.2.

Summary Report of Structural Assessment and Retrofit Design

Contents

Appendix

A1. Concrete strength (concrete core test)

A2. Building unit weight

A3. Machine layout

A4. Irregularity index and Time index

A5. Evaluation of each column

A6. Beam column joint

Figure 2.5.2 Summary of Assessment and Retrofit design (Calculation) of RMG

b) Seismic Retrofit Planning

RMG Factory No. 1

This is a 4 storey RC frame structure building. Concrete strength was found to be low, but member size and reinforcement were of certain level. The assessment results for the beams, columns, floor slabs and foundations satisfied BNBC93 for both, vertical or gravity loads. However shortage of horizontal stiffness and eccentricity were observed for lower storeys and double height area. Retrofit design was done to improve irregularity and horizontal strength at lower two stories. Steel framed braces were provided at outside of external wall and storage area so as not to affect factory operation. RC shear walls were also provided beneath the steel framed brace, since the exiting foundation was located at a deeper position.

Figure 2.5.3 Framing elevation of RMG Factory 1

RMG Factory No. 2

This a 6 storey building with a mixture of RC frame and flat plate structure. Strength of concrete was found to be low and column size was smaller, and the assessment revealed that the structure was not satisfying BNBC 93 with respect both of vertical or gravity load and seismic load.

The ground is very soft. Existing foundation was not satisfying necessary safety factor and harmful settlement was assumed. The operation of the factory was suspended during the retrofit

design stage.

As a method of retrofitting, column RC jacketing and capital were planned for flat plate against punching shear. Seismic capacity was increased by the provision of steel framed brace and RC wall at external wall portion in both directions. Existing independent footing was changed to continuous footing to increase the capacity.

Modification of deviated portion of the building from approved drawing was also included in retrofit plan and design.

Bill of quantity and necessary documents for tendering were prepared based on retrofit design drawings. However, actual retrofit work was not undertaken due to the reason of high retrofit cost.

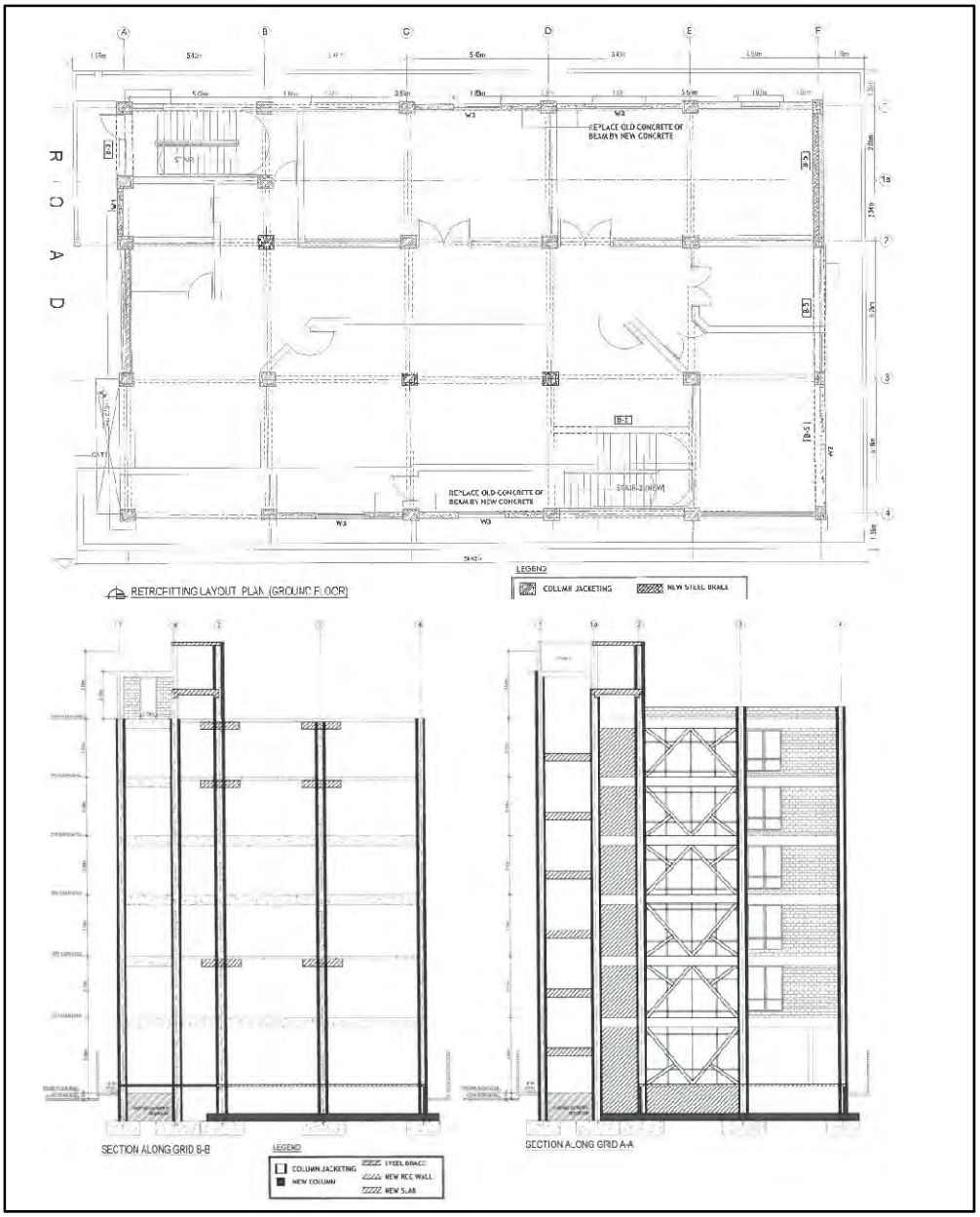


Figure 2.5.4 Framing plan and framing elevation of Factory No.2

2） Structural experiment

Structural experiments were carried out in 2012 and 2013. These were basic experiments to incorporate the results in Manual of seismic assessment and Manual for seismic retrofit design. For more detail, reference is made to the attached document “8.4 Structural experiment”. Time schedule of experiments performed in 2013 is shown in Figure 2.5.

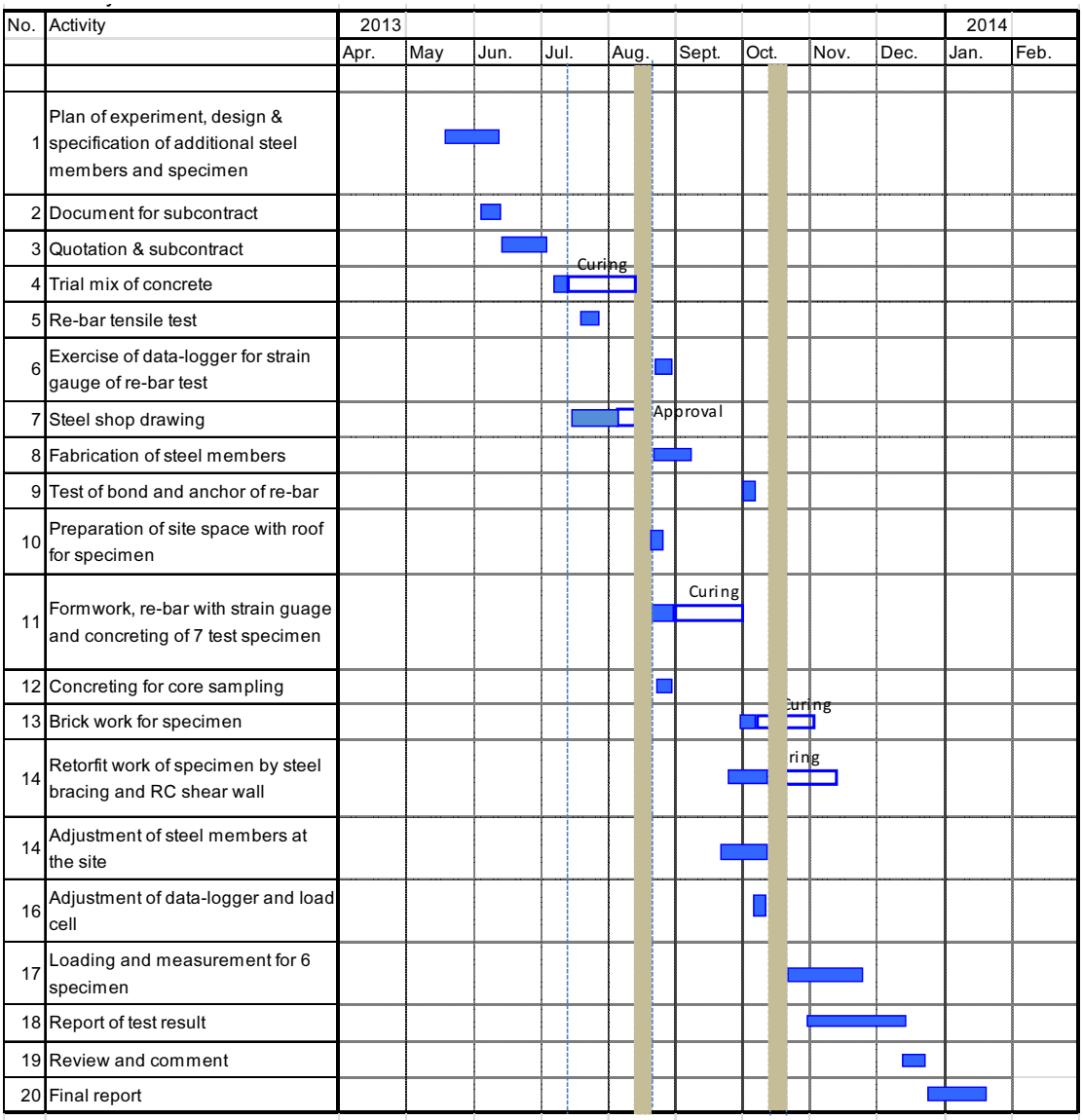


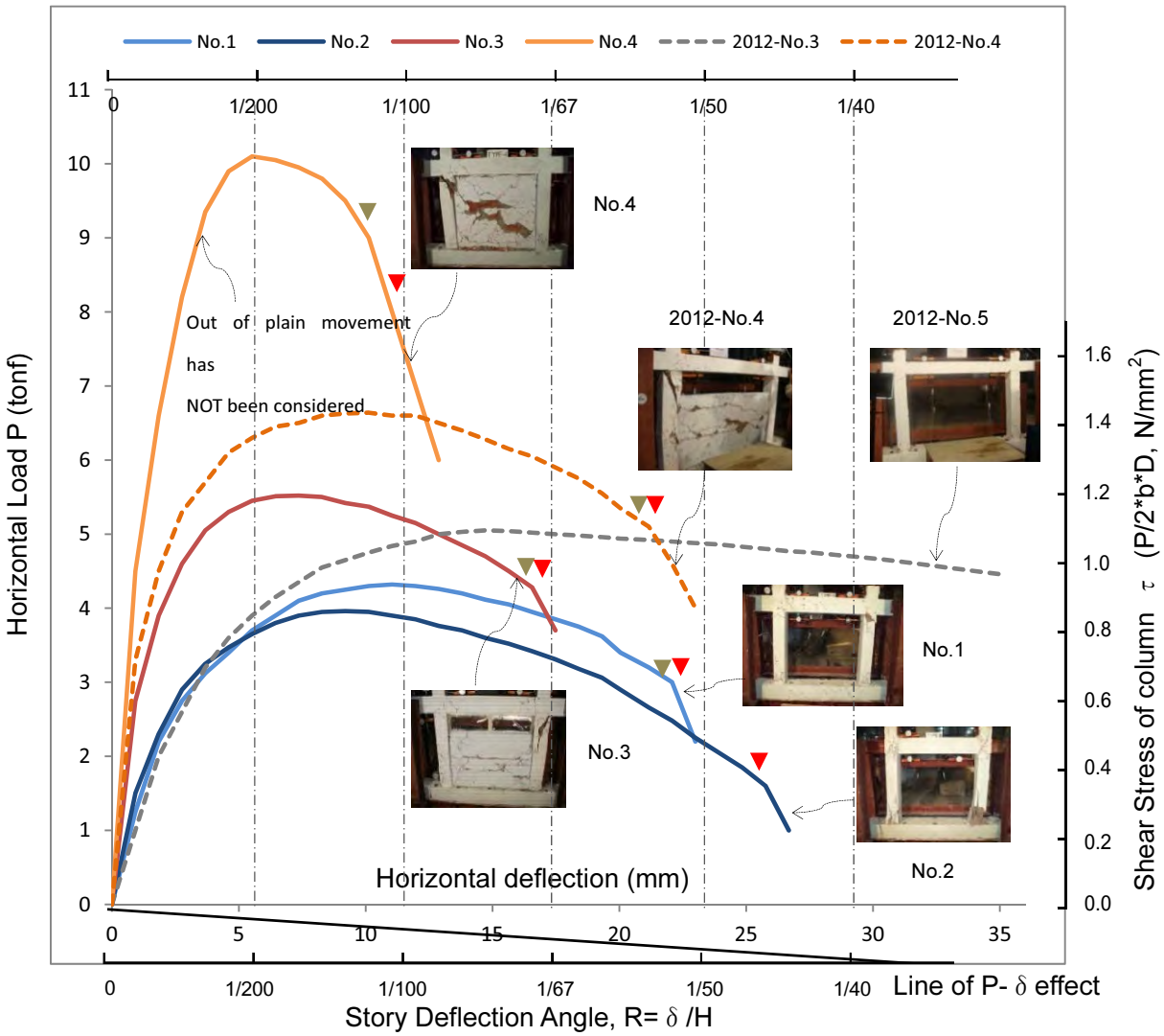
Figure 2.5.5 Time schedule of Structural experiment (2013)

Structural experiments in 2013 were performed for specimens with low strength concrete. Simplified monotonic loading deflection relation of each specimen was considered for comparison purpose using repeated loading deflection results and engineering judgment. Figure 2.5.6 shows the results. Specimen No.1, No.2 are columns with high axial force ratio (0.68) resulting very low plastic deformation capacity of the frame compared with Specimen 2012- No.5 which had average axial force ratio (0.44). Specimen No.3 and 2012-No. 4 were frames with brick standing wall showed their initial stiffness and strength but had reduced plastic deformation capacity. Specimen

No.4 was a frame with brick wall without opening showed high stiffness and strength but showed least deformation capacity.

Figure 2.5.7 shows the results including the retrofitted two specimens. The retrofitted frame with RC shear wall (Specimen No.5) and steel framed brace (Specimen No.6) increased horizontal strength but reached to maximum strength at an early stage, while reduced horizontal strength sharply showing no plastic deformation capacity. When vertical load can't be supported the shear failure of columns occurs. This loss of vertical load support capacity is mainly caused by shear failure of columns due to low strength concrete and poor shear reinforcement.

Axial force ratio: Specimen No.1 ~ No.4, N/ (b*D*Fc) = 0.68 (Fc=10.6N/mm^2, N=163kN)
Specimen 2012-No.4, 5, N/ (b*D*Fc) = 0.44 (Fc=16.5N/mm^2, N=163kN)

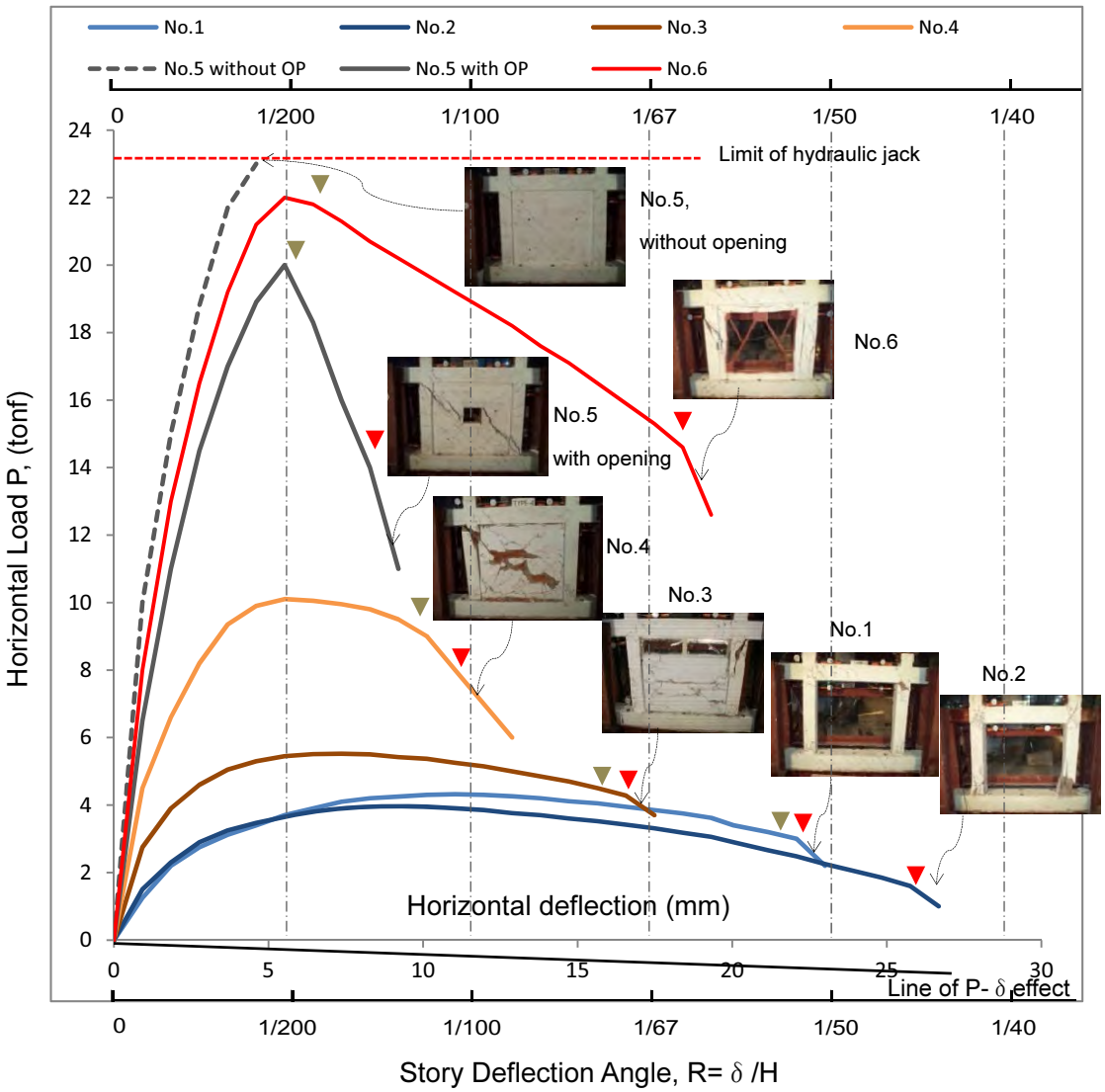


Note: Marking: ▼ denotes a point of "Drop in vertical strength".
▼ denotes a point of "Shear failure" by the visual observation.
R: Story deflection angle = Horizontal deflection (mm)/ Story height (1,175mm)
b*D: Width and depth of column (mm* mm)

Fc: Concrete strength (N/mm^2)

1tonf = 2, 205lbf=9.8kN, 1Mpa= 1N/mm2, 1N/mm2 = 145 psi

Figure 2.5.6 Simplified load-deflection curve (1/2)



Note: Marking: ▼ denotes a point of "Drop in vertical strength".

▼ denotes a point of "Shear failure" by the visual observation.

R: Story deflection angle = Horizontal deflection (mm)/ Story height (1,175mm)

b*D: width and depth of column (mm* mm)

Fc: Concrete strength (N/mm^2)

Axial force ratio: Specimen No.1 ~ No.6, N/ (b*D*Fc) = 0.68 (Fc=10.6N/mm^2, N=163kN)

Retrofit: Specimen No.5, Fc of wall =10.7N/mm^2

Figure 2.5.7 Simplified load-deflection curve (2/2)

3） Manual for Seismic Retrofit Design

"Manual for Seismic Retrofit Design" was developed under CNCRP project as an application manual incorporating building characteristics of Bangladesh (Figure 2.5.8 (b)). The basis of this guidelines is the "Guidelines for Seismic Retrofit Design of Existing Reinforced Concrete 2001" published by Japanese Building Disaster Prevention Association (JBDPA)

To ensure the quality of the manual, "Technical editorial board" was established both in Bangladesh and in Japan. Members were professors of universities. Suggestions and advice of the board were incorporated for the preparation of the manual. Main issues were, status of the manual, scope of application, evaluation of seismic demand index, axial force ratio and deformation capacity of column, use of 1st level screening, brick standing wall, beam column joint, and others. The status of this manual is the technical recommendation for seismic retrofit.

(a) Guidelines on Retrofit Design 2001 (b) Retrofit Design Manual (c) Commentary on Guidelines for Retrofit 2001

Figure 2.5.8 Covers of Seismic Retrofit Design Manual

Index of "Retrofit design Manual" is shown in Figure 2.5.9.

Modifications of Japanese standard and guidelines for their application in Bangladesh are summarized in Chapter 1. Example of retrofit design is shown in Chapter 4 for easy understanding. Supplement A includes useful supporting data, and Supplement B includes reference documents and data. Index of the manual is shown in Figure 2.5.8. Suggested modification of Japanese Standard and Guidelines for their application in Bangladesh are shown in Table 2.5.1.

MANUAL FOR SEISMIC RETROFIT DESIGN OF EXISTING REINFORCED CONCRETE BUILDINGS

CONTENTS

Figure 2.5.9 Index of Manual for Seismic Retrofit Design

4) Comments on Guidelines for Seismic Retrofit 2001

This is the translated version of the Japanese commentary portion of "Seismic Retrofit Design Guidelines" (Figure 2.5.8 (c)). This translation work has been approved by "Japanese Building Disaster Prevention Association (JBDPA)" for CNCRP project. Existing English version 2001 includes the main portion of the Guidelines, and this commentary portion of the Guidelines includes the explanation of background and useful figures and tables. This commentary version is used for reference and to supplement the Retrofit design manual of CNCRP.

2.6 **Seismic Retrofitting.**

2.6.1 Development of Seismic Retrofitting Techniques

"The capacity to implement retrofitting of the public buildings is developed" is one of the Project's outputs. In connection to this output, during the first 2 years of the Project, the theoretical technology transfer and essential test works have been carried out.

As for the theoretical technology transfer of seismic retrofitting techniques, JET trained Bangladeshi C/Ps with necessary techniques such as post- installation of hooks for tie-hoop bars for columns` strengthening, post-installation of headed anchors and reinforcing bar arrangement, re-bar arraignment, installation of splitting prevention reinforcing bars for walls, installation of formworks, concrete placing, from top levels of existing floors or beams to columns or walls, column strengthening by steel plate jacketing and injecting grout, column strengthening by steel plate jacketing and injecting grout, column strengthening by carbon fiber wrapping, and strengthening by steel bracing. In addition, studies/researches on actual seismic retrofitting works followed in and around Japan were also carried out for dissemination purposes.

As for the test works, the project replicated the actual retrofitting cases. In the test works, materials to be used, bar-arrangement, filled joints between old and new concrete parts, and material strength of concrete core samples were checked. In addition, as for reinforcement with steel materials, JET and C/Ps discussed implementable techniques considering available materials and skills of Bangladeshi welders. Based on the discussion, a total of 10 retrofitting methods were selected and tested. Furthermore, to raise awareness on the importance of seismic retrofitting and to disseminate its techniques, the project exhibited the test works, hold a technical discussion forum, and presented the importance of seismic retrofitting works through displayed materials.

During the test works, the construction progress was filmed and it was used for trainings and awareness raising materials.

In the third year of the project, Tejgaon Fire Station building was selected as pilot project to apply the techniques and transfer of knowledge to the CPs. Initially, a total of 3 public buildings were

nominated, however, considering the available budget and size of the buildings, only the Tejgaon Fire Station building was selected to be retrofitted. Following the selection, design and cost were studied. During the 3rd and 4th years of the project, bidding process was completed and followed by the construction.

Meanwhile, since the collapse of Rana Plaza in April 2013, a support for seismic retrofitting works for private Ready-made Garment (RMG) factories was added to the project as a new scope in the 4th year.

The activities carried out during the 4 years of the Project are summarized and presented below.

1) Technology Transfer of Retrofitting Works (1st Year)

(1) A lecture to introduce actual seismic retrofitting cases was carried out by JET in June 2011 at the first seminar of the project.

(2) Bangladeshi C/Ps visited Japan for a training, during the period of which they visited two seismic retrofitting work sites in Chiba, Japan in August 2011. After returning from the visit, C/Ps introduced the Japanese cases as well as retrofitting work supervision methods to their colleagues in Bangladesh in October 2011.

(3) Prior to the test works, WT-3 had a training seminar among themselves to study the construction management guidelines in Japan to be equipped with basic supervision methods.

(2) Test Works (1st and 2nd Years)

(1) In the 1st year of the project, as a result of consultations with C/Ps, JET selected 6 methods (refer to Figures 2.6.1 and 2.6.2) for retrofitting works and respective drawings were prepared. In November 2011, a tender was called and a contractor was selected. The test works were commenced on 11 December 2011, and completed at the beginning of February 2012.

(2) The 6 retrofitting methods for seismic retrofitting were: a) Slit on Brick standing Wall, b) Concrete Jacketing, c) RC Wing Wall, d) RC Shear Wall, e) Steel Framed Bracing, and f) Carbon Fiber Sheet Wrapping around RC Column.

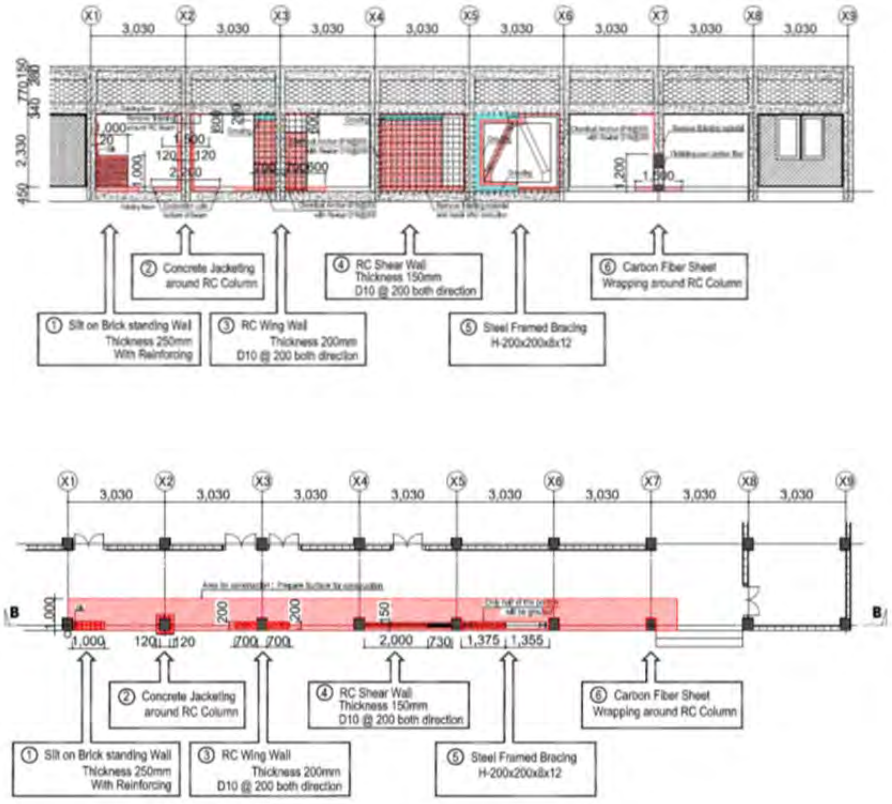


Figure 2.6.1　Outline of Test Work　（1st Year）

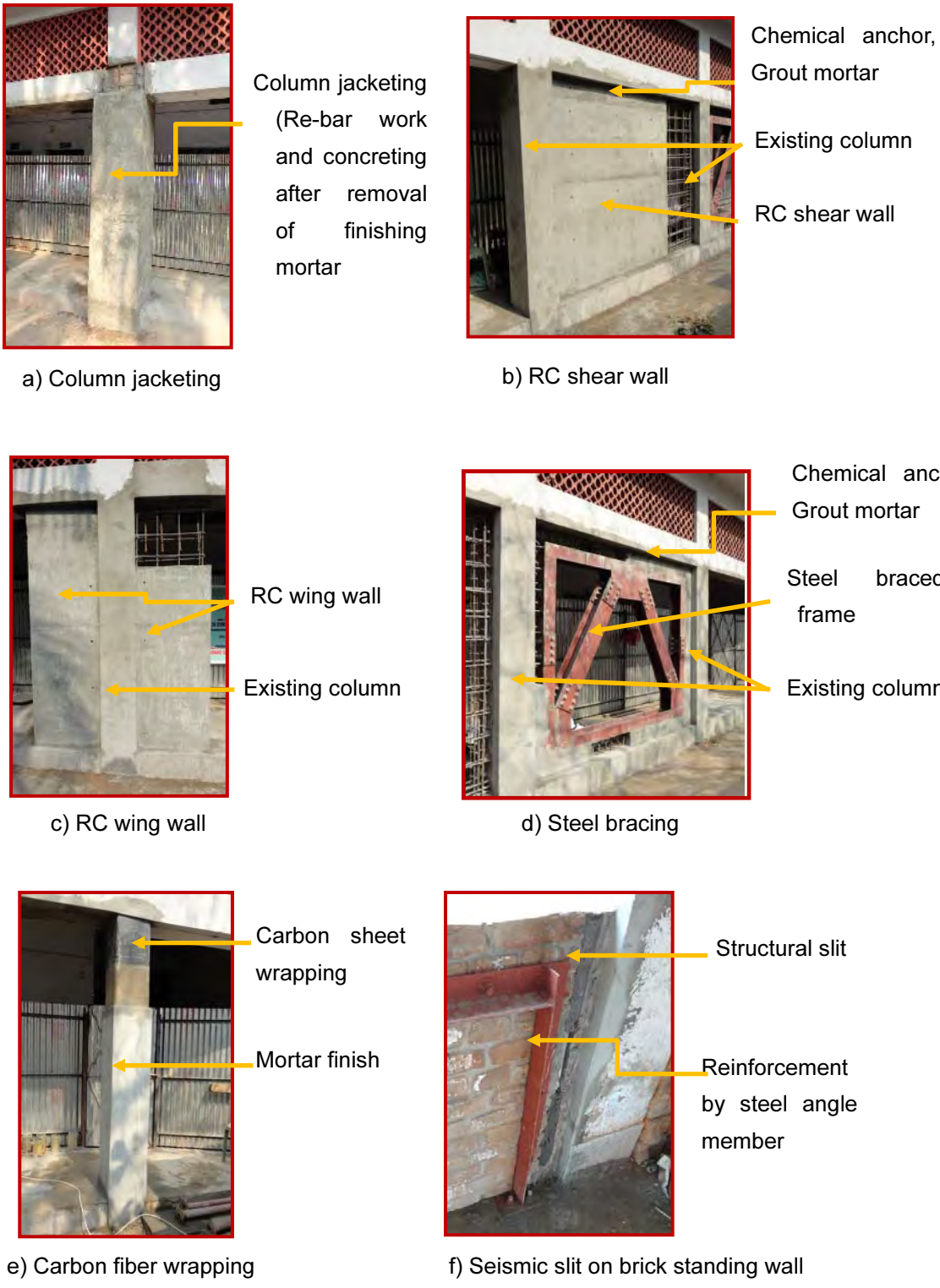


Figure 2.6.2 Construction methods of Test Work (1st year)

(3) In the 2nd year of the project, based on the achievements of the 1st year and architectural issues in Bangladesh, g) installing external steel braces, h) Concrete placing, from top levels of existing

floors to columns, i) Concrete placing, beams, j) Casting New floor slab were tested. Most of the works were entrusted on PWD engineers, in order to confirm how many of the seismic retrofitting techniques had been transferred to Bangladeshi C/Ps.

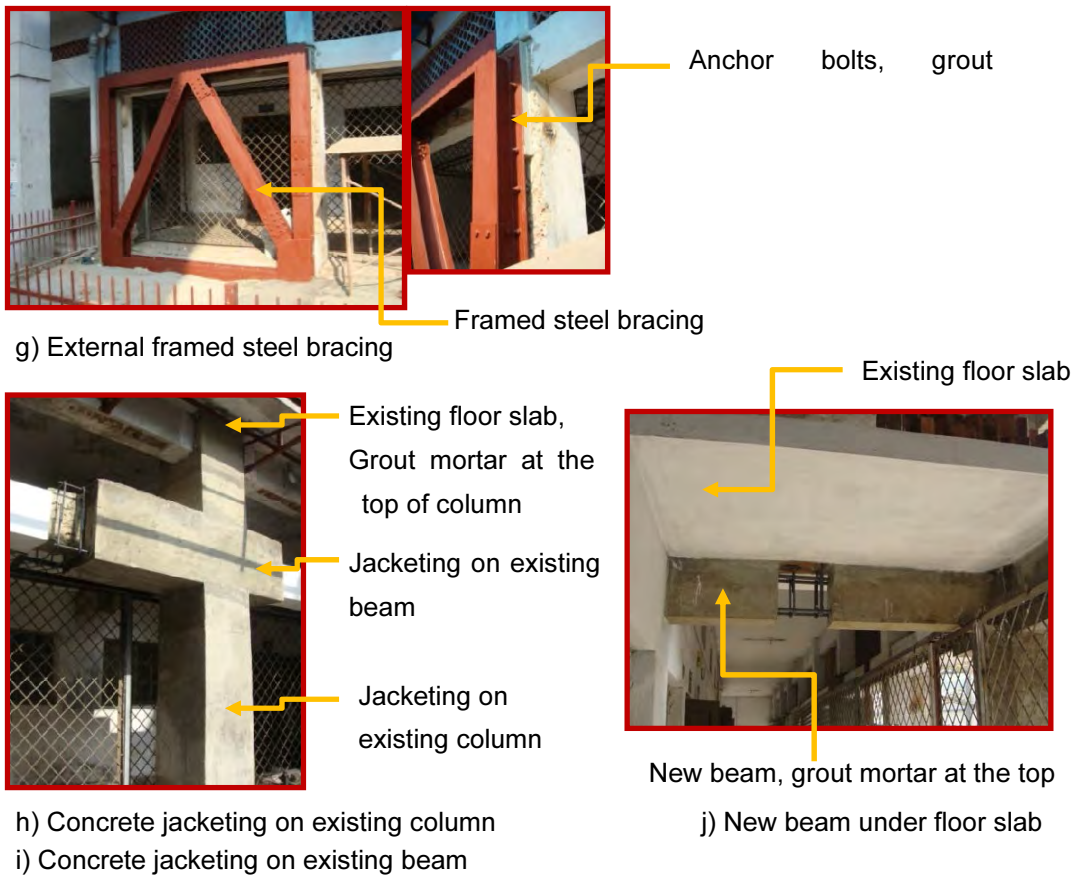


Figure 2.6.3 Construction methods of Test Work (2nd year)

3) Exhibition of the Test Work (2nd, 3rd and 4th Years)

(1) During the test work, the seismic retrofitting works were exhibited in the site for other PWD engineers as well as relevant engineers of other agencies, in order to disseminate information of seismic retrofitting techniques and to raise awareness on their importance. The exhibition was held on 5 January 2012 for engineers of public agencies and for engineers of the academic sector.

(2) Since the site of the test work was kept open to the public responding to a request, various people visited there. The site was developed for the purpose of awareness raising in the future as a kind of museum.

(3) A technical discussion forum was held on 29 February 2012. Main discussion themes were methods and indicators for vulnerability assessment of existing buildings, seismic retrofitting design of existing buildings, and basic issues for seismic design for new construction. 10 Bangladeshi structural engineers and academicians in Dhaka participated to discuss the test work of the project, seismic retrofitting techniques. its achievements and future procedures to be taken.

(4) On 1 March 2012, at the 2nd JCC (Joint Coordination Committee) meeting, the project disseminated the progress of the test works as well as information and techniques of seismic retrofitting works.

(5) The test work was filmed to be presented at the 2nd Workshop on 8 March 2012. This video drew attentions of the participants for better understanding about seismic retrofitting techniques. It is now available as training and enlightenment materials.

(6) The experience and knowledge accumulated from the test works were applied to the pilot project started in the 3rd year. Seismic retrofitting design and construction were implemented in an existing fire station building located in Dhaka city as a pilot project.

2.6.3 Preparation of a manual for supervision for seismic retrofitting works

From the 1st year to 3rd year of the project, referring to "Guidelines for Seismic Retrofit of Existing Reinforced Concrete Buildings, 2001 (by Japan Building Disaster Prevention Association)," JET under took the task to prepare the "Manual for Retrofit Construction Management" which was meant to be useful in the Bangladeshi context. However, following discussion on copyright issues with the Japan Building Disaster Prevention Association, and changes in contents, in the 4th year of the Project, it was decided that the new manual would not only cover seismic retrofitting methods but also general construction supervision work methods for PWD engineers. The name of the manual was also changed to "Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings."

The manual introduces minimum requirements for construction supervision, incorporating the experience and knowledge gained through the test works and the pilot project. By doing so, the manual has become useful introductory guidelines for all supervisors in the context of Bangladesh where construction supervision work is not well-understood so far.

The manual consists of two parts. Part I covers techniques necessary for seismic retrofitting works in Bangladesh, while Part II covers basic points in construction supervision and sample documents including ones that are necessary for various inspections.

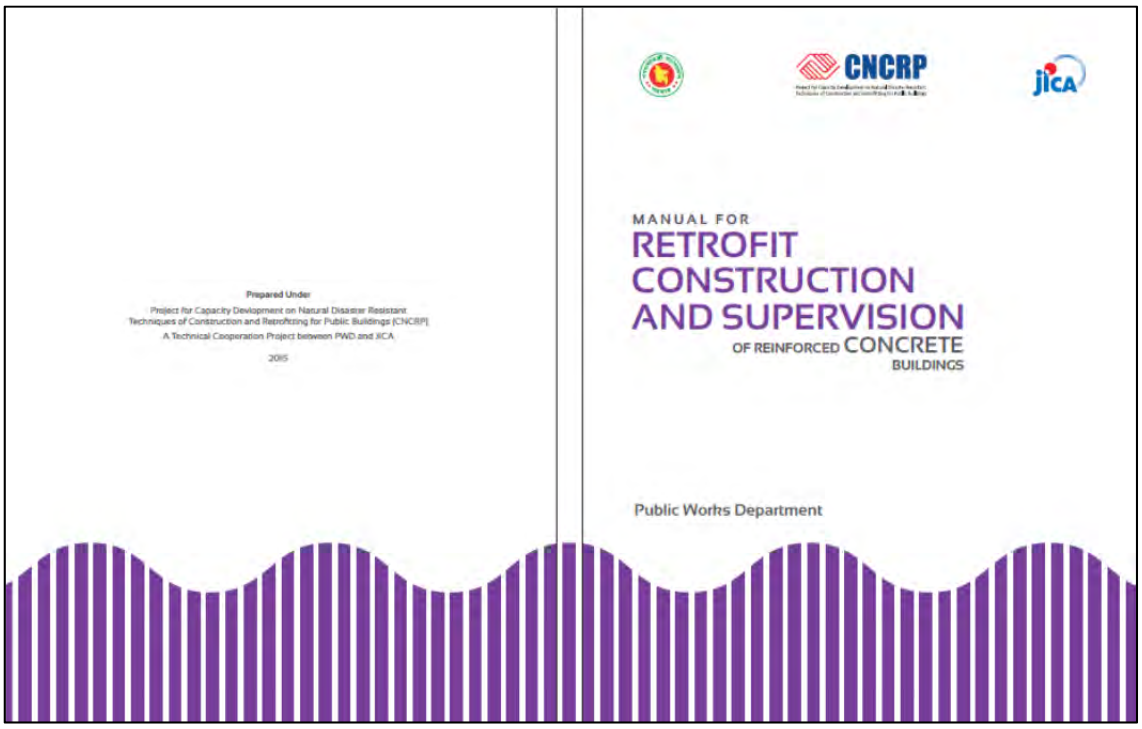


Figure 2.6.4 “Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings” (Cover pages)

Table 2.6.1 Major contents of "Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings" (Part I)

CONTENTS

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Table 2.6.2 Major contents of "Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings" (Part II)

2.7 Quality Control

2.7.1 Preparation of Checklist and Judgment Guidelines

Since in Bangladesh, there is no practice to keep and compile necessary documents during designing and construction, the preparation of the Quality Control Guidelines and Checklist was judged as the most difficult task. Therefore, considering the preparation of something related to retrofitting from the beginning was considered more difficult. The guidelines and checklist for new construction which will be more general in nature, is better to be prepared first using the knowledge of Japanese examples. It will be recommendable to prepare document for retrofitting with reference to other manuals prepared under CNCRP and then adding necessary items for retrofitting process of designing and supervision.

The draft Quality Control Guidelines and Checklist, prepared during the third fiscal year of CNCRP in accordance with new construction design and supervision, is consisted of the concept of quality control and several format examples of operation. In the future, based on the knowledge gained through the tests performed at new and retrofitting constructions, reviews and revisions will be made.

So far, to confirm the prepared guidelines and checklist for new construction, some applications were attempted in new and retrofitting design and construction. First of all, it was applied to the PWD daily work, but it was insufficient. Then, it was applied in the construction of the pilot project, as to target a retrofitting construction. In fact, as described in 2-10, there were several problems in the operational process and was hard to conclude that it was utilized well. Therefore, based on the review of results obtained from the pilot project, the guidelines and check list were applied to the construction supervision of the RMG project (garment factory retrofitting support).

Next, in the RMG project, to build a system of site supervision, a consultant who carried out seismic retrofitting design was hired. He was present at construction site for daily supervision. Regarding quality control at site, a fundamental checking system was set so that the contractor follows the construction works as designed.

Initially, the stationed supervisor was seen confused to some extent seeing the difference between conventional Bangladeshi way and supervision procedures of this time. For this reason, a detail instruction was given regarding how to organize regular meetings, how to draft a minutes of meeting and so on. In addition, before the commencement of construction, how to use the construction supervision manual (draft) and quality control guidelines, prepared under CNCRP was explained. Also, samples of daily, weekly, and monthly reports, together with inspection items and inspection tables were shown and instructed how to use them. In addition, JET members participated in regular meetings together with PWD members, and reviewed the issues encountered every time, and made them to note down in reports.

An example of a check sheet used for concrete engineering for seismic retrofitting construction work is shown below. In addition to this, the check list of daily and weekly reports, minutes of inspection table and regular meetings were prepared.

It should be noted that the existing status of quality control guidelines and checklist is the same as described above. Currently Bangladesh side is revising it for further improvement, therefore the printing of those document was postponed at the present time.

Table 2.7.1 An example of Check list for Concrete Engineering

DRAFT COPY

INSPECTION SHEET FOR CONCRETING WORK (During Construction) SL NO: IS(CC): con. const./MAR/18

NAME OF THE PROJECT: Retrofitting works of DK Knitwear Ltd.

LOCATION OF THE PROJECT: Elamgopa, Azuliya.

DATE: 18-03-15

CONCRETING ITEM [ ] FOOTING [ ] PILE [✓] COLUMN [ ] BEAM [ ] SLAB

	G1-1		
1) Number of floor level			
2) Location as per grid Nos of structural drawing:			
3) For bonding with old concrete, the edges of old concrete are to be rough to give a firm bonding.	YES	NO	✓ N/A
4) Concrete rough surface are washed properly with clean water.	✓ YES	NO	N/A
5) Grouting is used for construction joint.	✓ YES	NO	N/A
6) Electrical pipes are in proper place.	YES	NO	✓ N/A
7) Rain protection arrangement is considered	✓ YES	NO	N/A
8) Clear cover are monitored before placing of concrete.	✓ YES	NO	N/A
9) Casting sequence are decided with engineer in charge.	✓ YES	NO	N/A
10) Chutes, concrete buckets are cleaned and ready for use.	✓ YES	NO	N/A
11) Vibrator nozzle are checked and ready for use.	✓ YES	NO	N/A
12) Vibrating nozzle is placed vertically.	✓ YES	NO	N/A
13) Tower crane for vertical lifting is provided.	YES	NO	✓ N/A
14) Thickness checking device is provided.	YES	✓ NO	N/A
15) Site engineer is presented at the placing point of concrete.	✓ YES	NO	N/A
16) At mixture machine location, specific person for load counting is deputed.	✓ YES	NO	N/A
17) During casting sufficient carpenters /shuttering men are kept for constant watch on prop.	YES	NO	✓ N/A
18) Water is sprayed on surface of shutter.	✓ YES	NO	N/A
19) Concrete is placed within 30 minutes after mixing the water.	✓ YES	NO	N/A
20) Height of free fall concrete is within 3 feet.	✓ YES	NO	N/A
21) Concrete is laid from one end, then continuously proceeded to the other end.	YES	NO	✓ N/A
22) Thickness is checked @ 3'-0" interval over the concrete slab.	YES	NO	✓ N/A
23) Frequent movement of labors over reinforcement is avoided during casting. Use of plain sheet as walk way for carrying concrete at place.	YES	NO	✓ N/A
24) During casting, immediate remedial measure are taken in case props get loosened.	YES	NO	✓ N/A
25) For beam and column, concrete compaction is done properly by vibrator.	✓ YES	NO	N/A
26) Compaction is done within the 15 minutes after the fresh concrete is placed in position.	✓ YES	NO	N/A
27) Vibrating is stopped as soon as laitance of mortar appears on the surface. (excessive vibration segregates the mix.)	✓ YES	NO	N/A
28) Vibrating is executed properly in vertical placement of vibrator.	✓ YES	NO	N/A
29) Vibrating is executed without touching the re-bar.	✓ YES	NO	N/A
30) Proper surface vibration of slab surface with thick & plain wooden plank.	YES	NO	✓ N/A
RETROFITTING			
1) Adhesive chemical's for bonding between old and new concrete is used as per design specification.	[ ] YES	[ ] NO	[ ] N/A

CONTRACTOR

CONSULTANT ENGINEER

2.7.2 Monitoring of New Buildings

In PWD, sub-divisional engineers are responsible for carrying out the construction supervision work for public buildings. The JICA Expert Team (JET) recommended to include monitoring work in case of new building construction, based on the checklist and judgment guidelines. However, as described in the item of the pilot project of 2-10, it could not be applied because of a couple of reasons. They are that there are no stationed supervisors, and the sub-divisional engineers cannot be instructed or guided directly by the counterpart, because there is no practical division in the counterpart of CNCRP.

Basically, new building construction, similar to the seismic retrofitting construction, the construction supervision is fundamentally consisted of compilation of business records, such as daily and weekly reports, the implementation of inspection at the appropriate timing.

In the future, regarding the RMG project (Ready Made Garment Factories Support project), the possibilities of the rebuilding is being studied in the case that seismic repair work is difficult. For the factories considered rebuilding, the construction supervision will be carried out through the trial of the check list for new construction design and new construction. Through such activities, the practical application of checklist associated with the construction supervision will be materialized.

2.7.3 Monitoring of the PWD Works

One of the projects that PWD has implemented is the RMG project (Ready Made Garment Factories Support project). It has implemented safety control, quality control and process management in construction supervision by employing stationed supervisors. In general, the main job of PWD is to perform design and construction of public buildings, however, through the PWD's involvement in RMG project it has been proved that construction supervision is very effective

During the RMG project, the followings qualities are ensured by the check list.

(1) By implementing material testing of reinforcing steel, concrete etc., the material strength of the materials used is ensured at least equivalent performance to design documents.

(2) By checking the number of rebar, angle of bending and anchor length etc. by site supervision, it is confirmed that construction is implementing as designed documents.

(3) Due to the accumulation of day-to-day daily report, identification of wrong doings are easy, and the measures and ways of countermeasure become clear when the issues arise

(4) Since the statement and the promise at the regular meetings are documented, it is easy to cope with process control for compliance for each organization.

(5) By utilization of check sheets for inspection recording and safety control, it enables the traceability when unexpected trouble occurs, also it is effective to identify causes of issues and measures against them.

(6) By confirmation recording of progress volume in monthly report, an effective means can be established through process management and construction supervision comparing plans and achievements.

In addition, through the utilization of construction supervision manual, the following items can be also managed.

(7) Regarding the safety control of the construction site, by conducting regular training for safety control.

(8) Regarding the major consideration issues and the resolution matters, by conducting joint meetings together with owner, PWD, private consultants in charge of supervision and contractors, the fairness can be maintained.

(9) According to the invoice of intermediate payments submitted by construction company, the contents are checked, and the verification of the validity is reported to the owner, and then payment was made.

By accumulating the effective examples that the check list and construction supervision manual are applied to field, it is recommended to apply the checklist of design and construction as well as the construction supervision manual to the all PWD projects.

In particular, stationing on-site supervisors is a necessary support by PWD, although the development of human resources system and budget allocation as well as the management scheme are essential.

2.8 Training and Dissemination

In this project, to disseminate the technology related to design and construction for design and retrofitting of buildings is one of the purposes through such as training. For this purpose, the following activities were carried out; daily communications, seminars/workshops, technical discussions, training courses for local engineers, and other activities related to public relations, disaster prevention education for the community and school.

2.8.1 Seminars/Workshops

In order to disseminate knowledge and experience of the project to staff of PWD as well as other stakeholders, Dissemination seminar, technical discussion and local training course were organized by the project. Dissemination seminars for seismic design and retrofitting of building were organized five times. Participants of seminars were coming from MoHPW, other ministries, universities, media companies, private construction companies and PWD. And, an international seminar was organized to discuss seismic design and retrofitting in the case of other countries such as Turkey, India, Nepal, Indonesia, China and Japan. At the last seminar during 2015, the manuals prepared under CNCRP were presented to public as one of the outcomes. Totally, more than 900 participants joined the seminars, number of participants for each seminar is shown in the following table.

Table 2.8.1 Dissemination seminars for other stakeholders

Date	Title of Seminars	No. of participants
July, 2011	No.1 “First step to seismic design and retrofitting”	123
November, 2011	No.2 “Appropriate technology of retrofitting in Bangladesh”	137
February, 2013	No.3 “Retrofitting for reduction of risk by earthquake ”	124
February, 2014	No.4 “Importance of structural design of building in Bangladesh”	115
September, 2014	International seminar on “Seismic Design, Retrofitting and Good Practices of Building Construction for Safer Cities” (two days)	291
June, 2015	No.5 “Manuals prepared under CNCRP”	115
Total		905

2.8.2 Technical Discussion

Prior to seminars mentioned above, technical discussions were organized to unveil the results of activities and achievement of the project. Engineers and academicians in Bangladesh were invited to know the results of structural tests and trail constructions. Totally, 235 participants joined the technical discussions which included a round table for accident of Rana Plaza, number of participants for each time is shown in the table below.

Table 2.8.2 Technical discussion

Date	Title of Seminars	No. of participants
February 2012	No.1 “Seismic Evaluation, Retrofitting Design and Seismic Design”	15
February 2013	No.2 “Structural Test in 2012, and Retrofit Design ”	65
July 2013	Round Table meeting for collapse of Rana Plaza “Role of expert for cause of accident and construction of safety building”	100
February 2014	No.3 “Structural Test in 2013 and Iso as Seismic Demand Index of Structure”	60
Total		235

2.8.3 Training course for local engineers

Local training courses have been conducted in Training Academy of PWD. Knowledge and experience of seismic design and retrofitting works gained from the project have been thought in the 7-days courses. Participants of the courses were staff of PWD and engineers from other government agencies, universities and private companies. Totally, 134 participants have joined the courses. In the training courses for retrofitting construction and quality control, 53 participants joined from private sector. Number of participants for each training course is shown in Table 3-10. In the courses, members of WT2 and WT3 become trainers to explain their experience and gained knowledge from the project activities.

Table 2.8.3 Training Course for local engineers

Date	Contents of Training	No. of participants
February 2013	No.1 “Seismic evaluation, new building design and retrofitting design for existing RC building”	29
April 2013	No.2 “Seismic evaluation, new building design and retrofitting design for existing RC building”	31
February 2014	No.1 “Techniques of retrofit construction and quality control for R.C. buildings”	30
November 2014	No.2 “Techniques of retrofit construction and quality control for R.C. buildings”	44
Total		134

2.8.4 Public relation

On the other hand, the project implemented several public relation activities. Those are school education programs on disaster prevention, public relation materials, media program, web-site and so on. And, the Project and Department of Fire Service & Civil Defence (FSCD) jointly organized disaster education and evacuation drill in three public apartments. Ministry of Disaster Management & Relief would be responsible for these activities mainly, the project has considered how PWD support the ministry in future. Regarding present condition of Output 5, indicators have been shown in below table.

2.8.5 Local Trainings (Construction Management of the Retrofitting and Quality Control)

In the 3rd year, a new domestic training program for the Construction Management and the Quality Controls was implemented. The contents and the number of trainees etc. were decided on the basis of a series of discussions with C/Ps. Trainers were from WT members, and they introduced their experience to other organizations, while JET members supported the training program as far as possible as advisors. To motivate those who were trained, training certificates were awarded upon completion of the program. Details of the training program and participants are shown in the table below.

Table 2.8.4 Contents of the local training program and participants

Item	Content
Title	Techniques of Retrofit Construction and Quality Control for R.C. Buildings.
Output	Construction management of retrofitting (Output-3),Quality Control（Output-4）
Participant	Engineers / designers of PWD、Engineers of PWD sub-divisions PWD, Other organizations, Private sectors, Designers of University, and the Engineers of the University. Total Approximately 30 persons.

Trainer	Members of WT-3 and WT-4（JET participated as an advisor）
Period	From February 25 to 27 , 2014 (3days) (PM2:30~5:30, 3 hours each） The ceremony was held on the last day, to hand a training certificate to the participants
Contents	i） On 1st and 2nd days, after an explanation of each theme, there were lively discussions among the participants. ii) On 3rd day, at a construction site of PWD, rebar inspection of the pressure plate was done. Implementation of quality management practice was carried out by using a check list.

In the training, the trainees asked many questions to the trainers, i.e. team members of WT3, WT4 and PMG, and they answered the questions accordingly. In the last day, the trainees visited a site of PWD of about 100m square large, where they practiced inspection for the reinforcement at the pressure plate.

At the site, the supervisor explained the progress of the construction site using the construction progress chart. Also, the trainees exercised a bar-arrangement inspection with a checklist prepared by WT4 owed by lively exchange of opinions on safety management.

Question and answer session

Site inspection

Photo 2.8.1　Domestic Training (February, 2014)

2.9 Public Relations

In Bangladesh, vulnerability of buildings is high, and seismic retrofit technology is necessary. However, there were some cases in RMG project that owners mistook seismic retrofit for renovation of buildings. In order to spread the seismic retrofit technology, it was thought that it's necessary to increase society's awareness about seismic retrofit, and some issues related to seismic retrofit of buildings were addressed through DRR education at schools and dissemination activities using media.

2.9.1 DRR activities at schools

Regarding DRR education activities, one public school was chosen to focus the project activities. The school has five vulnerable buildings with a high risk of earthquakes.　The issues relating to DRR

education were recorded aiming at sustainability, a plan for DRR activities that may carried out in schools from now on was prepared, Specific activities are as follows.

(1) Implementation of DRR training for students
(2) Implementation of DRR workshop for parents
(3) Support for activities of "DRR Club"
(4) Evacuation drill
(5) Research on changes in students' awareness of DRR

(1) Implementation of DRR training for students

The detail of implementation schedule with number of participants are as follows:

I. June 2014: 183 students of 8th grade participated in the training (DDR lessons)
II. September 2014: 250 students of 9th grade participated in the training (DRR lessons).
III. June 2015: 750 students of the 1st- 5th grade participated in the training (DDR lessons)

DRR training (I, II) for 8th graders and 9th graders were implemented in 45-minute classes, with 4 classes for each grade. In the classes, basic knowledge about earthquake risks in Bangladesh, such as risks due to buildings' vulnerability when earthquake occurs, or possibility and effects of earthquakes etc. was introduced through pictures, posters, and other teaching materials.

For the 1st graders and 5th graders, classes were conducted as preparation for evacuation drill with the following contents: a) What to do when earthquakes occur, b) What to pay attention to when evacuating – to ask students and provide them chance to think about that, then c) Where to evacuate- to instruct students where their class should go when evacuating.

Photo 2.9.1 At the class before evacuation

(2) Implementation of DRR workshop for parents

In order to encourage parents to take part in DRR activities, a DRR workshop for 100 parents was organized. As a part of the activities, DRR handbooks written in Bengali was distributed to all participants, and encouraged conversations at home about raising awareness of earthquake, fire or heavy rain, and preparation for emergency bags or evacuation places.

The participants were mainly housewives (81%) aged 30s (67%). According to the result of a

survey after the workshop, 83% of the participants answered that they “concern about earthquake risk and measures to take when disasters occur”. 53% answered that they “did not know about earthquake risk” before attending the workshop, 100% answered that “schools should prepare for disasters”. 42% thought that “school buildings’ safety and resistance to earthquake needs to be checked”, while 37% thought that “evacuation drill is necessary”. 100% agreed that “preparation should be made not only in schools but also in families”. Participants also showed eagerness for emergency bag preparation (42%) and check for buildings’ safety and resistance to earthquakes (33%). Responses by the participants were good in general. It can be thought that support in DRR training and DRR activities for parents and local residents like this will create an effective environment for DRR measures of Dhaka city. Before the evacuation drill which was planned to be held in June for all the students, each family was given a homework of preparing emergency bags that parents would bring to the evacuation drill. A plan to create chances for participants to talk about necessity of DRR was also made. Although in fact, the training could not be held in June, parents and local residents’ awareness has increased, which is indispensable for building DRR capacity for the area; therefore, implementation of future DRR activities that involve parents and local residents is highly expected.

Photo 2.9.2 A DRR Workshop with Parents

(3) Support for activities of “DRR Club”

Activities of the DRR Club, as mentioned below, were implemented throughout the year. After members were recruited and the club was founded, activities were implemented periodically through re-entrusting. The activities include newspaper clipping, school map creating, town watching, discussing on rendezvous of the family in disaster time, preparing emergency bags or training by the Fire Service etc. Besides, 60 students participated in the rehearsal of the evacuation drill. These activities will be used as references for future DRR activities at ward level. When information was shared with the Head of ward, he expressed high concern.

The students’ reaction was especially good in town watching, which focused on confirming dangerous places near the school. Many places seemed to be in high disaster risk, such as narrow streets of tottering brick houses, old buildings, small factories for stocking chemicals etc. Students asked residents of the old buildings about safety of the buildings and distributed posters that raised awareness of earthquake among the residents who expressed concern during the town watching. Such

activities by students have made an opportunity for the residents to think about DRR. After town watching, the students created hazard map.

The above activities have become reference for DRR activities at both ward level and school level. If issues in operation such as re-entrusting, budget, a system for continuous activities, human resources etc., can be solved at local level, the activities will be independently and continuously developed, therefore, promotion is necessary. It is hoped that an useful proposal for DRR activities should be created.

Photo 2.9.3 Clipping of newspapers relating to DRR

Photo 2.9.4 Town watch

Photo 2.9.5 School maps that students created

Photo 2.9.6 Firefighting training with the Fire Service

(4) Preparation of evacuation drill

As preparation for evacuation drill, two training sessions in (1) basic DRR and in (2) evacuation drill for the principal and 35 teachers of the school in May 2015 were implemented. In the drill, participants listened about evacuation scenario, evacuating methods and what teachers worried about evacuation, then received advice from Fire Service's staff and determined evacuation routes.

As happened in the Nepal earthquake, some issues were mentioned, for example, when all the students sheltered in the campus as instructed by the principal, some teachers evacuated without instructing students, or students screamed and pushed one another and teachers' instructions could not reach the students…… caused anxiety that accidents may occur in the evacuation drill this time, therefore, in order to carry out the drill smoothly, two training sessions for teachers were done. Moreover, members of DRR Club or, in case of the classes that have no students in DRR Club, class commissioners from higher classes were appointed to be supporters for teachers. After training for teachers, 60 persons including teachers and supporters for teachers implemented a rehearsal for

evacuation drill (in May 2015), and confirmed about task allocation, time allocation, notes for students and parents, etc. for the real training. Based on the scale of the rehearsal, arrangement of lining up students on the schoolyard was changed into a different way from the first plan. The evacuation drill was planned to be held in June 2015. Preparation and personnel arrangement were continued until the day. But due to urgent announcement of a Hartal (a strike) right before it, the training that was planned for all students of the school, their parents and local residents could not be implemented because students could not go to the school. For that reason, a "DRR Guidebook" including evacuation training manual was produced so that the target school can implement an evacuation drill in the future as a substitution. The evacuation drill that could not be held in June is expected to be implemented through in September when CNCRP is ended, and the "DRR Guidebook" is expected to be handed at that time.

In evacuation drill, teachers' will and preparation are very important. After the experience of the Nepal earthquake, it was confirmed based on remarks in the meeting that teachers' awareness has especially increased. After the planned drill in this September, it is hoped that it will be implemented periodically at the school in the future.

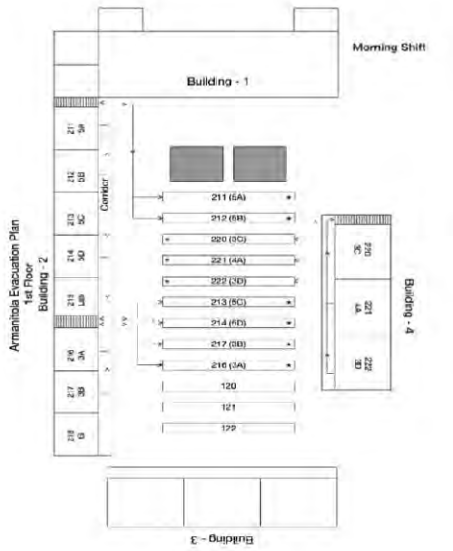


Figure 2.9.1 Evacuation route map for evacuation

Photo 2.9.7 Rehearsal of the evacuation

Photo 2.9.8 Training for teachers

(5) Evacuation Drill in Armanitola

The evacuation drill which could not be implemented within the project duration due to a Hartal, was implemented on September 16th 2015. About 1,100 students from grade 6 to grade 10 participated in the drill. As this was an activity by the school itself, the teachers conducted the evacuation drill by following what they had learned from the training during the project as well as the School DRR Manual/Guidelines created under this project. Moreover, the members of the DRR Club which was supported by CNCRP played leading roles in the drill and also assisted the teachers. After the drill, the teachers and members from the Red Crescent Club also instructed students in rescue and first-aid method.

According to an interview after the drill, the principal mentioned that the open space used during the drill was not large, so it was extremely hard to evacuate more than 1,000 students all at once in a well-disciplined manner. However, as reflection of the experience gained from this time, the Principal decided to put some permanent signs on the schoolyard so that students can gather at their respective areas in a smoother and more disciplined way next time. The evacuation drill motivated the students to a great extent. From the drill, the students learned how to act and provide first aid when an earthquake occurs while the DRR Club members could utilize their learning during the CNCRP.

After the drill, the teachers' awareness was also increased. Especially, the Principal considered conducting evacuation drill as one of her important duties and she has declared to conduct the drill at least three times a year. We hope that periodical implementation of evacuation drill will help in building the teachers and students' capacity to response to earthquakes. It is thought that support in practical DRR education will still be necessary for the wide spread of this kind of activities to many other schools in future.

Photo 2.9.9, Photo 2.9.10 Evacuation Drill at School (left: evacuation, right: first aid)

(6) Research on changes in students' awareness about DRR

Research through surveys on students before and after the activities was conducted. The extractions are as follows.

a) Changes in students' awareness and knowledge of earthquake risk before and after DRR training

In terms of DRR awareness, when asked about "Your awareness level in the past" ("How much did you know about the earthquake in the past?"), the rate of students answering "My awareness

level was low" has increased significantly from 33% to 85%. The result can be taken as evidence that after taking DRR training, students had their proper DRR knowledge increased and therefore they could realize how low their awareness was in the past. To the question about "Your awareness after taking DRR training", 79% of the students answered "Good". Besides, if they have a chance, the hazard that students want to study about the most remained "earthquake" after the training, but the rate of students having concern about earthquake has increased from 21% to 57% as an effect of DRR education through the CNCRP. In big cities like Dhaka, the environment changes year after year, leading to changes in risks of disasters such as earthquake. Hence, the DRR education that is sustainable, not transient, is really in need.

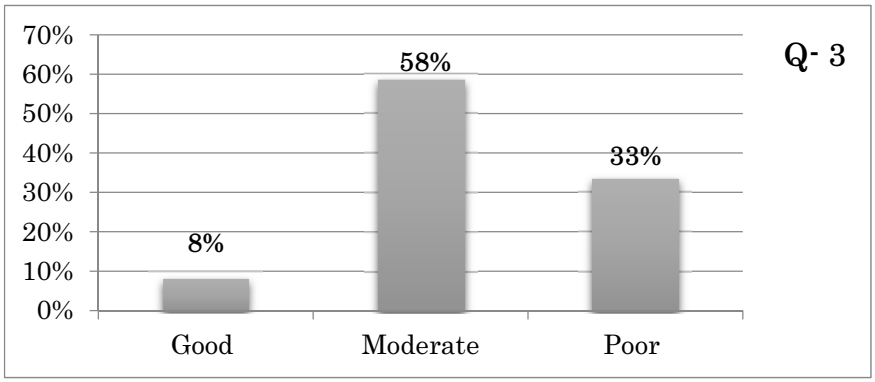


Figure 2.9.2 Result of survey on "Your awareness level in the past" conducted before the DRR training

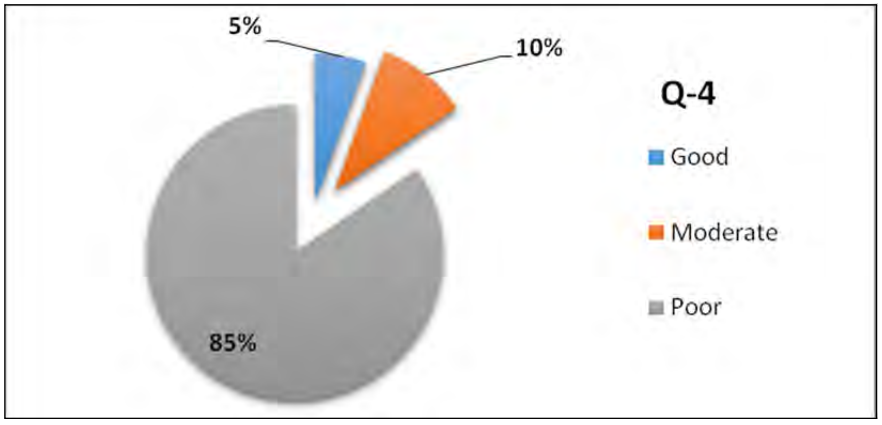


Figure 2.9.3 Result of survey on "Your awareness level in the past" conducted after the DRR training

b) DRR measures in schools

To the question of what DRR measures can be taken at schools, at first, many answers were "preparation of emergency bags" and "confirmation of buildings' safety", but later the order of the answer turned to be "evacuation drill", then "preparation of emergency bags" and "confirmation of buildings' safety". Two reasons can be thought for this result. The first is the occurrence of the Nepal earthquake. When it occurred, tremors could also be felt in Dhaka, everyone evacuated in the schoolyard following the principal's instruction. At that time, the students were all in panic because they had never experienced such tremors; teachers and parents were worried about the

students' safety. By experiencing a real earthquake, they realized that evacuation didn't go smoothly and awareness of DRR measures may have changed since then.

The second reason is that in the DRR training when the first survey was conducted, they learned about tremors of buildings caused by earthquake through video of earthquakes and "Kamibururu", so the number of people choosing the answer "confirmation of buildings' safety" was nearly equal to other answers at first. But through earthquake experience as well as activities throughout the year including, awareness raising posters, measures in families and schools such as hiding under tables or preparing emergency bags were also stimulated, so the answer for those measures were prioritized when the project ended.

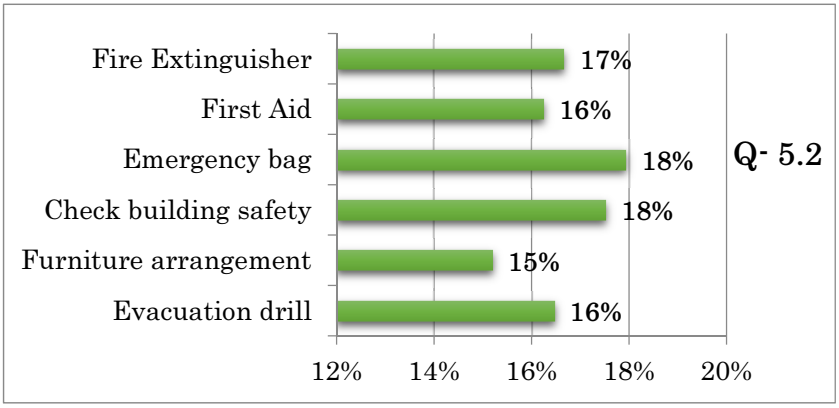


Figure 2.9.4 Result of survey on DRR measures to be undertaken at schools conducted before DRR training

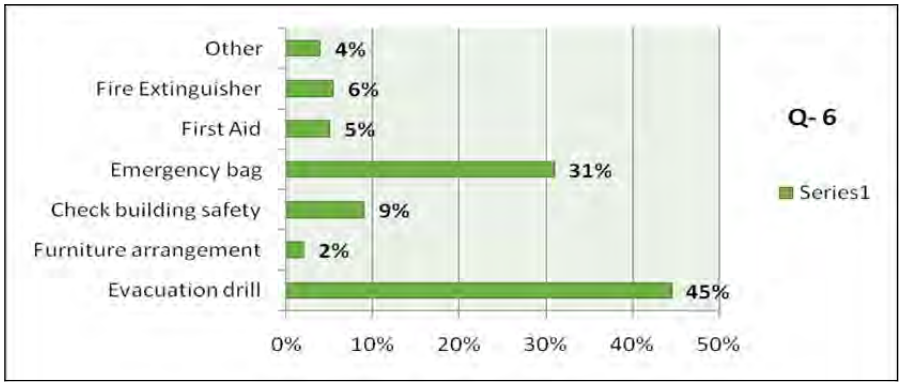


Figure 2.9.5 Result of survey on DRR measures to be undertaken at schools conducted after DRR training

c) DRR measures in families

Moreover, in reply to "what actions families can take?", the answer "preparation of emergency bags" and "confirmation of buildings' safety" remain their order, but their importance has risen from 19% to 36% and from 18% to 21%. Regarding the rising awareness of preparing emergency bags, parents also involved themselves and stimulated the preparation. Regarding confirmation of buildings' safety, it was understood that their concern had risen because comparing their houses with school buildings are easy, and because they considered the strong relation that the houses are of their own.

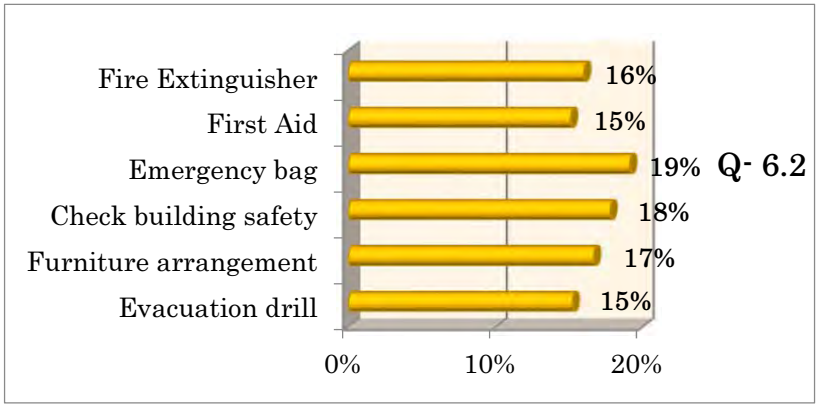


Figure 2.9.6 Result of survey on measures to take in families conducted before DRR training

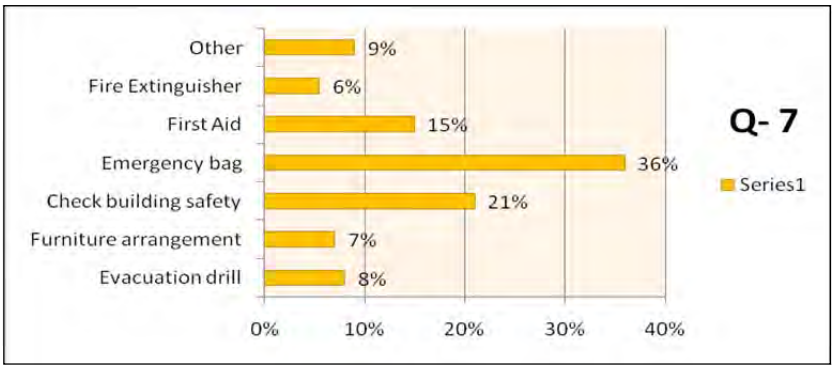


Figure 2.9.7 Result of survey on measures to take in families conducted after DRR training

d) Future DRR activities at schools

To the question that which activity schools should continue in the future, nearly half of the people answered that "evacuation drill should be held every year". Moreover, "Participating in DRR Club" accounted 22% of the answer, and understanding of the importance of periodic activities had deepened. In order to help schools to implement evacuation drill by themselves, "DRR guidebook" was created that features "evacuation training manual". It is hoped that evacuation drill will continue to be implemented in the future.

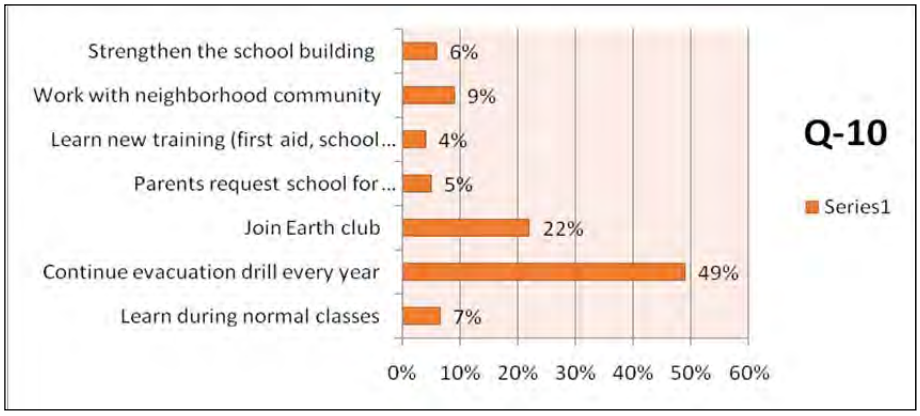


Figure 2.9.8 Result of survey on activities to be implemented at schools in the future

2.9.2 PR through media

Media is a highly effective means to spread the project activities widely. Its cost is often high, but there are some means that have low price yet high effect such as the internet or videos. Through using these means, the PR activities can make good use of media's characteristic which is to convey to general citizens easily, which helps the activities of the PWD and CNCRP to be effectively spread.

(1) PR of the project

Regarding paper medium, promotion to related technical experts, administrators, and general citizens through posters and pamphlets was implemented by creating and distributing a) Project PR leaflets, b) DRR handbook2 version (earthquake and fire) and c) Posters to raise awareness about earthquakes.

Regarding internet medium, PR documents or press releases used for JICA Bangladesh's Facebook page were shared to online media.

Moreover, PR activities for the project in Bangladesh was extensively implemented through newspaper articles such as 4 editorials, and through media publicity in 6 events in the fourth year of the project (a) Article on the first retrofit work in the country, b) International seminar, c) Film festival, d) Technical workshop, e) Article on workshop following the completion of the Manuals, f) Interview on retrofit work of the first RMG factory). Besides, project activities were broadcasted twice on TV news (once on Bangladesh National Television and once on private television "Mohona"). In addition to that, in March 2015, the project was introduced and publicized in a media event by NHK about the Third World Conference of Disaster Risk Reduction held in Sendai city, Japan (broadcasted on the next day).

Regarding PR through counterpart's homepage, each time the homepage was reloaded, CNCRP and its logo was introduced at the Top Page so that CNCRP page could be viewed immediately. Besides, the counterpart also attempted to make it easy for homepage viewers to learn about the project as well as safe construction. Unfortunately, the number of views was not high. Regarding the manual that was completed at the end of the project, it's important to share it widely among related parties, thus, it is hoped that it will be uploaded to the homepage, and information of CNCRP implementation in future will periodically be updated as well.

(2) Short film competition

A Short film competition was held from September to November 2014. It was promoted mainly among film production companies of Dhaka city. As the result, 20 candidate films were received. Based on judgement by the judges, 3 films were selected for Best Film Awards out of 10 excellent films. In November, the Central Library was rented to hold an award ceremony and projection, which was attended by 300 people. "This was such a good attempt because it offered young people an opportunity who don't have much experience involving earthquakes. "This event would be the first step for DRR preparation of general citizens", Chief Representative of JICA Dhaka office commented when he attended the projection.

The competition was held as an effective means to raise DRR awareness among the citizens. Citizens' awareness is the most important thing and it can be made more effective through

observance of construction standards, which in turn will play an important role to reinforce buildings in Bangladesh. a) It was fresh because it was the first attempt/ trial, b) It brought about incentive to producers, and raised DRR awareness, c) Organizers can find out feasibility of various activities. d) Through watching, the audience felt familiarity and had DRR awareness embedded in minds, e) Films can still be utilized in the future for disseminating DRR. With this event, JICA Bangladesh introduced "JICA Public Relations Grand Prix", too.

Regarding public relations (PR) through media, appearance of the event on TV: 4 times, newspapers: 25 times, radio: once, others: 26 times of exposures. Through social media and 6 local short film committees, information of the event and the most excellent works have been viewed and joined indirectly by 18,000 people.

This attempt was an effective means for raising DRR awareness in Bangladesh. Through this, information transmission through social media could be confirmed. Moreover, a way out to disseminate DRR to general citizens using entertainment factor was achieved.

In the future, it is expected that efforts will be made in making excellent films and circulating through social media and film previews so that more and more citizens will see them. Social media allows dissemination without fees, and viewers can easily make secondary dissemination through sharing, so it is expected that information will be shared through JICA Bangladesh Office's Facebook page.

(3) TV commercial for awareness raising

Regarding making of TV commercial, it was an idea to see how media in Bangladesh would convey the message of DRR to general citizens. Three production companies were contacted and after explaining background and message, request for draft proposals was made. Two companies submitted their proposals. The first company could not make a good impression, they used a lot of animations, which was unable to make a powerful expression to the target class of over 30 year-old child raising generation. In addition. The cost for this proposal was also high, thus it was rejected. The other company had work experience in collaboration with UN agencies and other international aid organizations. Their draft proposal was a simple one with actors, using script. It was thought that the story would easily attract the sympathy of the viewers. Moreover, the cost was within planned budget. Therefore, the second company was selected for the job.

When making scenario for TV commercial, basic few techniques were used so that a strong impression to the viewers can be made, such as use of a child actor, emphasis on emotional expressions, and also referring to images collected in the Short Film Competition because these images reflect the way people in Bangladesh think about risk of earthquakes. During making the commercial, many comments along with sincere cooperation were received from CNCRP counterparts, which can be considered as one of the achievements of the 4-year project. Since the commercial was only 60 seconds long, there were certain limitations in delivering messages. Thanks to many discussions held among the related parties including JICA Bangladesh office to determine the message to be conveyed, the commercial achieved a high level of accomplishment.

The commercial was shot in two days. The first day was in studio, while the other day was at an earthquake-proof reinforced construction sample site located in the Public Works Department

(PWD)'s premises, and also at a pilot retrofit construction site of Tejgaon Fire Service station. Besides, narration and soundtrack were added in another day.

The commercial was broadcasted in July 2015 on 3 news channels in their golden time. Those channels were: a) Ekattor News, b) Shomoy TV, and c) ATN News. It was broadcasted during Ramadan, the broadcasting time was decided based on the activities of general families in Ramadan, which means on Friday: Families' gathering time after Jumma Prayer, on Saturday: after Iftar (break fasting) and before Tarabi Prayer- special prayer during Ramadan.

Data of TV commercial's content were shared with related parties, and there were some positive comments that they would use it in future workshops or presentations. If there is enough budget, the broadcasting frequency can be increased and introduce it to future project's homepage, and JICA Bangladesh Office's Facebook page to make more chances for people to access it. In particular, it is hoped that uploading on Facebook will be implemented soon because it is free and less time consuming, and the comments on it can be seen as well. If similar TV commercials are to be made in the future, hearing from target viewers will be included before the completion of the commercial in order to make it a video based on ideas of the target viewers.

(4) PR achievement and future issues:

The current technical cooperation project targets only a part of public buildings (for example, schools are not a target), and a part of garment factories, so the project's achievement as well as awareness of its necessity are very limited.

In Japan, people are familiar with seismic retrofit, because there are a lot of earthquakes in Japan and each time an earthquake occurs, people know the effect of seismic retrofit through media, for example in the Hanshin-Awaji Great Earthquake. Among them, the effect of seismic retrofit of school buildings are conveyed from students to their parents. Especially, if seismic retrofit building are something familiar to children, it will become familiar to their parents and the local area, too.

Meanwhile, in actual condition of schools, when schools were targeted in the third year of the project, the knowledge about earthquakes and buildings was confirmed, it was learned that the knowledge was poor, and deeply felt the necessity of immediate DRR activities, therefore DRR education was implemented as well as PR activities. In fact, in an earthquake in Kathmandu, although the tremor was very little, there are cases that the teachers were the ones who ran first. In addition, there are cases that the teachers' direction was difficult to understand due to students' shouting.

In fact, if evacuation drill is well planned and practiced, it will be successfully implemented. Considering that result and regarding schools' disaster reduction, in addition to hard measure which is seismic retrofit of buildings, DRR education with a planned system which includes evacuation drill is also necessary. In fact, the students' parents also mentioned about necessity of "evacuation drill" and "preparation of emergency bags" besides "confirmation of buildings' safety".

The following are the issues in schools' disaster reduction in Bangladesh:

a) Creating schools' inventories and screening.

b) Check for the safety of the school buildings.

c) Proposal and implementation of seismic retrofit of school buildings.

d) Implementation of DRR education for teachers.

e) Implementation of DRR education in each school.

Issues mentioned in a) to c) it is prerequisite that the Ministry of Education and Ministry of Rural Development take initiative and prepare the budget. Although it takes time, but soft measures like DRR education has prompt effects, so it is hoped that related agencies such as Ministry of Disaster Management will soon implement DRR education for students considering disasters such as earthquakes, fires and floods.

It is difficult to confirm the achievement of media activities, but with the fact that 20 works were submitted in the Short Film Competition, it was thought that people are getting to know more about DRR. The fact that project activities like seminars were published at least in 5 newspapers was a big improvement compared to the activities before the second year of the project.

Moreover, the TV commercial was a hard trial because it was not about products, but about a project, so the promotion target was ambiguous. However, promotion of necessity of seismic retrofit was in its content, so it is believed that it had its own effect.

The above PR activities will be forgotten if they are not continued. Therefore, the following recommendations are made.

i) PWD or the technical cooperation project team should secure a budget for PR and use media in PR activities in the future.

ii) There are many technical matters in seismic retrofit technology, so it is hard to create such explanation that is easy to understand about the technology. Therefore, considerations should be given on how to use media not only for seminars or events, but also for serial technology introduction in newspapers.

iii) Effort put in visual means such as TV commercials or videos should be continued.

2.9.3 LEGAL ASPECTS FOR BUILDINGS IN BANGLADESH

(1) Relevant Regulations

The major regulations related to building construction in Bangladesh are shown in the following table.

Year of Enacting	Most Recent renewal	Name (Act, Code, Rule)
1952	2006	Building Construction Act (BCA)
1993	2006	Bangladesh National Building Code (BNBC)
1953	2006	Building Construction Rules (BCR)
1996	2008	Dhaka Metropolitan Building Construction Rules (Dhaka BCR: GAZETTE)

Since BCA describes the rules for conduction the BCA, such as BNBC, then BNBC and the rules are under BCA. The contents of the rules are similar to BNBC and more practical. Thus, BCA is the law with punishment, and BNBC is regulation (code) without punishment and the rules are practical enforcement issues with punishment. The Dhaka BCR (GAZETTE) has some collective provisions such as floor-area ratio, building coverage rate, building height etc. Therefore these Bangladesh building construction relating regulations are totally similar to Japanese system of the combination

among “The Building Standard Law, the Building Standards Law Enforcement Order, and the Building Standards Law Enforcement Regulations.

(2) The New BNBC

According to the HBRI editing and publishing authority of the new BNBC, it was expected to be approved by the Ministry of Housing and Public Works in December 2014. However, in November 2014, the Steering Committee composed of representatives from related organizations, was reviewing the draft.

The new BNBC could not be confirmed so far, the experimentally print-out version was confirmed in HBRI. It is the proposal version in late September 2014. It was consisted of 3 parts in A4 size (Volume 1: Part 1-5, Volume 2: Part 6, Volume 3: Part 7-10). Simply compared to 1993/2006 editions, it becomes three times volume.

The following table shows the key points to be revised in the new BNBC. The shaded portions indicate that either portions added in the new BNBC, or portions added particularly notable provision in the chapter although almost the same configuration as the old version BNBC. It is confirmed that totally 27 chapters (shown in Table 2.3.3) are added or added notable provisions thorough Part 1 to Part 10.

The major changed portions from above table are described as below

a) Setting Bangladesh Regulatory Authority (BRA)

BRA is a special committee, which is and Public Works involving BNBC and the related national level policy formulation. BRA is composed of the engineers with more than 30 years’ experience, architects, lawyers, social workers, and urban planning experts.

So far Authorized Officer (AO), who is the chief executive involved in the building permit, had been the same for private buildings. However, by the new BNBC introduction, BRA will be installed as the top institution of AO. The system that BRA will monitor AO will be in place. This has been seeking a stricter building permit system. In addition, AO has the responsibility for the examination of the legal adequacy of architectural drawings, and BRA is not involved in directly drawing review.

The provisions is also included that BRA has the right to advice for measures of penalties to designers and contractors, if it has been confirmed that the design and construction of the building has not been compliance to Building Construction Act (BCA) and BNBC. On the contrary, the penalties for designers of illegal buildings are not defined in BNBC. The penalties are specified in Article 12 of the Building Construction Act (BCA).

b) Increase of Number of Seismic Zone

In the new BNBC, the number of seismic zone is increased to four from three in Part 6-Chapter 2 “Loads on buildings and structures”. The current BNBC has defined three seismic zones in 1993, when seismic coefficients were not studied on the basis of sufficient data. The new BNBC defines 4 seismic zones and seismic coefficients based on well study.

c) Addition of Provision on “Maintenance Management, Repairs, Retrofitting and Strengthening of Buildings”

The new BNBC will add the chapter regarding to "Maintenance Management, Repairs, Retrofitting and Strengthening of Buildings" in Part 7. However, even the chapter is added, the provision remains to promote designers such as Architect and Engineer to conduct repair and retrofitting keeping costs rather than new construction in some situations. Provisions do not define the technical approach for repair and retrofitting methods.

In addition, the pilot project, which was carried out under CNCRP by PWD is for seismic retrofitting of the existing fire station. It is the first retrofitting case of the public buildings in Bangladesh.

(3) Building Permission System

a) Building permission system for public buildings by DoA and PWD

Most of all ministries’ public buildings in Bangladesh are basically designed by DOA and PWD. DOA has consultations with clients or ministries on their requirements and prepares architectural design documents. After they have been prepared, PWD prepares structural and building services design documents. In Rules of Business, which is regulated by Cabinet it is stipulated that DOA and PWD do design works for buildings of most ministries.

The exceptions of public buildings for above are the school buildings to be designed by MOE and the hospital buildings that have less than 100 beds to be designed by MOH. Further, the local governments’ buildings are often outsourced to private design offices by LGED. Local governments do design works for their buildings by themselves. Even if they have in-house architects and engineers, they often contract out design works to private design offices. These buildings’ constructions need getting approval from Authorized Officer (AO) unlike the case of the public buildings designed by DOA and PWD. Necessary process of application by building owners to approval of AO is described in the next sections.

b) Design Works by DOA and System of Approval of Architectural Design Documents

The DOA architects have consultations with clients (ministries) to confirm their requirements and then prepare architectural design documents in compliance with BNBC, BCR and other associated regulations. After the architectural design documents have been prepared by the DOA architects, whether they are prepared according to BNBC, BCR, and other associated regulations is examined by DOA’s Chief Architect (CA). If CA approves them, they are regarded as authorized documents.

CA is regarded as “Authorized Officer (AO)”, definition and responsibilities of that are stipulated in Building Construction Act (BCA). BCA (Chapter 2 (a)) stipulates that any design documents are authorized if AO approves them. There is not a legal system in which external organization examines the DOA’s design documents unlike in the case of Japan.

The DoA architects prepare only architectural design documents. Structural design documents are

prepared by the PWD engineers. Although the DOA's architects complete university studies in architecture, they do not complete structural engineering unlike in the case of programs of the architectural course of university in Japan. Therefore, generally, the Bangladesh architects do not have knowledge of structural engineering.

c) Building permission system for private buildings by RAJUK

Speaking as a rule for private building, if constructing a building in Bangladesh, it is necessary to issue a construction application, etc. to the authority. However, they vary by region. For Dhaka city it is RAJUK (Rajdhani Unnayan Kartipakha, Capital Development Authority of Bangladesh under MoHPW), and for Chittagong, Khulna, Rajshahi, Cox Bazar, Development Authority of each City Corporation will manage. In addition, when local governments are concerned LGED will be, and others are District Office of PWD or City Corporation such as Sylhet will manage. It seems to be unknown portions that in some cases it is subdivided by the height and usage of building. Furthermore in practice, there are often cases that the owner can choose authority from possible ones.

In Bangladesh, the parent law relating to the construction of the building is BCA, the Building Construction Act, 1952 (East Bengal Act No. II of 1953). In addition, based on BCA, each authority manages using local BCR (Building Construction Rule, among stakeholders called Bangladesh GAZETTE) as its practical rule. Therefore, the content of them are almost the same as the GAZETTE of RAJUK. In addition, GAZETTEs are in accordance with BNBC as previously described.

GAZETTE is the rule for the owners of buildings and the building contractors, because it is the rules for building construction including private buildings. GAZETTE shows the necessary documents and materials including drawings for the application of construction, and necessary report for the completion of construction.

Management authorities including RAJUK should be the Authorities regulated in GAZETTE. In other words, for all over the country, the almost common rules are distributed, and submission destination authorities for construction application will be the jurisdiction authority. In Dhaka the Authority is RAJUK, for Chittagong CDA (Chittagong Development Authority of Chittagong City Corporation) will be the authority.

Regulations surrounding the building construction works will be primarily BCA and GAZETTE. Though the rules and agencies are defined, many people suggested that the rules prescribed in GAZATTE are not effective actually. In other words, they are not mostly complied. The reason is that the consistency in the rules and customs of the country has problems, in practice, such as it is possible to apply for either even City Corporation even RAJUK, in Dhaka. Also, that the penalties regulations have not been effective has a possibility to inhibit the operation. On the other hand, as described later, both the digitization the procedure of application and the commencement of effective use and enhancement of the human resources have begun. Disaster management can proceed just after tragic disaster is common all over the world is happy but sad.

Moreover, as mentioned later, BCC (Building Construction Committee) will review the

inspection by RAJUK, designated in GAZETTE. And BRA (Bangladesh Building Regulatory Authority) exist as management institutions above RAJUK. Their functions are defined in BNBC, but they have not yet worked at all in practice. In order to achieve the safe buildings in Bangladesh, the owners or the related organizations of the buildings should follow the rules. Therefore, the efforts from both directions of below and above, on improvement of management systems, capacity building of related organizations, and requires mandatory rules compliance.

In the following, because rules are almost the same, taking the Dhaka City as an example, the reality of construction and application around RAJUK will be described.

d) Process of Building Permit

The process of building permit from application by building owner to approval by RAJUK is shown in Figure 2.9.9. These processes are stipulated in Chapter 2 of the GAZETTE (Dhaka BCR). Also, after approval of permit application, GAZETTE defines the task of RAJUK for inspection during construction works, as well as the review after the completion of construction. Further, GAZETTE defined the necessary documents and drawings during the process such as the application, and completion as below.

As mentioned below, around 5,000 to 7,500 applications in a year for RAJUK, that maybe some part (supposed 1/2 to 1/4?) of all the building construction in the designated area of RAJUK. And most of them not always follow strictly the GAZETTE. Especially, for inspection during construction works and following review at the completion, it is said only 5% or less of the application.

Building owners submit necessary documents for application to one of the RAJUK regional office. The necessary documents include application form, soil survey report, building design documents, etc. In addition, they need to pay application fee. The minimum fee is BDT15,000. It depends on floor area of the building applied.

In some cases, building owners need to apply to CAAB (Civil Aviation Authority of Bangladesh), DESA/DESCO (Dhaka Electric Supply Authority / Dhaka Electric Supply Company Ltd.), TITAS (TITAS Gas Transmission and Distribution Company Ltd.), FSCD (Fire Service and Civil Defence Department), WASA (Dhaka Water and Sewage Authority), DOE (Department of Environment), DCC (Dhaka City Corporation), DTCB (Dhaka Transport Coordination Board) and DMP (Dhaka Metropolitan Police) before they apply to RAJUK. It is called “9 types of clearance”, as there are 9 organizations. But, it is on very rare occasion to get approvals from all 9 organizations. Although there is often an occasion to get approval from FSCD, it is on very rare occasion to get approvals from other eight organizations unless the building applied are special in terms of building use and location of construction site. It is not until they get obtained approvals from those organizations that they can apply to RAJUK.

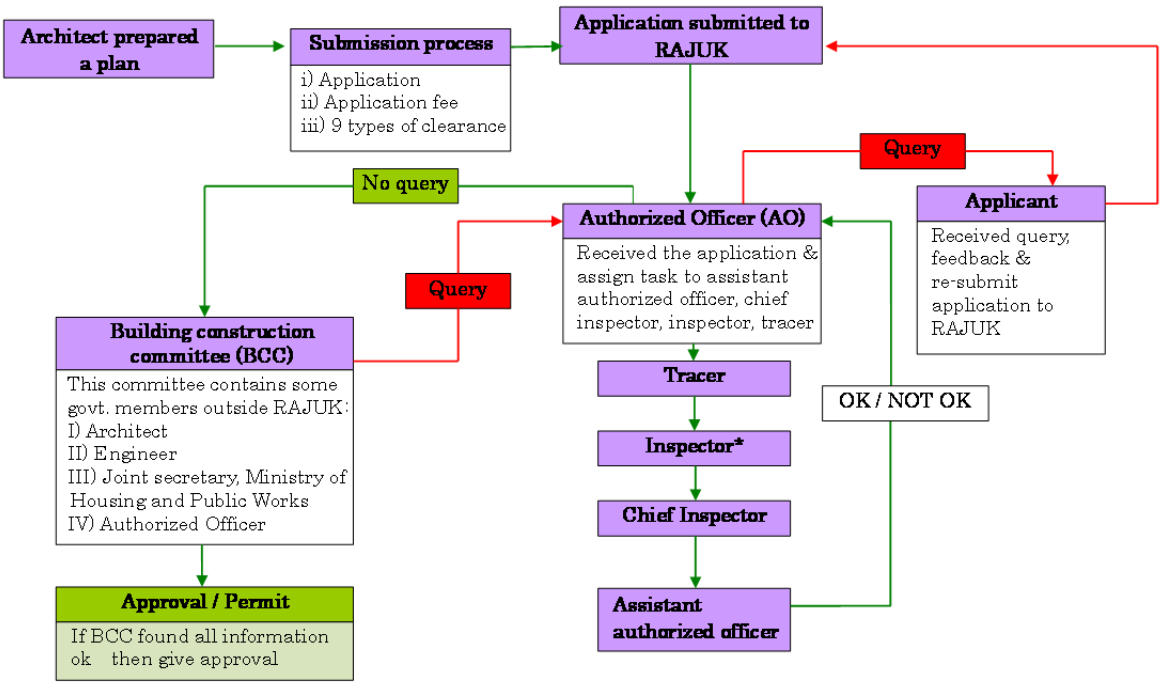
Once building owners submit the necessary documents to one of regional office of RAJUK, they are sent to AO in a regional office. Then, AO gives instruction to tracer to confirm whether the building applied can be constructed in the site applied according to the GAZETTE. Afterward, inspectors visit the site for inspection of the surroundings. Lack of inspectors has also been a

problem, as only 5 inspectors in every regional office (40 inspectors in all regional offices) are stationed and have to do inspections of about 940 buildings in average in a year. Totally, about 5,000 to 7,500 buildings in all regional offices are applied to be inspected.

After the results of survey by inspectors are verified by chief inspector, they are sent to Assistant Authorized Officer (AAO). If they are approved by AAO, following by AO, the works of building permit by RAJUK end. The academic background of AO is architecture or civil engineering. But, in fact, AO cannot adequately examine the design documents applied by building owners, because the number of application is too large.

Finally, the documents applied by building owners are scrutinized by Building Construction Committee (BCC). BCC is a special committee and composed of five members: an external architect, two external engineers and a RAJUK AO. BCC was established in 1999 in order to strengthen the system of examination by RAJUK, when urbanization of the Dhaka area rapidly progressed in 1998 and it had to be necessary to strengthen the system for examining safety of building structure properly.

The term of process from building application to approval has to be no less than 45 days in accordance with BCR. However, in fact, actual term is more than 45 days. In some cases it take more than 6 months



*Inspector investigate 3 time in a construction site i) After submit the plan, ii) During start the construction & iii) After completion the project.
Source: RAJUK

Figure 2.9.9 Process of Building Permit

e) Inspection by Fire Service & Civil Defense (FSCD)

If the buildings exceed 20m in height and they are school, public hall, office, factory, hazardous

buildings exceeding 500sqm, they need to be inspected on ensuring fire safety by FSCD under Section 3.2.3.6 in Part 2 and Part 3 of BNBC. However, if they are designed by DOA and PWD, they are not needed to be inspected. As the PWD's SEs who are an authorizer of building services design documents are regarded as Authorized Officer (AO), all building services design documents approved by the PWD's SEs are regarded as authorized documents.

f) Improvement of regulations for Digital Bangladesh

International Finance Corporation (IFC) of World Bank Group is planning a project "Regulatory Modernization for Digital Bangladesh (# 584327)" targeting RAJUK. In the project, by automating the procedure by IT introduction, the activities will be implemented to improve the efficiency of operations for reception of building applications from the owners. If proceeding as planned and is due to be introduced in February 2015. The automation system introduced by the project, building applicant is possible to transmit electronic data applying documents from the PC screen. Since it becomes rather than traditional paper-based application, the applicant owners are not necessary to visit RAJUK to bring application documents. Moreover, this system enables to save time for the staff concerned in building permit in RAJUK to scrutinize the application documents to a large extent.

In addition, since the information management becomes easy introducing electronic application process, operational efficiency can be realized even for RAJUK staff. In other words, time to re-input process from the description of the paper-based documents submitted by applicants to another document so far will be skipped. Therefore, if it will be carried out as scheduled, not only applicants but also RAJUK staff can reduce the work load, the process can be performed more quickly and accurately, and shortening time involved in licensing will be achieved.

It should be noted, the technical inspection of the confirmation request documents does not done automatically through the introduction of this system. As for the technical inspection, AO, Tracer and Inspector inspect reviewing the application drawings as usual. Even when drawings are electronic, inspection is not automatically carried out by the machine.

2.9.4 Activity for Improvement of Building permit and monitoring system / Building application system / Dissemination and Enlightenment

(1) Outline of Activity

Since RANA Plaza accident, soundness of the buildings in Dhaka has become a social need. C/P of CNCRP is PWD which target is public works. However, Ministry of Housing and Public Works (MoHPW) is in a position to lead the construction works by private sectors as well. RAJUK who controls the system of building construction permit in the capital Dhaka, is also under the umbrella of MoHPW.

Currently, the purpose of building inspection in the capital Dhaka conducted by RAJUK is mainly the confirmation of urban planning.

In reality, the quality and safety of the building are depending on moral and ability of developers

and building supplier side. Not only RANA Plaza building, but many buildings have not undergone inspection properly. In future, if vulnerable buildings will be kept using by citizen without a sense of crisis, the building supplier side continues developing dangerous buildings. In addition, considering the effect as a deterrent to eliminate them, as being part of the publicity and awareness on disaster management, the activities aimed at improvement for the system of construction permit.

In the 3rd fiscal year, the current situation survey on construction permit of RAJUK is performed. And in the 4th fiscal year, based on that, the enlightenment activities for RAJUK is performed for safer building such as recommendations of the feasible Improvement measures.

(2) Enlightenment activity to RAJUK

To clarify the whereabouts of responsibility for building construction based on the Dhaka Metropolitan City Building Rules 2008(hereinafter referred to as "RAJUK GAZETTEE"), some recommendations to RAJUK is performed.

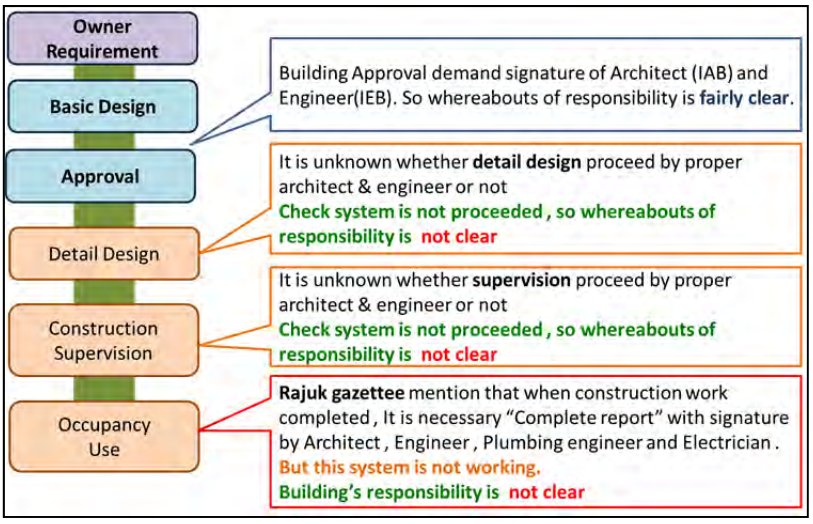


Figure 2.9.10 Process and Issues of Building Permit

In the current flowing system, in case of building permit, both signatures are required from architects registered by IAB (Institute of Architects Bangladesh) and engineers registered by IEB (Institute of Engineers Bangladesh). Also, both people should have the responsibility on the design of the building. These are popular in the Bangladesh society.

In the RAJUK GAZETTEE, at the time of commencement of the construction work, completion of the work of plinth level of building and completion of the work, It is defined that the report of construction with the sign of Applicant, Architect, Structure engineer, and supervisor (hereinafter referred as "the Reports") should be submit to RAJUK. The function of clarification of the whereabouts of responsibility for building construction is included in the Reports. However, it is rarely followed. It is recommended that enforcing the Reports is mostly important to clarify the whereabouts of responsibility for building construction.

Enlightenment to the high officer of RAJUK is performed with the poster named "Where is the responsibility of building construction?" that made in the 3rd year of the project with officer of RAJUK.

Internal workshop of RAJUK had planned and presentation tool is prepared. However, political unrest deprived of the opportunity of Workshop.

Figure 2.9.11 Workshop Poster

(3) Promotion of participation in CNCRP of RAJUK

Thus far, relationship between RAJUK and CNCRP was very rare. However, considering vulnerability of Metropolitan city Dhaka from natural disaster, It should have more relationship between RAJUK and CNCRP.

Promotion as for RAJUK of participation of CNCRP International seminar executed in September 2015 has been performed. It was discussed about building inspection, permission system and whereabouts of responsibility for building construction. The member of RAJUK spoke some opinion actively.

The seminar with PWD, DoA, RAJUK, HBRI and CNCRP became good opportunity to mention vertically-divided administration of MoHPW.

2.9.5 Community Based Disaster Management Activities

In CNCRP, the technology transfer targeting PWD engineers have been implemented. However, the earthquake resistance of the building is a cost and time-consuming activity. Therefore, an activity that seeks to be tried in disaster management activities at Dhaka, such as how to proceed in parallel the hardware software measures. The hardware measures are such as strengthening the earthquake resistance and soundness of buildings, and software measures are such as the improvement of disaster management awareness due to community disaster management activities. In practice, since PWD is handled public buildings, a community disaster management activity was performed targeting the residents official residence of PWD related, assuming they will have a higher interest for the building.

(1) Selection of target areas

Based on the cooperation of PWD engineers as C/P, the three housing colonies, Motijheel colony, Azimpur colony and Elenbari colony were selected. These buildings are official residence, which PWD designed, also carried out construction as well as maintenance. During the selection, these were considered that C/P, though technical engineers, is better also have knowledge of the community based disaster management activities, on the other hand, a higher disaster awareness should be available for the residents. In fact, unfortunately, initially disaster awareness of residents was not different as much as normal citizens.

(2) Implementation procedure

In advance, a plan that summarized the objectives, contents and procedures of community based disaster management activities was prepared, was shared the information among PWD as counterparts and expert team. Activities were carried out twice in November and February in the same colony. First time, the lecture in room or the passive activities were mainly. The second time, even though the items were similar, "thinking", "touching" and "bodying" were the main concept to explore the continuity of activities. Activities done were as follows.

Lecture in room

a) a simple questionnaire survey
b) video watching for earthquake disaster
c) A description of the earthquake disaster
d) practice of "Bururu" of a training and teaching tool

Hands-on training

e) evacuation drills during earthquake and fire in collaboration with the firefighters and volunteers
f) fire extinguishing training and first aid lessons in collaboration with the firefighters and volunteer

(3) Results of the disaster management drill

a) Participants

Initially, around 50 participants were planned. However, in both Elenbari and Motijheel colonies, around 10-20 people were increased at second time. And, it has shown that disaster management activities came to known. In particular, participation of women residents reached as high as 20 percents, and it was remarkable.

b) Improvement of knowledge and experience:

Participants, who experienced evacuation drill and events, were extremely small. Therefore, there were many participants, who got knowledge of earthquakes and its disaster, disaster vulnerable Bangladesh, as well as the behaviour and response at the time of disaster, in the training activities,

c) Awareness raising:

In fact that the participants were increased, it was an indication of the awareness raising of the participants. By the way, from the following questions or comments, awareness of disaster prevention can be seen.

- Further disaster management activities are required. Would like to participate.
- Evacuation spaces are required.
- Need sufficient education and services related to disaster management.
- It is good to know how to behave if an earthquake occurs while night.
- Would like to know whether the government has a plan to retrofit all vulnerable buildings.
- It is better to expand the disaster management activities in other places such as private apartment buildings, factories.

(4) Issues and Lessons

According to the implementation of disaster drills in each colony, several challenges and lessons have been obtained.

a) The second time was not possible to implement in Azimpur colony

Residents of this colony are relatively higher rank government officials. Therefore, since the organizer or coordinator are absent, communication and involvement among the residents are sparse. Therefore, even though individuals or families have interests in disaster management, commonly active participation consciousness to the events such as disaster drills of the entire residents is also sparse.

However, since even higher government officials who should have affected if an earthquake happens, their training is also necessary. From the fact that once participated, it can be easily imagined to participate, if there is guidance from the government or belonging ministry. Sometimes, if there is a leadership of such as Disaster Management Ministry and the Ministry of Interior, it may be possible to increase the effect, such as to participate reluctantly.

b) Importance of utilization of colony management association

After selection of the target building, by implementing a meeting of the leaders of the residents, the purpose and content of CBDM activities were described. In the process, the will of their participation and cooperation was confirmed.

In these colonies, there are associations similar to Japanese house union, which are conducting an adjustment for equipment maintenance and collection of trash. Therefore, the involvements as an adjustment function as well as the base place for the community disaster management activities were expected. Although they became the contact points for disaster management activities

including evacuation drills, it was not a positive for the adjustment capability of drills. Eventually the coordination by Japanese experts, PWD and FSCD were effective. It is also conceivable to adopt the activities of disaster NGOs.

To carry out activities such as disaster management drills continuously in each colony, it is essential to have cooperation and initiative of the colony management association.

c) Efficient contents of training

When the residents will participate disaster management trainings, at the same time, it may cause they spare of their life time. Therefore, even Saturday, there are also residents who have schedule of shopping, etc., there are demands to reduce the duration of training. To continue training activities, it is necessary to review the training contents to focus the contents and to increase effectiveness within a short time.

d) Cooperation by FSCD (Fire Service and Civil Defense) and Urban Volunteer

Based on the cooperation by FSCD such as meeting, planning, description of plan for site visits, the evacuation drills could be implemented. In addition, considering the necessity of cooperation of Urban Volunteers, its involvement was realized the planning stage. In this project, what the cooperation of those organizations was obtained from the planning stage is significant from the point of the cooperation of leaders to support the disaster management activities of the country.

On the other hand, the activities of FSCD and Urban Volunteers are essentially a fee-based (need expenses). FSCD cooperated with almost free of charge in this JICA project, from the spirit of the JICA activities. However, in the case of carrying out training by the hands of residents, even insignificant required expense for the fee, it is necessary to squeeze the funds.

Photo 2.9.11 Disaster Management Drill at Colonies

(5) Toward the community based disaster management in Bangladesh

The community based disaster management activities are primarily that "The disaster management activities by the unit of neighborhood residents to be able to exert the function as mutual assistance". Therefore, considering the current test case (disaster drill), located in each colony, "management association" becomes important. Also, it can be expected to future expansion and development in ingenuity.

The following items are the issues to be solved for “the management association" to implement the community disaster management activities from now.

a) Transfer of authority to management association

As a specific system of Dhaka, there are elders of the organization above the management association. Since the elder have the wisdom and experience, they are the presence to be respected. However, for active contents such as disaster management, the management association should be the main. It is important that the elders are devoting to advice, on the other hand the management association becomes the primary for the activities.

b) Establishment of disaster management club

There is a successful model by the establishment of disaster management club in case of evacuation drills of school. Although due to the scale and characteristics of the colonies, only management association is also conceivable that cannot be sufficient to respond. Therefore, to place a disaster management club, after selection of one person each for about 10-15 households, may increases the effect. Similar to the case of schools, the members of disaster management club conduct activities such as identification of dangerous areas by town-watching, selection of evacuation spaces and storage of emergency food during the disaster management activities, so that they can become a main players.

c) Collection of disaster management club fees

In order to continue the implementation of the disaster management club activities, as well as the invitation of Urban Volunteers for disaster drills and food storage for the time of evacuation during the disaster drills, there needs the activity to collect fees for those.

Currently, management associations normally collect monthly 200-300TAKA is assumed. Since the disaster management club activities costs annually will take up 100,000TAKA. In case of 100 households, a household may afford 1,000TAKA/year increase. Overall, association dues will increase about 50 percent.

In fact, Dhaka fell into panic when the buildings shook due to the Kathmandu earthquake. Considering the example of a school where everybody rushed to the exit, knowledge of earthquake disaster and smooth evacuation activities are the shortcut to disaster mitigation. Therefore above activities are considered to high investment and cost performance ones.

2.10 Pilot project

(1) Background

In CNCRP, seismic retrofit design and actual work were undertaken aiming at the dissemination of seismic retrofit technology. This Pilot project was implemented by a fund allocated by the Government of Bangladesh. Originally seismic assessment of three public buildings was done, of which one building supposed to be selected for pilot project. The buildings are as follows:

(a) Garage building (office building), constructed between 1985~1986,
RC frame structure, 5 storey.

(b) Clinic building (at Secretariat), completed in 1984.
RC frame, 5 storey.

(c) Burnt building A, Dhaka Medical College, construction1999~2003,
RC frame, 6 storey.

(a) **(b)** **(c)**

Photo 2.10.1 Candidate buildings for Pilot project

Seismic retrofit is done after the seismic assessment. The assessment of the above mentioned buildings revealed that retrofitting cost is higher than the budget. Therefore, a smaller size building, two storey Tejgaon fire station was selected for Pilot project. The structure is mixed of RC frame and brick masonry. But brick masonry structure is not included in the scope of work of this project. However, for detail investigations as-built drawings were prepared and as an exceptional case, seismic assessment and retrofit design were performed in the 3rd year. Prior to the actual construction, temporal diversion of cables and piping in the ground floor and layout change of residential area in the 1st floor, consideration of cost reduction, workability study were done. The construction work was started in June 2014, and finally completed in March, 2015.

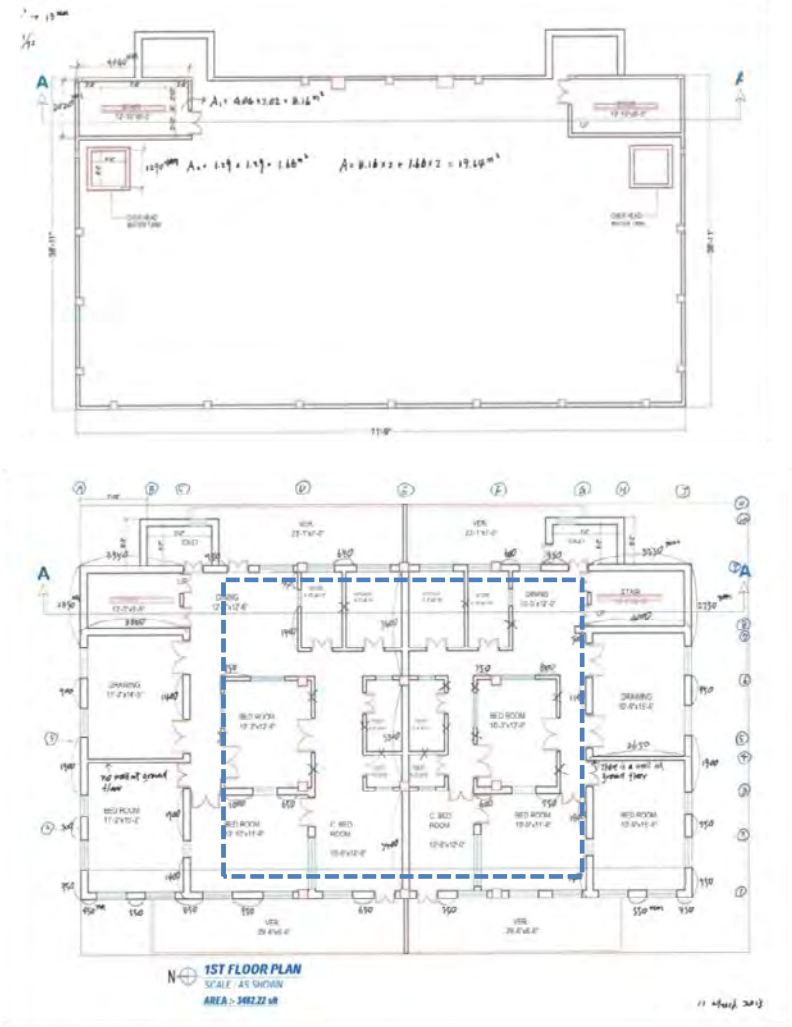
This is the first attempt of seismic retrofitting for any public building in Bangladesh. Wide variety of responses from both in and outside during and after construction have been received. In total, more than 100 people visited the pilot project site.

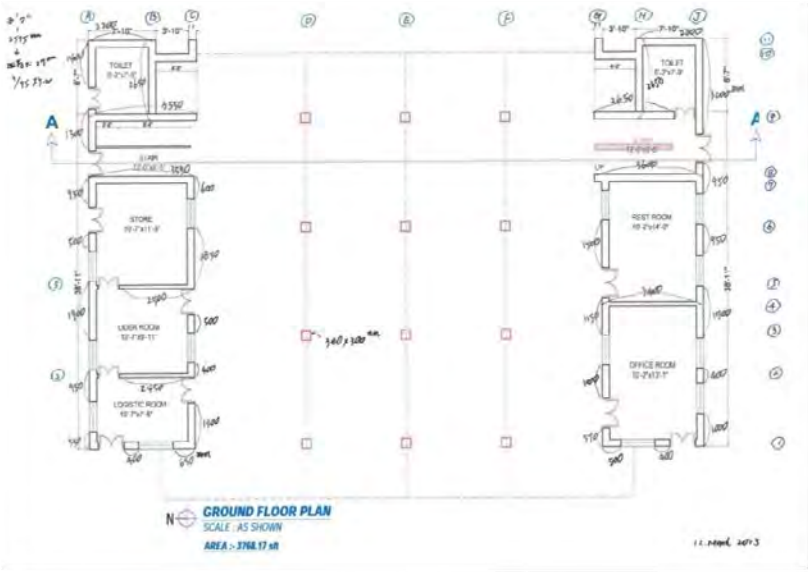
(2) Outline of existing building

External view of existing building is shown in Figure 2.10.1. Plan and elevation drawings are shown in Figure 2.10.1 and Figure 2.10.2 respectively.

a) Facade b) Parking c) Office

Photo 2.10.2 External view of Tejgaon Fire Service and Civil Defense Station





RC frame structure

Figure 2.10.1 Plan drawings (Brick wall thickness, 250mm for perimeter, others 125mm)

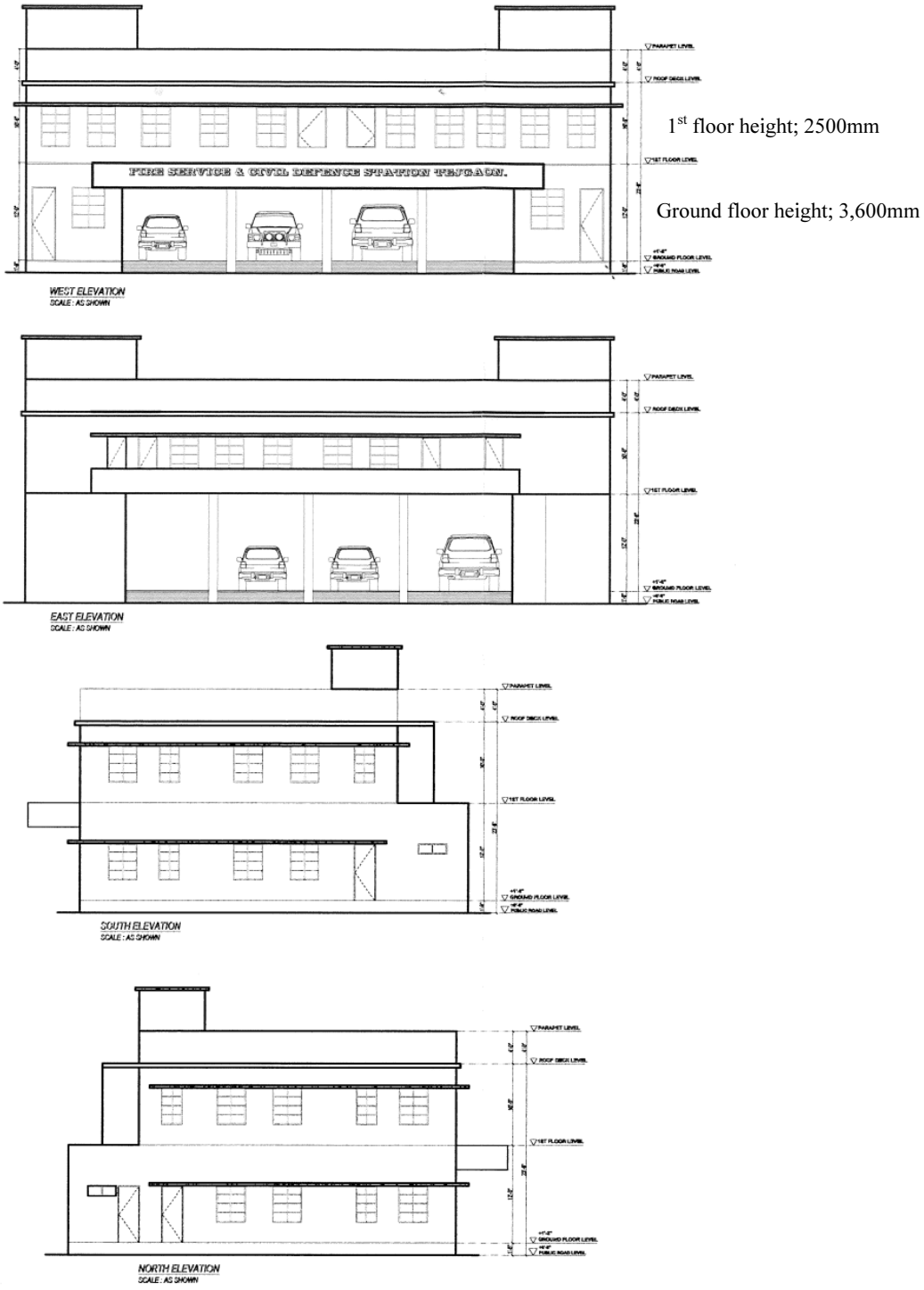


Figure 2.10.2 Elevation drawing (storey height 3,600mm, 2,600mm at 1st storey)

(3) Seismic evaluation

For this, a 2nd level screening was done. Proposed seismic demand index "Iso" was calculated as follows. Importance factor 1.5 was used as recommended in BNBC 2015.

$T = C_t (h_n)^m = 0.0466*(5.5)^{0.9}=0.22$ sec.

In case concrete moment-resisting frames, Ct = 0.0466, m = 0.9, h_n = height of building in meters

Soil type is SC, then; Iso = 0.80*2/3*Z*I*Cs=0.30x1.5=0.45

(Note: Soil type SD, Iso= 0.36x1.5=0.54)

(Note: In case of BNBC93, Iso= 0.32x1.25 (I) =0.40)

The evaluation result is shown in Table 2.10.1. It was found that both floors and both directions were not satisfactory.

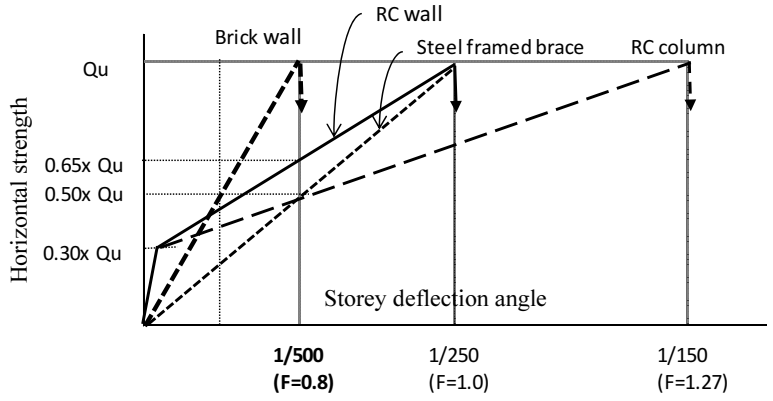
Table 2.10.1 Result of Seismic Evaluation

Story	X direction				Y direction			
	C	E	Is	Iso	C	E	Is	Iso
2	0.71	0.42	0.31	< 0.45	0.89	0.55	0.38	< 0.45
1	0.25	0.23	0.14	< 0.45	0.36	0.29	0.21	< 0.45

(4) Retrofit design

a) Basic concept

1) To prevent shear failure of brick masonry walls, which cause the collapse against vertical load.
2) To increase horizontal strength and to unite the brick masonry area, floor slab and RC frame area, "concrete jacketing" of perimeter walls is provided.
3) Strength oriented retrofitting is used in order to reduce horizontal deflection.
4) Assumed load-deflection characteristics are as follows,



Reference: Japan Building Disaster Prevention Association, "Examples of Seismic Retrofit for Existing RC buildings 2009 (in Japanese)" Supposed curve of steel framed brace is added.

Figure 2.10.3 Supposed load-deflection curve

(5) Strength contribution factor α,

Strength index C is evaluated incorporating the Strength contribution factor**α** of each cases, namely, RC shear wall, steel framed brace and RC column. The values are;

for RC shear wall; α =0.65, for steel framed brace; α =0.50 and for RC column; α =0.50

Assumed Ductility index of brick masonry, **F** (ductility index) = **0.8** (story deflection angle, 1/500).

b) Assessment after the Retrofit

The planned retrofitting works were RC jacketing on column, steel framed brace at center of transverse direction, RC wall jacketing on existing brick wall and RC shear wall for transverse direction. As a result, seismic index of structure "Is" was exceeded "Iso" as shown in Table 2.10.2.

"Is", Is=E*SD*T=0.630x1.0x0.95=0.60 >Iso=0.45 (BNBC2015 soil SC)

Table 2.10.2 Assessment after Retrofit

Story	X direction				Y direction			
	C	E	Is	Iso	C	E	Is	Iso
2	0.97	0.58	0.55	> 0.45	1.05	0.63	0.60	> 0.45
1	0.75	0.60	0.57	> 0.45	1.03	0.83	0.78	> 0.45

Proposed Iso=0.45 (2nd level screening, New BNBC, soil type SC) (Soil type SD, Iso= 0.54)

Retrofit design drawings are shown in Figure 2.10.4.

(6) Summary of Retrofit work

Usage : Fire Station and Civil Defense

Structure : Mixed of RC structure and brick masonry, Two storey

Floor area : ground floor 339m^2, 1st floor 313m^2, total 652m^2 (excluding PF at roof)

Retrofit work : Seismic retrofit (RC jacketing on column, steel framed braced, RC shear wall), renovation of partition, door and sash, toilets at 1st floor.

Construction period : 18 June 2014 ~ 12 March 2015 (9 months), the structural works took 4 months. although original schedule was 3 months.

Construction cost : Approximately Taka 6 million (4.5 million for seismic retrofit, others for renovation work at 1st floor), however, the final cost became Taka 7.2 million.

Cost was increased mainly due to inclusion of RC jacketing on column and a new reinforced brick wall in the 1st storey.

For information, cost for construction of a new similar type of building would be Taka 12 million, excluding rental fees during construction.

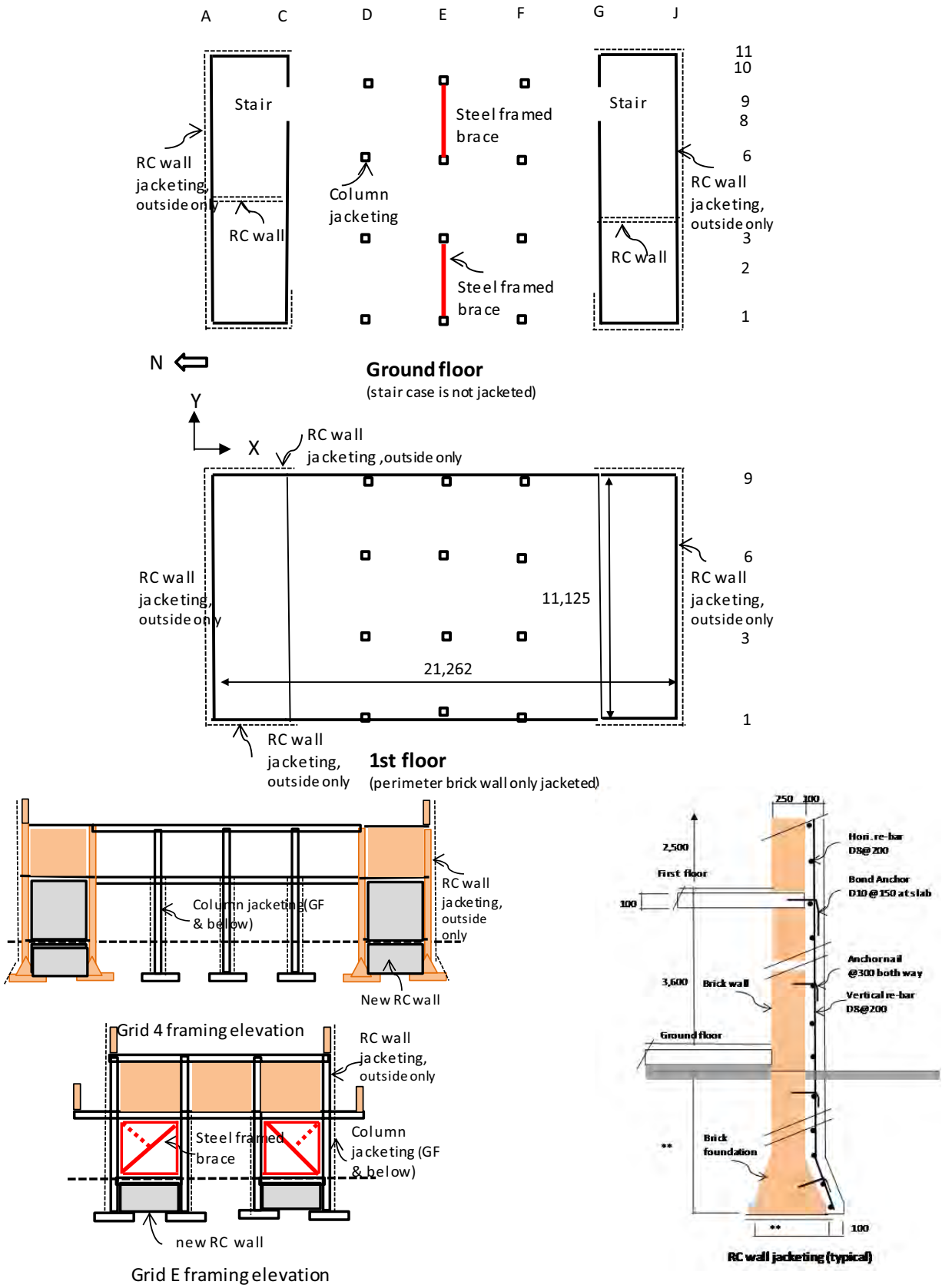


Figure 2.10.4 Seismic retrofit plan

(7) Retrofit construction

Construction sequences of each step are shown in the following photos.

a) RC jacketing on column

1. Chipping of plaster mortar for columns and brick walls
2. Excavation work
3. Chemical (epoxy) anchor work for re-bar
4. Main rebar and tie re-bar work
5. Shuttering work
6. Concreting work
7. Non-shrink mortar pressure grout work at column top

a) Re-bar and concrete work

b) honey-comb on column

c) Non-shrink mortar pressure grout work

Photo 2.10.3 RC jacketing on column

b) Brick wall jacketing work

1. Chipping of plaster mortar for brick walls
2. Excavation work
3. Chemical anchor work for re-bar
4. Wall re-bar work
5. Chemical anchor to existing RC floor slabs
6. Shuttering work
7. Concreting work

a) Wall re-bar work

b) Concrete work

Photo 2.10.4 Brick wall jacketing work

c) Steel framed brace

1. Drilling and chemical anchor work for existing RC members
2. Erection of steel framed brace with headed stud (using chain block)
3. Ladder type re-bar work (to prevent sprit failure of concrete)
4. Pressure grouting of non-shrink mortar work at perimeter of frame

(a) Post installed anchor work (b), (c) Pressure grouting of non-shrink mortar work

Photo 2.10.5 Steel framed brace work

Connection detail of steel framed brace was considered to incorporate welding skill of Bangladesh. Fillet welding was used instead of butt welding as done in case of a factory. Actually width of brace was fabricated bigger than the design, and modification at joints of frame and brace were also made as required considering the site.

d) New RC wall (replaced by new RC wall from exiting brick wall)

1. Demolish of existing brick wall
2. Foundation concrete and wall re-bar work
3. Form work and concrete work
4. Post installed anchor work for 1st floor slab and grout mortar work

(a) Formwork for RC wall

Photo 2.10.6 New RC wall work

e) Completion of Retrofit work

External finishing mortar and coloring was done by DoA.

a) Facade

b) Rear side

c) Side

d) Office

e) Steel framed brace

f) Connection of steel member

Photo 2.10.7 Completion of retrofit work

(8) Construction supervision

Knowledge and experience gained from the test works of retrofit in 1st and 2nd year were applied for actual construction of pilot project.

Trials, such as comparison of design drawings and actual construction, documentation and its maintenance at the site was done by each team member of CNCRP. This was useful for the technical improvement and development of construction supervision manual of retrofit work and quality management guidelines.

Check list and related documents were tested at the site, and the discussion between supervisor and contractor was made regularly. Some improvements were observed in the roles of both parties and application methods.

Items to be modified were investigated such as technical and application aspects, training of site engineers and application system.

The experience gained from this pilot project became useful for the actual retrofit works of other existing building.

(9) Quality management

Quality management was maintained using check list and judgement guidelines for new buildings, since check list and judgement guidelines for retrofit of existing buildings were not prepared at the time of pilot project resulting limitation of items applicable to retrofit. Therefore high level of quality management was not achieved.

On the other hand, involvement of engineers from each team was observed, especially improvement in dissemination activities.

Some proposals related to items for check list and judgement guidelines were received during pilot project. It is believed that these would be useful to prepare the check list and judgement guidelines for quality management of retrofit design and work.

Proper documentation and filing at a site were not a common practice before, but they were done properly in case of this pilot project. This will be the good aspect of improvement of sense of

quality management.

(10) Evaluation

This pilot project was carried out by the own responsibility of PWD, focusing on a series of processes related to seismic retrofitting of buildings from planning, survey, design, construction, construction supervision up to quality management, in the form training and learning.

Through this pilot project, how to do acquisition, dissemination and improvement of knowledge of seismic retrofitting technology have been achieved. However, not all planned works went well. Some trials were to fix the errors and also some failures were there. Some of them were corrected while progressing the works.

Construction period was extended significantly, due to the learning efforts of PWD engineers as well as the additional requests from FSCD. Such failures can be taken as a part of good learning process.

On the other hand, for Bangladesh, since this is the first seismic retrofitting for the public building, the site has attracted a wide range of visitors during and after the construction. As it is facing the main street, it has become one of the billboard. It should be noted that, the visitors from Japan criticized on the quality of transferring the Japanese technology. However, they understood by our explanation that this is a pilot project as an attempt for technology transfer.

2.11 RMG Project

(1) The circumstances of RMG project initiation

The tenant building including garment factory was collapsed in April, 2014. This collapse shocked the society of Bangladesh. Therefore, PWD is going to carry out seismic evaluations and design of retrofitting under the national demand. If the factory owner wishes, PWD is also going to carry out the top supervision regarding the retrofitting construction to keep the construction quality. CNCRP also agreed with purport of PWD project, and CNCRP is going to support RMG project.

Although the retrofitting work is noticed by the JICA, it has a possibility not to know the retrofitting correctly. Therefore, the publicity is going to be carried out to inform the citizens of the purport of JICA technical cooperation or CNCRP. Publicity work about the necessity for the technical assistance about technical projects and the building of JICA (we decided to also implement a school (a student, a teacher, and a guardian), the disaster prevention educational activity in a colony, and construction applications (improvement of process, etc.)

After Rana plaza collapse, Japan International Cooperation Agency (JICA) established the fund to improve the working conditions in the garment factory. JICA was converted for this purpose a one billion taka from the 5 billion Taka funds for Bangladesh refinancing plan passed to Bangladesh bank.

July 12, 2013 , Bangladesh central bank : the (BB Central Bank of Bangladesh), has announced garment factory can receive the low cost loan to improve a safe work environment . The announcement by the BB, the factory of the members of the BKMEA (Bangladesh Knitwear

Manufacturers and Exporters Association) and BGMEA (Bangladesh Garment Manufacturers and Exporters Association) are eligible to get a loan. However the target factories have currently employs from 100 to 2,000 people.

The loans were prepared for the equipment and construction in order to ensure the health and safety of workers. The methods were considered by rebuilding the plant, by changing the place and so on. The reimbursement of the loan is a grace period of 2 years in 15 years. However the financing has a limitation that is the maximum one hundred million TAKA. The financing will be started soon and the finance is going to start by two step loan. Namely the finance is conducted by city banks.

Regarding the RMG project, on 3rd November, the MOU was signed among JICA, BGMEA, BKMEA, MoHPW and Bangladesh Bank. Implementing out during the CNCRP was specified in this MOU.

(2) Progress and achievements of Project

1) Organization

In the retrofit project (it is henceforth considered as a RMG project), The Focal point meeting is held biweekly among the related organizations. The participants are JICA, BB, BGMEA, BKMEA and CNCRP (PWD and JET). The direction of the RMG project is decided in the focal point meeting.

2) The selection process of a retrofit building

a) Submission of application

At first focal point meeting on November, the criteria was decided for application.

- The target building exists in around Dhaka.
- The factory is not rental.
- The building structure is RC frame
- The employee is less than 2000.
- The retrofitting is high priority
- The building has drawing (Approval, architecture and structure)

i) Initial Findings

CNCPR carried out the following issues. Concretely speaking, CNCRP made Initial finding lists with factors, numbering, situation of filling in the application form, the information of other donor application, building name, address, number of employee, stories (present and approval), total floor area, information of building permission (organization, approved year) drawing (architecture, structure and soil report). Several information is written in Bengali. PWD confirmed it. When we could not find the material strength in the application document, we remarked it in comment row.

ii) Scoring

The above score is approved by Technical committee and Focal Point Meeting.

iii) Site visit

Total 20 buildings (10 BGMEA and 10 BKMEA) were selected by the higher scored buildings, And CNCRP visited to meet owner to confirm their willingness. The especially issue to confirm

is the following

- Existence of building
- Building structure
- The owner's demand, whether retrofitting or not

Finally, total 8 buildings (4 BGMEA and 4 BKMEA) are selected after site visiting. These buildings are approved by Technical committee and Focal Point meeting, And the bank clearance was carried out in the target four buildings.

iv) Seismic Evaluation

After Focal Point meeting of 24th Feb, the member of the meeting made three building candidates , "Purple Apparels" and "DK Knit ltd.". In the meeting CNCRP informed to perform seismic evaluation for these buildings. The owner will apply the next stage after considering the results of seismic evaluation. This seismic evaluation needs approximately 2-3 months to complete.

3) Retrofitting work

Regarding the retrofitting designs, the detail designs of "DK Knitwear Ltd." and "Purple Apparels" was done based on the basic designs of each factory. The basic designs of structure, architect, fire protection, electric plan and basic cost estimation was done by not only PWD but also by DOA or by private consultant.

The detail designs were done by the same members with supporting hired private consultant. Especially building structure design was done by PWD based on the skills of CNCRP.

The detail designs of two factories were finalized, however, only "DK Knit wear Ltd" went to next stage "construction stage". "Purple Apparels" could not go to the next stage because the bank could not provide the loan to the company based on the financial evaluation.

4) Selection of contractor

The retrofitting construction of "DK Knitwear Ltd." was done by based on JICA loan. The selection of contractor was done by bidding. The documents that are necessary for bidding, they were prepared by PWD. The target construction companies were passed through the pre-qualification based on PWDs standard. They were short listed in advance.

After bidding, the evaluations of the cost and company profile of the each bidding company and "Joint venture of United Engineering and Value Engineering". The contract between owner and contractor agreed on January.

5) The supervising work

To keep construction quality, RMG project hired the construction supervisors. They did the quality control work, schedule control work and safety control works based on check lists based on the check list of CNCRP. Besides, the supervisors were managed by the CNCRP.

6) The retrofitting construction

The retrofitting to the target of "DK Knitwear Ltd." was commenced in January. The retrofitting works are first experience for the contractors and supervisors, therefore, they could not understand CNCRP way, and the actual work progress delayed comparing the scheduled one. These were resolved by instructions by CNCRP members.

Besides, the work schedule, quality test are monitored by PMC (project Monitoring Committee). PMC composed of CNCRP members, contractor, supervisor and owner. In this committee also

discussed non-tender items or payment issues. PMC did the best to keep work qualities and smooth progress.

The DK is, incidentally, under the Accord group. Accord has own rules and own procedure the receiving the permission regarding the fire protection.

Accord requested several items to owner based on Accord way. Then this project was accepted non tendered items and their requests made the construction delay.

The below photographs show the construction circumstances.

1. Technical discussion

2. Ground Beam reinforce

3. Shear Wall Checking

4. Steel Frame Bracing

The construction of retrofitting construction of "DK Knitwear Ltd. "will be done by the end of December. The check lists that were applied for this construction are shown in Appendix.

2.12 Formulation of roadmap for the PWD retrofitting work

PWD is implementing its work on design (mainly for structures), construction management and maintenance management of public buildings. Although PWD currently aims to design along BNBC, the number of experience of seismic design is not necessarily a lot. Actually for private buildings, as a rule, only PWD is possible to carry out work in special conditions like this RMG project. However, PWD is expected to conduct the model design and construction as well as trainings and manual preparation. With regard to permission of building, basically limited government agencies such as RAJUK etc. under MoHPW and PWD branch are controlling. Many private building are under such management. On the other hand, public buildings are under the control of PWD and DoA.

By the way, in Bangladesh, the Building Act was enacted in 1952, and National Building Code

(BNBC) was established in 1993. BNBC has been enforced from 2008. MoHPW is prescribed the role to disseminate BNBC to all buildings regardless public or private in SOD, therefore MoHPW is expected to tow and to guide the relating activities. However, in practice these have not been almost active.

In Bangladesh, since the accident of Rana Plaza, vulnerability of private buildings has been recognized, on the contrary the buildings that comply with BNBC are known to be very limited as a whole. Such as "Urban Building Safety Project" has been planned to actually reinforce private building, it is expected that the seismic retrofitting works as measures are to be also implemented. In addition, seismic retrofitting is mentioned in BNBC2015 currently in development.

In addition, in connection with the RMG project that is currently being carried out, there are variation in the criteria of inspection of existing building according to among those by ACCORD, ALLIANCE, temporal union of the United States and Europe for garment industry, also International Labor Organization (ILO), or this project of CNCRP. One issue is that DIFE (Department of Inspection for Factories and Establishments) involved with NTC (National Tripartite Committee) has implemented inspections for large number of garment factories with under the level of BNBC, together with ACCORD, ALLIANCE and BUET. They described that the fire prevention and the working environment are to be prioritized basically rather than sufficient consideration on the structure matters, such as seismic design and seismic retrofitting work. ILO has started coordination and efforts of these discrepancies on the retrofitting design and construction currently.

The first shortcut is to follow BNBC, in order to strengthen the buildings and to ensure the standard strength for buildings in Bangladesh. First, all the buildings are strengthened by 50 years, if all new building construction are following BNBC. Although it will be possible to ensure the strength of the buildings above the level of BNBC by retrofitting, considering technical issues, preparation of materials, duration, budgetary issues, and life cycle, only such very limited critical structures are to be retrofitted. For seismic retrofitting work, it is one of the serious issues that each organization of ILO, BUET, ACCORD, and ALLIANCE is considering temporary measures with the criteria below BNBC level.

In BNBC2015 currently under development, the installation of BRA as an organization to monitor the compliance of BNBC (Building Regulatory Authority) has been described. In this situation, currently JICA is planning to install the TRP (Technical Review Panel) in the "Urban Building Safety Project". TRP is located as the BRA until its establishment, and JICA tries to implement the technical management of the JICA ODA loan projects and the World Bank project. Including these, as an organization to manage the safety of the buildings in Bangladesh, both initiative of MoHPW and the active involvement of MoHPW and PWD is desired. In particular in PWD, seismic design, it is desirable to set up a unit dedicated to seismic retrofitting especially, to provide activities such as actual works, trainings and dissemination.

The draft of this TRP is shown below.

Proposal Draft

Technical Review Panel (TRP) for Safer Urban Buildings

2015 August

OYO International Corporation

Contents

1. Introduction

Recent 10 years in Bangladesh, huge accidents inclusive of loss of lives have occurred frequently such as Rana Plaza collapse, Phoenix building collapse and fire incident of Tazreen Faison, because of the high vulnerability of buildings and lack of fire protection measures. Survey under the Project for Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh (CNCRP) reported that there exist a large number of buildings with similar vulnerability level of above mentioned buildings. JICA and other organizations conducted surveys after the Rana Plaza collapse and reported that 60 to 70% of existing buildings are substandard of earthquake-resistance strength required by Bangladesh National Building Code (BNBC). BNBC was drafted in 1993 and revised in 2006. However BNBC was not effective until Pouroshova Law established in 2008. Because of delay in legislating, most buildings do not satisfy the current BNBC. Comprehensive Disaster Management Programme (CDMP) reported (2011) that 320,000 buildings do not satisfy the current BNBC. According to Rajdhani Unnayan Kartripakkha (RAJUK), about 5,000 buildings are built every year. Hence it is assumed that about 90% of existing buildings are built before enforcement of BNBC which means unprecedented unsafe state of buildings. In addition, there are operational deficiencies in licensing, approval and inspection procedures, construction quality control is also not regulated and not been customary. Most of the buildings are highly vulnerable for long-term usage when natural disasters such as earthquake are considered.

In handling unsafe buildings and enacting legislations, Japan have a similar experience and successfully overcame. Therefore introduction of Japanese policy making process would be somewhat effective for development of legal systems in Bangladesh. In fact, JET (Japanese Expert Team) has experience from Ready-Made Garment (RMG) project within CNCRP, which helps to conclude that it is necessary to consider not only technical problems but also illegal deviation such as setback. If there is a difference between approved building design and actual building, the actual building will need large-scale repair.

Ministry of Housing and Public Works (MoHPW) drafted a plan of BNBC in 1993. MoHPW is entrusted responsibilities not only design and construction of public buildings but also standardized

building safety for all buildings. In addition, MoHPW has been involved in building safety enhancement through the JICA's technology transfer project named CNCRP for four years from 2011. Therefore, MoHPW has responsibility to secure the safety of Bangladesh society by increasing the number of buildings which meet BNBC requirement under MoHPW initiative.

Meanwhile, JICA has assisted to establish quality control method through CNCRP as technology transfer to the engineers as main target in Public Works Department (PWD). The other items includes assistance in safety enhancement, support to the RMG sector project with loan program, diagnosis and assessment of buildings, and construction management for new design, retrofit design and construction during the four years project period starting from 2011. In addition, JICA is considering to implement Urban Building Safety Project (UBSP) and extending CNCRP as Building Safety Promotion Project (BSPP) for Disaster Risk Reduction. However, during the last four year time frame, a very limited number of engineers and garment factories could be supported. People need more assistance, and they are needed to be implemented and expanded.

Reasons of large scale building vulnerability in Bangladesh are not only due to delay in legislating and problem within the government but also lack of understanding about BNBC by engineers. There is a possibility that principal factor for low quality buildings is economic (CNCRP). Quality control is hard because of increased burden of necessary construction supervision such as safety management and quality control. It is a fact that actual condition won't be changed unless low awareness about building safety is improved. As an indirect support, publicity and education in a broad sense are also needed. These activities should be undertaken from elementary schools to technical colleges / Universities, citizens, teachers, factory owners, building constructors and its engineers, especially involvement of university professors is very efficient.

Under the above circumstances, even though international aid agencies inclusive of JICA support constructions, these supports may be against the spirit of securing urban safety and increase substandard buildings of BNBC without quality control of design and construction. Therefore, JICA, preceding assistance agency of seismic retrofitting of building and refurbishment of construction, is proposing the establishment of Technical Review Panel (TRP) for controlling the buildings which are supported by JICA and World Bank within the opportunity of Urban Building Safety Project (UBSP) of Yen loan. TRP is established as a tentative step until Bangladesh Building Regulatory Authority (BRA) can operate normally. BRA encourages everyone in Bangladesh so that they abide by BNBC (Attachement1). BRA is written as BBRA in BNCB 2015, which drafted and awaiting for approval by the Government.

2. Aim and Activities of TRP

Aim of TRP establishment is to ensure safety of all buildings (both new and retrofitted) in Bangladesh while maintaining equivalent design and construction standards of BNBC. This aim has to match with the aim of BBRA (Bangladesh Building Regulatory Authority) as proposed in BNBC (Refer [Attachment 2]).

If recent examples of building disasters are considered, the building of Bangladesh collapsed even without any earthquakes, the buildings are not capable to prevent spread of fire in case of a fire event. However, if the affected buildings were built complying BNBC, the disaster could be mitigated or no damages have occurred by the disasters. Therefore TRP is required to review and validate the building's design and construction. In recent years, population is concentrating in Dhaka and Chittagong due to urbanization. There is a high possibility that building disasters will increase in these cities. Therefore, buildings in urban areas, at least, need to meet the requirements of BNBC. For achieving this, 1) existing buildings which are substandard of BNBC shall be retrofitted to satisfy the seismic performance stipulated in BNBC, 2) for new buildings, design and construction shall comply with the standards of BNBC, it is necessary that newly constructed buildings perform according to the standard of BNBC.

BNBC Requirements for Safe Buildings		
Existing buildings	Substandard of BNBC Seismic performance > retrofitting	Safe buildings having seismic performance complying BNCB
New buildings	Design and construct complying BNBC	

In order to fulfill the above requirements, TRP's scope of works are witten below.

TRP's Scope of Works
(1) To prepare policies for promoting and encouraging design and construction of buildings complying BNBC
(2) Implementation of building inspection in accordance with BNBC
(3) Capacity development and promotion of engineers and technicians involve in public and private buildings, and dissemination of awareness and technology for safer buildings

There are several organizations for approval and inspection of buildings: RAJUK, Division Authorities, City Corporations, Municipalities and Building Officials as outpost agencies of PWD. Building approval procedures are very complicated due to overlapping of works of the authorities. Hence, some people can select an organization for getting approval easily, this causes unsafe building construction. Lack of officials for approval as against number of applications causes faulty checking system. As a matter of fact, officials cannot perform both checking of applications and visiting construction sites. Therefore until the establishment of an effective approval procedure among BBRA and above mentioned approval organizations (within a time frame of 10 years), the case could be made that the authorities of those organizations will be shifted to TRP temporarily. There are 12 activities of BBRA as described in BNBC, 2015 are shown below. As scopes of TRP are not included all of BBRA activities, TRP may have to cover BBRA activities.

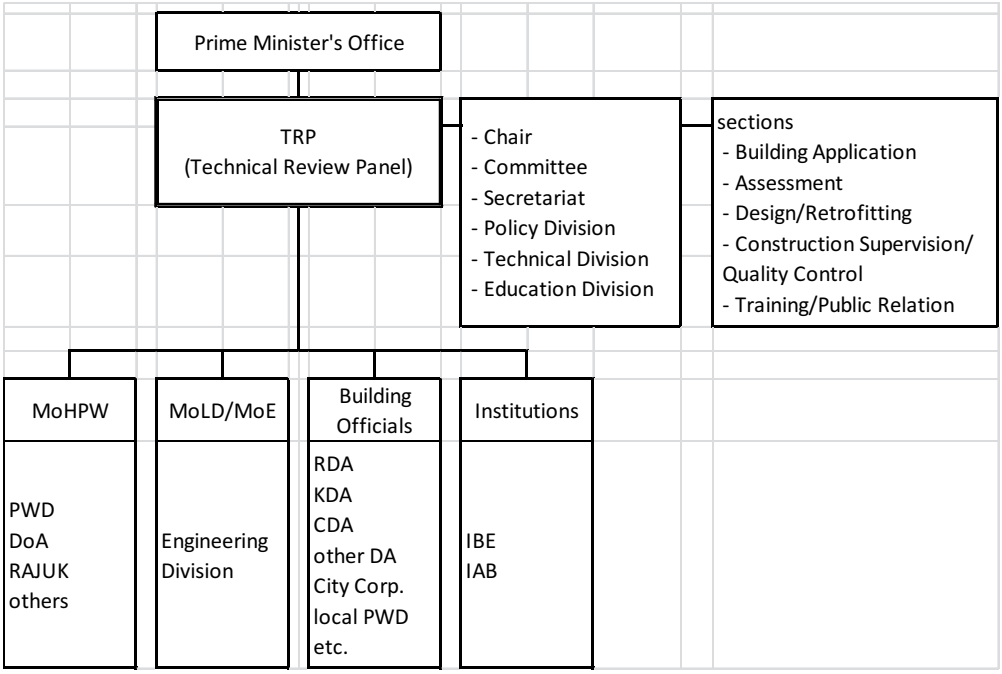
Summary of BBRA activities in BNBC 2015	
a)	To establish regulatory framework for building design and construction with efficient and effective compliance mechanism.
b)	To develop building check and control procedure for ensuring high degree of regulatory

	compliance in planning and the Code requirements and reduce information asymmetry between the end user(building occupant, home owner) and seller (developers, builders)
c)	To streamline and improve transparency through dissemination of information related to build environment including detail land use plan, regulations on safety, water and environmental conservation, health, energy efficiency and urban planning requirements through print and digital media including its website.
d)	To develop an effective licensing system, jointly with the professional bodies by forming a National Council for Licensing of Building Professionals (NCLBP) for conducting examinations for the members of those respective professional bodies.
e)	To update the requirements of building permit and inspection procedure as per Bangladesh National Building Code.
f)	To require the owner of an existing or under construction high risk building, having major impacts on public safety for inhabitants within and near the building, to carry out review of design and construction by registered professionals acceptable to the Authority.
g)	To introduce IT based automated procedure for permits and online information system to enable the applicants to track the progress of the permitting process.
h)	To establish an independent quasi-judicial dispute-resolution body that can make binding decisions in disputes between practitioners, developers, stakeholders and permitting authorities on matters related to interpretation of the Code or sufficiency of compliance, which cannot be appealed except to the Supreme Court on matters of law .
i)	To recommend punitive and other measures against developers and professionals for violation of the Code and safety measures.
j)	To take measures for updating of the Code in light of research, improved building design and construction technique, availability of new products and technology.
k)	To advise the Government on policy and administration of building regulations including capacity development.
l)	To take up matters from time to time which the Authority deems necessary.

3. Organization and Roles

TRP requires to show strong leadership and provide instructions to a lot of relevant agencies even focusing only on field of construction. Therefore, TRP shall be placed under the direct command of the Prime Minister's Office. This has the reference of models of Turkey and Japan. As for Turkey, the Turkish Disaster and Emergency Management Authority (AFAD: Afet ve Acil Durum Yönetimi Başkanlığ) is under the Prime Minister Office as an independent institution and has effective power. In Japan, National Land Agency (NLA) used to manage the disaster issues. It was observed that NLA had parallel position to other ministries and agencies, which hindered NLA to act prudently for the important works of disaster prevention. Then, it was brought under the direct command of PM's office, now instructions of NLA have become more effective where other ministries and agencies act together.

The organization chart of TRP is shown as below.



Organization Chart of TRP

TRP main office is consisted of Chair, Committee, Secretariat, Policy Division, Technical Division, and Education Division. And under Technical Division, there are sections of Building Application, Building Assessment, Design and Retrofitting, Construction Supervision and Quality Control. The Training and Public Relations Sections are put under Education Division. In addition, under TRP, relevant Ministries and Agencies inclusive of private sectors and engineers will be involved.

(1) Chair (TRP Leader)

A person who has a vast experience and trusted by not only TRP members but also all people and Prime Minister's Office.

(2) Committee

Will be consisted of 5 members following BBRA of BNBC, such as Civil Engineer, Architect, Planner, Lawyer and experienced person for civil services in Bangladesh including Chair person. Committee members deliberate and resolve all TRP activities and policies.

(3) Secretariat

1) Personnel

Experts of general affairs and administration

2) Tasks

Administration, logistics and accounting work of TRP

(4) Policy Division

1) Personnel

Vice Minister of Prime Minister Office, MoHPW, Ministry of Home Affairs, and Ministry of Labour and Employment

2) Tasks

a) Improvement of application and inspection system for construction approval by building offices and authorities such as RAJUK
b) Improvement of guidance system for labour environment inclusive of buildings by DIFE (Department of Inspection for Factories and Establishments)
c) Strengthening of fire protection law such as guidance on fire protection design, facility design and inspection for approval and licensing by FSCD (Department of Fire Service and Civil Defence)
d) Planning and implementation of certification/qualification system of professionals including design and construction supervision
e) Consideration for budget etc.

(5) Technical Division

1) Personnel

Experts from PWD, Department of Architect (DoA), Architectural Association and major developers (or representative of construction field), University (BUET: Bangladesh University of Engineering and Technology, UAP: University of Asia Pacific)

2) Tasks

a) Preparing manuals for construction (design and construction supervision of new and retrofitting buildings)
b) Setting of fair price of construction and related works (revision of Rate Schedule)
c) Checking system at the time of inspection and building permission at the time of building approval by building offices such as RAJUK (quality control for new building construction by private)
d) Preparation of a combined check list for the simplified evaluation, the advanced simplified evaluation and labour environment (proposal of technical judgement criteria for the base of instruction guidelines by DIFE)
e) Review of fire protection law
f) Preparation of check list for fire protection design and facility design to be used as the base of instruction guidelines by FSCD

(6) Education Division

1) Personnel

Experts from PWD, DoA, Architectural Association and major developers (or representative of construction field), University (BUET, UAP, etc.)

2) Task

a) Establishment of education/training system considering the levels of engineers
b) Issue certificates to the successful trainees
c) On the job training (OJT) of Implementation of design utilizing the Yen-Loan Project by JICA
d) On the job training (OJT) of Implementation field management using Yen-Loan Project by JICA

4. Role of JICA

In principle, policy matters should be decided by Bangladesh Government. However, JICA will support by dispatching long term experts to the Policy Department for whole duration. They will assist by introducing Japanese examples, providing necessary advice as well as dissemination activities.

About Technical assistance, output of technical cooperation project (with PWD: Phase 1 and Phase 2) such as technical manuals checklists, and guidelines, and disseminating ASE (Advanced Simplified Evaluation) method by Seki (2015) will be used for improvement of building application and inspection processes, and design and construction quality control. In this context UBSP (Urban Building Safety Project) can be used as an actual example.

About education, education program and plans such as curriculum for appropriate levels will be prepared, while using the opportunities of technical cooperation project and yen-loan project of UBSP. In this regard, both assistances namely public (USBP) and project dealing with private buildings will be brought under TRP support. Five teams will be organized under the Technical and Education Divisions of TRP. These teams will be supported by UBSP.

1) Building Application Team

Will accept applications for building safety improvement. Application form must be supported by evidence of building permit, architectural drawings, structural drawing and ground survey report. During implementation of the RMG project, it was revealed that there are many buildings which do not have building permits.

In case applications are not supported by proper documents, TRP strongly advises relevant organizations inclusive of RADUK to introduce re-application system from the view point of building safety

2) Building Assessment Team

Building assessment should be conducted on basis of drawings and site investigations. The buildings should be evaluated into three levels “A: STRUCTURALLY SAFE”, “B: NEED DETAILED STRUCTURAL ASSESSMENT” and “C: NEED IMMEDIATE DETAILED STRUCTURAL ASSESSMENT”

CNCRP (2013) reported that Rana Plaza building was assessed “Level C”. “Level C” buildings are highly vulnerable, In that case, MoHPW would provide guidance to the owner for safety enhancement by retrofitting.

3) Design and Retrofitting team

For buildings assessed with the support of institutions other than the TRP, such as JICA loan, should be supported in reinforcement design or implementation. If building owners select private contractors and carry out seismic design, although not directly, items such as checking of design specifications, and quality control should be performed in cooperation with TRP.

In case of seismic retrofit, design, structure, fire protection and facility design should be included. In addition, TRP recommends, that the construction specifications, tender document guidance etc. are properly prepared so that the applicant can perform the works smoothly.

4） Supervision and Quality Control Team

Quality control during and at the end of works should be conducted. When buildings are checked, ASE method (Seki 2014) developed under CNCRP should be applied since it satisfies BNBC requirements. When the lower quality is a concern, provide guidance for improvement. If the quality is not enough or decreased, TRP advises to improve it. During and after construction, owner has to report to TRP the result and get approval. If necessary, TRP may issue a quality improvement order to the owner.

5) Training and Dissemination team

A certain number of PWD engineers has already acquired the knowledge of building assessment, reinforcement design technology, and know-how of the construction supervision and they should disseminate these to the private sector and also to promote widely the buildings that meet the design criteria of BNBC. Training team, will prepare education curriculum, teaching materials and support the instructors. Those who understand the content of the lessons and meet certain criteria, completion certificates should be awarded to them. In addition, TRP should support the dissemination activities to convey relevant information and educational materials widely.

5. Schedule and Budget

1) Schedule (draft)

Schedule of 10 years plan is shown as below.

(1) Preparatory Period (Hop: 2 years, from 2015 to 2016)

Using the actual conditions of target buildings of private sector such as building vulnerability, construction cost and construction control which were obtained through the CNCRP implemented by JICA and PWD, a detail schedule from 2017 is to be prepared

In addition, as four buildings planned to be retrofitted in this period under CNCRP, on the job trainings on design renovation, retrofitting and new construction for TRP and private sector engineers will be conducted.

(2) Implementation Period (Skip: 5 years, from 2017 to 2021）

Regarding RMG buildings, TRP will perform seismic strengthening design including construction supervision and management.

In addition, within this period, improvement of construction design and construction management capacities of whole of Bangladesh including trainings and dissemination to the private sector will be pursued.

In addition, confirmation of decisions on applicability of the actual attempts in the policy part of the TRP will be made.

(3) Advancement Period (Jump: 3 years from 2022 to 2024)

Within this time frame, trained engineers of private sector will engage in safe building design and construction. TRP will engage in inspection which is its main role, and will prepare for returning their roles of approval and inspection to the original organizations such as RAJUK. In addition, construction rules decided by committee will be made into law by Policy Division.

Schedule of 10 years plan

Year	2015-2016	2017-2021	2022-2024
Period	HOP	STEP	JUMP
	Preparation	Implementation	Advancement
TRP (tentative name)	Establishment	Activity	Delegate some functions to private sector
Number of Trainees (Private Sector)	20	50	30
Number of seismic retrofitting (1)	6	10	6
Number of seismic retrofitting (2)	0	8	20
(1)+(2)	6	18	26
（Attention） (1) TRP is main organization (2) Private sector is main organization		Total	50

In yen loan UBSP, 2014, above (1) would be supported through the entire period, and establishment of the organization will take place. In addition, actual construction will take place for a priority building of above (2). To establish organization written as above (1) can be the place where other donors can join to work together.

Time		2015-2016	2017-2021	2022-2025
Time division		HOP	SKIP	JUMP
		preparation	Implementation/development	Finishing
1)	Long-term Expert (assist policy making)	←	———	→
2)	Institutionalization of CNCRP/BSPP (Technical Cooperation Projects)	←	→	
3)	Assistance to Soft Components of CNCRP/BSPP	←	→	
4)	SME loan	←	→	

5)	Institutionalization of Yen-loan project of UBSP, 2014	
6)	Priority building retrofitting by Yen-loan project of UBSP, 2014	
7)	Activities of TRP	 Transfer to BBRA
8)	Development of Private sectors	
9)	Other Donors	
10)	Additional Assistance from Japanese Government	

Chapter.3 Issues to be addressed, improvements to be made and lessons learnt

3.1 Building Inventory and GIS

The database of 2,756 building inventory for the three cities, Dhaka (2194), Sylhet (252) and Chittagong (523), which PWD maintains, was established. From the database for Dhaka, basic information arrangement of the building management situation by PWD have been conducted, for instance construction age, rates of RC and non RC buildings, vulnerability classification of public buildings etc. these will be used for future planning including the road mapping. On the other hand, issues in data quality and maintenance still remain, the database for Sylhet and Chittagong have been formed fundamentally by both headquarter and subdivision of PWD themselves can be highly welcome.

The issues to be resolved are the following;

1) The qualities of the building database

The building inventory to grasp the current situation is the important tool in order to consider the future plan of building seismic resistance. From this point of view, a fundamental important database was established. However, the qualities of them were poor, for example two types of units that are meter and feet regarding to the total floor area was found. Then, average area was uncertain. If so, the retrofitting cost or rebuilding cost is mis-estimated.

At first, JET instructed the problem of mis-type in and collected the data under JET's instruction. Therefore, it took time to correct data. For future, it is necessary to form the system to revise smoothly and to be able to check fundamentally by PWD side.

2) Maintenance and management

The draft version of the building inventory was prepared. However, it is necessary to develop the procedure and system to maintain such data. For this future maintenance of database should be conducted by PWD and sub-division. It is necessary to establish collaboration between PWD HQ and sub divisions by confirming the necessity using a seminar targeting subdivision engineers.

Though PWD is sometimes questionable to collect subdivision engineers, it is necessary to search the possibility to develop cooperative relationship by collect nearby subdivisions at first.

3.2 Fragility evaluation (seismic evaluation)

The basic survey on the fundamental differences between Japanese and Bangladeshi structures was insufficient. Therefore, in the process of preparing the Seismic Evaluation Manual, the issues in terms of fundamental structure of Bangladeshi buildings and unclear transitions in terms of structure were encountered. As long as the Bangladeshi side does not respond to these issues and establish a

system for dealing with them, it will not be possible to solve them. This is just one step towards the preparation of Seismic Evaluation Manual under this project with the aim to achieve understanding and synthesizing the Bangladeshi design standards and culture rather than bringing the Japanese standards unilaterally.

Issue	Measures that should be implemented to solve the issue
The individual problem points in terms of building structure have been determined to a certain extent. Evaluation methods cannot be easily derived for any single problem. In Japan also evaluation methods have been derived over many years from earthquake damage and structural testing, so evaluation is very difficult.	(1) Carry out actual pull-down experience on existing buildings that contain elements that are particularly significant in terms of evaluation, to determine the deformation properties and collapse process of Bangladeshi buildings, and obtain a standard index (limit state) for collapse of buildings in Bangladesh. (In Japan this index is obtained from actual earthquake damage) (2) Continue to carry out structural experiences in which buildings that contain elements that are particularly significant in Bangladesh are reproduced, and determine the building strength, deformation properties, and collapse process. (3) Efforts should be made to determine the present status of buildings by carrying out site surveys on many existing buildings, including materials tests.
There are problems with the quality of concrete strength and reinforcement strength caused by construction accuracy and quality that increase as the building aging issues.	
For evaluation of existing buildings, it is necessary to provide evaluation standards for the main structural members from which the whole building and the structure are configured. For this, it is necessary to understand and set the background to the seismic performance of the building as a whole and the design methods for the main structural members, as required by BNBC, the current Building Standard Regulation. However, there is insufficient understanding of this background.	In the future, it is also necessary to make efforts to understand the background of overseas standards which BNBC refer to.
There are differences between the building seismic design methods of Japan and Bangladesh (imported from the United States). This issue is likely to be the bottleneck for spreading this method of diagnosis in the future.	It is necessary to clarify the differences between the two standards, and make a case for the advantages of the Japanese method of evaluation. At present, seismic retrofit construction has been completed in the RMG project. It is necessary to use this opportunity to make a case based on the actual performance.

3.3 **Seismic retrofitting design**

Issues	Resolution Policy
Setting of seismic demand index of structure, *Iso*	Setting of seismic demand index of structure "*Iso"* in Bangladesh is required to meet the seismic load of BNBC. Proposed "*Iso"* was estimated through the time history response analysis using the artificial earthquake wave corresponding to the design response spectrum of BNBC 2015. This proposed "*Iso"* was correlated to seismic load equation of BNBC 2015. Technical discussion has been continued with related researchers and engineers, and conclusion was made.
Countermeasures against out of	Following main items were considered to cover the characteristics in

scope work of Japanese standard and guidelines.	Bangladesh. 1) Low strength concrete (Fc< 13.5N/mm2) is covered up to 9.0N/mm2, by introducing the reduction factor of shear strength of column. 2) Ductility of low strength concrete column with high axial force ratio was estimated through the results of structural experiment 2012 and 2013 by CNCRP. 3) As far as beam column joints, existing literature and an sample calculation of typical members was utilized for the assessment.
Pilot project	Two storied fire station was selected as a pilot project. This building is a mixed structure of RC fame and brick masonry. Brick masonry is out of scope of CNCRP. Literature survey and related documents were utilized to evaluate and retrofit the structure. Feed back to design process was considered for the fabrication and erection of steel framed brace.
Delay of retrofit construction work of RMG factory	Contractors don't understand the contents of retrofit work well at the commencement of the work. It is requested to submit, 1) Bar chart construction schedule, 2) Construction plan at the tender. It is suggested to recommend the result of assessment to the factory owner with respect to both of the tender price and proposed technical documents.

3.4 **Construction Management**

In Bangladesh, construction works are carried out with an initiative of contractors and purposes and contents of construction supervision work is not well-established. Consequently, quality management, safety management and construction progress management are incoherent among construction supervisors to result in inconsistent quality. On top of that, the importance of the supervision work is not well-understood, the fact of which allowed money-short contractors to cut corners in construction. Therefore, it is urgent for the project firstly to raise awareness and improve techniques among construction supervisors.

1) General Supervision Issues

Issues to be addressed	Proposed solution
Quality Management Overall, construction supervisors have raised their professionalism as supervisors in the pilot project. However, there is still room for them to improve their ways for instructing contractors on quality management. **Progress and Construction Plan Management** Construction progress management is not at satisfactory level and the progress tends to get behind the schedule. Therefore, the construction supervisors always need to be aware about any delay and ready to instruct the contractors to catch up with the schedule. **Safety Management** The construction supervisors need to be able to plan temporary works (including dismantling of existing building parts to be retrofitted, and scaffolding) for better safety management.	**Quality Management, Progress Management, Schedule management, and Safety Management** JET found it positive that Bangladeshi C/Ps started keeping journals and inspection results. However, the project must ensure that C/Ps always use such documents in actual projects such as the RMG project. Thus, the project shall further promote the manual to be used in actual construction works.

2) Issues to be addressed in respective retrofitting techniques and proposed solutions

Issues to be addressed	Proposed solution
a) Slits on brick standing wall **b) Concrete jacketing on column** **c) RC wing wall** **d) RC shear wall** **e) Steel braced frame** Main structural material is reinforced concrete and steel is not common. This is true to private buildings. Thus, contractors do not have much experience in handling steel. It is important for them to gain more experience to handle steel. At this moment, procurement of steel is costly. **f) Carbon fiber wrapping** Procurement of material is costly.	(a) to d)) As for handling RC, no problem was observed in commonly used construction method in Bangladesh. (e)) As for seismic retrofitting works with steel materials, it is necessary for Bangladeshi C/Ps to check materials such as steel brace which are fabricated at a factory and carry out an acceptance inspection, in addition to a thorough pre-survey. If a problem is discovered, the C/Ps must demand for corrective measures. (all) At the time of implementation, it is crucial for C/Ps to carry out an inspection at each construction phase. (e), f)) Concerning the costs of steel and carbon fiber materials, with an increase of supply owing to spreading the seismic retrofitting works, it is expected to fall.

<Improvements observed>

For construction supervisors to manage construction, it is absolutely necessary that they coordinate well with the contractor. During the pilot project, supervisors kept journals and inspection records and took good photographs for construction record. All those acts have been rarely performed by Bangladeshi engineers, which indicates a positive change brought by the project.

In the months ahead, for the entire RMG project, that is, from the seismic assessment to the completion of retrofitting works, an appropriate “on the job training” must be provided.

<Lessons learnt >

As lessons learnt from the project, in order to introduce and disseminate a new technique, it is important that Japanese experts fully grasp the architectural context/environment in Bangladesh, and coach their Bangladeshi counterparts as partners rather than trainees. Also, it is crucial for Japanese experts to introduce techniques step by step after confirming that Bangladeshi counterparts are equipped with basic skills.

3.5 Quality Control

Regarding team management aspect, the JET member of WT4 had a team meeting in the 1st year, and suggested to share the works among the team members by defining clearly their works. Through the 2nd to 3rd years, JET has recognized that the works have been shared among the team members and executed by all the team members with cooperation, during preparation of checklist and guidelines targeting on quality control. In the 4th year, however, due to the organizational transfer, it seemed difficult for some members to join CNCRP and only one C/P remained in the project team.

Besides, WT4 has requested the other WTs to cooperate with them during trial running of checklist and guidelines. As the result, attendances from other WTs were observed during the monitoring of pilot project.

Issues and solutions concerning technical aspect have been recognized as shown in the table below.

Issue	Solution
Checklist and Judgment Guidelines To ensure quality control, inspection, corrective action (if needed), documentation including recording and storing during construction are considered to be essential. However, no construction and/or inspection records are stored at present in Bangladesh. Besides, target standard and allowance during the inspection are not defined presently. Further, trial running was performed only once. Therefore, it is difficult to make a conclusion that it was learned by the Bangladeshi engineers how to control the quality well.	Acquisition of the quality control process including inspection, corrective action and documentation shall be prioritized. Accordingly, reduction of the number of items to be checked during construction may be considered.
Monitoring Prepared checklist (MS excel format) for quality control can be used for monitoring database format. However, the number of project for applying quality control system using draft checklist and judgement guideline is very little.	It is necessary to promote the institutionalization of quality control system. RMG project will be the next candidate for example.

3.6 the Importance of Actual Practice Technical Transfer

It is possible to do Japanese retrofitting technology transfer by lecture, discussion, and seminar or

textbook, however, these method is possible under the limited conditions such as C/P has a basic technology or high motivation. Commonly speaking, the practical training is effective way for engineers because the experience to resolve the problems makes self-confidence and makes to be interested in the technology.

In this project, several practical training have done.

1) 1st-2nd year; Practical training; Seismic evaluation and retrofitting design
2) 1st -2nd year; Test Works.
3) 3rd year ; Construction supervision works for Pilot Project.
4) 4th year ; The seismic retrofitting design and supervision works.

The above were very effective for the technology curriculum for PWD. After 3 years, PWD could do retrofitting design for RMG project mainly, although they need small advice by JICA expert team.

The following issue is the actual results.

a) Seismic evaluation of Rana Plaza

PWD did the seismic evaluation for the target of Rana plaza that was collapsed. The report of PWD showed the technical evaluation of Rana Plaza that was collapsed. The report of PWD was applauded because the cause of the collapse was guessed based on the technology.

b) PWD made a presentation in the Kathmandu international symposium.

c) The seismic evaluation of Japanese school will be done by PDW.

Namely, when the technology transfer is planned, teaching knowhow is also important. Then CNCPR tried to do practical trainings.

The following practical training were added based on the request by

1) Retrofitting for PWD-HQ

It is the fatal issue to develop the retrofitting in Bangladesh, CNCRP are afraid whether design drawings exit. For this context, JET asked PWD to perform the practice of the as-build drawing of architectural and structural ones. In the 2nd year, PWD carried out the as-build drawing practices with a small scale survey.

As the results, PWD-HQ is relatively low strength building. Therefore, the detail survey and the seismic evaluation became necessary soon, because some concrete-strengths are very low same as the RANA Plaza building case. In this situation, PWD asked JET to support seismic evaluation and the retrofitting design for PWD-HQ building.

JET agreed to suggest PWD on this issue, because it is good opportunity for a practice. PWD made a detail survey plan on August 2013. PWD continues the survey by their own one by one. PWD informed JET they tried to acquire budget to progress.

2) Cost estimation using basic design examples

PWD does not have any experiences about the retrofitting works so far. Therefore, JET is afraid the cost estimation by PWD would be less, because they cannot image the actual retrofitting construction work circumstances. The retrofitting works have their own specific problems, because the target is the existing building. For example, in generally, the existing building does not have enough space to operate the large scale construction equipment Therefore, some buildings have a possibility the crane cannot enter the work area. Although, the persons who use the room shall be

shifted during constructing for some time, some rooms cannot be terminated to be used such as operation rooms of hospitals. As mentioned above, the retrofitting has its own specific problems that are not found in the new construction cases.

Considering these problems faced, JET asked PWD to carry out the cost estimation practice using the retrofitting design documents, which were established in the 2nd year. The effect was quite clear, because the cost estimation of the pilot project becomes realistic than that of previous.

3) Effective use for retrofitting

At previous plan, the pilot project was separated to CNCRP. However it is the first and only experience of retrofitting works for PWD. Then CNCRP decided to be concerned in pilot project positively. Concretely speaking, CNCRP uses the pilot project as training for the PWD or subdivision engineers. In this training, the checklists or construction management manual will be applied.

4) Domestic training

The domestic trainings are held for the engineers of PWD, universities, institutes, or private sectors. CNCRP made a rule that Bangladeshi of CNCRP becomes the trainer/lecturer in the domestic training. This rule is clearly effective. The selected C/P members as lecturer have to understand deeply to teach others. Then the lecturers become asking question frequently or starting to develop lecture materials independently. The domestic training is an extremely good opportunity for C/P to develop the technological capacity and raising the motivation. And nowadays, PWD can develop the domestic trainings by itself.

In 4th year, CNCRP would like to step up this domestic training. CNCRP notes that the motivations of trainees are also important to sustain this activity. For example, the certificated engineers of quality control and construction management courses have a priority to be involved in the projects under PWD.

3.7 Public Relations

An issue faced throughout the project was the impact of Hartals on schedule arrangement and travelling restriction on experts. During implementation of the project, arrangements with related parties were extremely difficult due to that reason. Regarding this issue, thanks to the related parties for their cooperation extended to experts at recipient country, most tasks ended without incident. In the case of the evacuation drill at school that could not be performed on scheduled time is expected to be held in September through re-entrusting.

The project's objective was technical cooperation for transferring technologies related to retrofitting and construction of buildings to the PWD's engineers. Therefore, in PR and DRR awareness area, how to get voluntary cooperation smoothly from counterparts in activities whose targets are not the same became a challenge. The reason was that dissemination of DRR was originally managed by Department of Disaster Management (DDM), not this project's counterpart. However, when project activities became busy, especially in PR through media or making of CM, cooperation was received from counterparts and JET members, which brought good results to news articles and CM.

What the counterpart (CP) implemented during this project and will implement in future continuously will be widely known and understood by general citizens, and will be the basis for

construction and retrofit of public buildings in the future. At this point, PR becomes very important for CPs. What CPs can do in current condition is development of public relations (PR) through homepage. The homepage is renewed so that it can be viewed more easily and CNCRP's visibility gets higher. However, there are still parts of the project activities that are not reflected sufficiently. Therefore, regarding PR through homepage, it's important for CP members to discuss and decide together task allocation, selection criteria for uploaded contents, information sharing etc. During that process, it's important for CP members, especially managers, to understand the importance of public relations.

Concerning DRR awareness activities at school, CP's involvement was limited. However, the Fire Service and Civil Defense (FSCD) enthusiastically cooperated in holding a fire drill as an activity of DRR Club, and also supported in evacuation training for free. Dissemination of disaster risks and the importance of DRR to general citizens are also indispensable for the final objective that is ensuring buildings' safety through observance of BNBC. Hence, regarding DRR awareness activities, it's appropriate to cooperate with FSCD, DDM and organizations related to local government.

3.8 **RMG Project**

(1) Problems to be resolved

To progress RMG project, CNCRP faced the shortage knowledge of the retrofitting among the owners, BGMEA and BGMEA.

Several owners expect to get a good chance to expand their business, and other owners expect the installations of fire prevention tools under heavy pressure by buyers. They strongly wish the low interest loan by JICA is approved for above purpose.

CNCRP believed that almost of factory owners are afraid the weak building after seeing Rana Plaza accidents. Then, this situation surprised CNCRP. Namely, almost of the owners don't think that their buildings are the similar situation with Rana Plaza.

Besides, as far as CNCRP checked JICA application form, a lot of owners don't understand the contents of MOU such as the differences among "Retrofitting", "Relocation" and "Rebuild".

(2) Efforts

1) The countermeasures in short range

Commencement of the project, owners have to know the vulnerability of their buildings, therefore, the quick assessment of the buildings are expected. In this project, the Seki Method (Seki etc. 2015) was applied for the quick assessment.

To apply Seki method for RMG project, CNCRP requested owners to provide the designs of architectural, structures designs. And Seki method was applied for the BNBC function.

This evaluation result shows the 30% of the factory are high vulnerability, and this fact makes owner understand the necessity to apply the retrofitting.

During quick assessment, the problems are found as the follows;

a) The difference between designs that is applied for authorities and the actual contracted building.

b) The construction failure are found in the existing buildings

The above issues have a possibility the evaluation based on the designs doesn't show the actual situation of the building vulnerability. In other words, if the building has judged as it has BNBC strength by quick assessment based on the designs, the actual build has lower performance because of the construction failure or different shape from the previous designs. Therefore, CNCPR evaluated the building by using site survey result such as estimated concrete strength and the information of deviations of design drawings to evaluate actual building strength.

As considering the results, approximately 60 % of the applied factory has lower than the BNBC performance. These are target of the retrofitting.

2) The countermeasures in long range

As a long-term countermeasure, it is necessary to grub up the requirement over explanation and its technology which the significance of a loan and the building of Bangladesh are vulnerable, also to BGMEA and BKMEA the owner side. Actually, 2/3 or more of an application is a defect on applications, and large misunderstanding.

The soundness of a building can be evaluated if the owner side can understand an application correctly and can arrange the right applications, and the merit is large.

Moreover, about the countermeasure of conflagration, a fire drill and fire extinguisher training were carried out in collaboration with the fire department.

Chapter.4 Degree of Achievement of Project Purpose

4.1 Output 1

Output 1 is The capacity to do inventory, fragility assessment (seismic evaluation) of the existing public buildings is developed."

Table 4.1.1 Indicator and status of achievement of Output 1

Indicator	Status of achievement
1-1: Volume of building inventory data	The inventory data of 2,194 buildings in Dhaka, 252 buildings in Sylhet, and 423 buildings in Chittagong were collected. Although the preparation of the inventory data was completed, the development of the maintenance system was remained as the challenge in future.
1-2: Vulnerability assessment (Seismic evaluation) manual is prepared	Seismic Evaluation Manual was completed under the guidance of Japanese experts and the contribution of PWD. The Manual is approved by the Ministry of Housing and Public Works. Also, it is included in one of the seismic assessment methods of ILO. These ripple effects will be assumed to be large. On the other hand, initially, the Manual was prepared on the basis of the seismic evaluation techniques of Japan. However, buildings in Japan and in Bangladesh have structural differences. The Japanese method has been changed for Bangladeshi conditions to make it easy to use. Then, a copyright problem occurred. Currently it is a bit difficult to use by the local engineers. In future, to make it more user friendly, consultation with PWD is necessary so that constraints of the copyright are resolved.
1-3: Roadmap for retrofitting public buildings is prepared.	The experience of the pilot project on a fire station carried out in this project became a seismic retrofitting roadmap for other fire stations. It is an outcome that will link to other loan cooperation projects of Japan. On the other hand, PWD does not have the budget required for new construction and retrofitting. Therefore, even if PWD plans construction project after considering the vulnerability of buildings under its management, it cannot be directly related to get the budget. For this reason, it is necessary to lobby and plan with the relevant ministries to pursue seismic retrofitting construction of mainly symbolic buildings.

1) Building Inventory

Before commencement of this project, no inventory survey was conducted by PWD. Beside no PWD staff could operate GIS technology. Under this project, an inventory survey on public buildings in Dhaka, Sylhet and Chittagong was carried involving WT-1 members. The numbers of buildings on which survey was conducted are 2,194 buildings in Dhaka, 252 buildings in Sylhet and 423 buildings in Chittagong. All buildings are managed by PWD. Results of inventory survey were stored as the database in PWD and reports were compiled for all three cities.

2) Seismic Evaluation (Fragility Evaluation)

It is considered that seismic evaluation technology has made a positive impact into the minds counterparts of PWD, in particular within the members of WT-2.

Initially PWD had no experience of seismic evaluation. However, it is considered that as a result of this project, they are now able to determine the problems in terms of structure of existing buildings that have been constructed long ago, carry out structural evaluation from viewpoints not as Bangladeshi design standards but using their training received in Japanese seismic evaluation methods, which has produced effects such as the range of response to structural problems. On the other hand, apart from WT-2 there has been hardly any permeation of seismic evaluation among the engineers. However, it is expected that these team members will transfer the technology to other engineers and will be recognized as the core members for seismic evaluation in the country. By this way, the technology will spread further. The followings are details of specific training in building survey and seismic evaluation methods achieved through this project.

(1) Methods of carrying out site surveys of existing buildings

(2) Guidelines for preparation of as-built drawings for buildings for which the drawings have not been retained.

Although not scheduled in the initial project, because the retention of as-built drawings in Bangladesh was low, it was necessary to prepare new as-built drawings in order to carry out evaluation. Preparation of as-built drawings requires skill and experience in its own way.

(3) Estimation of the collapse mode of buildings

The design of new buildings is based on elastic design. But in Bangladesh, the design is carried out without determining the collapse mode of the buildings (the ultimate limit state). The basis of Japanese seismic evaluation is the ultimate limit state. Because of this difference, the range in technical capability of carrying out evaluation while considering the collapse mode was broader. On the other hand understanding of their own design standards was improved by comparing the evaluation methods of Bangladesh and Japan.

(4) Dealing with evaluation work (improvements other than to design methods)

Actual retrofit design and retrofit construction were performed in the RMG sector project. Extremely valuable experience was gained in implementing evaluation, the evaluation results, and the policy for retrofit construction, and dealing with the retrofit construction for a private sector client. They also experienced a case where the seismic performance was low and seismic retrofit was necessary, but retrofit had to be abandoned due to various reasons. It is expected that this experience will be valuable when seismic retrofit design and construction for public buildings increases in Bangladesh in the future.

3） Prepared Roadmap of Retrofitting Projects for Public Buildings

(1) Achievement

It can be said that a practical roadmap has been prepared in which the planning of both retrofitting of other fire stations and construction of a new headquarter for fire service department are included and considered as a loan cooperation project by Japan. It is because of planning based on the seismic

retrofitting design technology, construction and cost required at the time of the pilot project implementation under this project.

(2) Challenges

- PWD does not have the sufficient budget required for new construction and retrofitting of public buildings. Therefore, even if PWD plans a seismic retrofitting after reviewing the vulnerability of the buildings under the management of PWD, the understanding and the cooperation of relevant ministries are essential to get the budget for the plan.
- In other words, first PWD prepares a roadmap which will be approved by relevant ministries and agencies. They will obtain the budget and ask PWD to design and construction of new and seismic retrofitting with the budget. This is the practical procedure. The previous plan of the new and seismic retrofitting project of fire stations was realized with the cooperation of the Ministry of Interior.
- Therefore, in the future, PWD needs to consider not only the vulnerability of public buildings, but also the important buildings in each ministry as well as the cost of new and seismic retrofitting construction, in order to apply the technology developed in this technical cooperation project.
- The aseismic roadmap and seismic retrofitting promotion plan can be considered as a necessity to devise, rather than the roadmap considering mainly the vulnerability of buildings. For example, it is an idea for planning to conduct seismic retrofitting mainly the symbolic buildings of other ministries and agencies considering ripple effect is important.

4.2 **Output 2**

Output 2 is “The design methods for new building designing as well as retrofitting the public buildings against natural disasters are improved.”

Table 4.2.1 Indicator and status of achievement of Output 2

Indicator	Status of achievement
2-1: Design manual for new building designing as well as evaluating and retrofitting the public buildings against natural disasters is prepared.	The manuals of new building design and the seismic retrofitting design were completed by the contribution of PWD under the guidance of Japanese experts. In particular, the seismic retrofitting renovation design manual, which has been applied by PWD to actual fields of the pilot project and the support for Ready Made Garment factories project, showed a huge ripple effect.
2-2: Design documents for retrofitting the selected buildings are prepared.	Two buildings of Ready Made Garment factories were assessed and in one of the buildings retrofitting construction work was implemented. In addition, as a pilot project, seismic retrofitting design documents for Tejgaon Fire Station was prepared.

Retrofitting Design / New building design

The indicators of Output-2 related to retrofitting design/ new building design are as follows.

Output 2-1. Design manual for new building designing as well as evaluation and retrofitting the public buildings against natural disasters

Design manual for new building designing and design manual for the retrofitting were completed and satisfied indicators.

Output 2-2. Design documents for retrofitting the selected buildings

The retrofitting designs of three garment factories were performed. Of them retrofitting construction of one building was carried out. Besides, the retrofitting design and construction of the Tejgaon Fire Service Station was also done as a pilot project. Thus indicators were satisfied.

During the preparation of manuals, or during preparation of retrofitting design documents, PWD and JET encountered several problems such as the lower strength concrete. Due to this experience, it can be said the capacity of PWD engineers has been improved.

4.3 **Output 3**

Output 3 is “The capacity to manage retrofitting works of the public buildings is developed.”

Table 4.3.1 Indicator and status of achievement of Output 3

Indicator	Status of achievement
3-1: Construction supervision manual for seismic retrofitting works is prepared.	The construction supervision manual for seismic retrofitting was completed by the contribution of PWD under the guidance of Japanese experts. This manual was used in "The support of design documentation, seismic retrofitting works and relocation works on seismic evaluation and seismic retrofitting for the buildings of Ready Made Garment industry” which is the newly added portions from the third annual of the project. The private consultant, under the guidance of the PWD, tried to use the minimum items and ledger sheets necessary during supervision that were included in this manual. This can be said that it is the big step forward on the process from tendering to construction implementation phase. Thus, the ability of the construction supervision of PWD was improved.

Construction Supervision

Basic techniques mentioned in the PDM, have been transferred to the Bangladeshi C/Ps through the test works and the pilot project. But, there is still much room for them to improve in seismic retrofitting techniques. In this sense, “Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings,” one of the outputs of the project, and “Quality Management Guidelines” are useful materials for them to refer to.

In the RMG sector project, a component added in the third year of the project following the collapse of Rana Plaza. Under the supervision of PWD, a private consultant was engaged to start the use of sample inspection sheets using the minimum requirements which are introduced in the

above-mentioned manual and guidelines. It is a huge step forward for the project that a private consultant is now exposed to the supervision manuals and seismic retrofitting works.

Earlier, due to ill-preparation and poor understanding of the contractor on the seismic retrofitting works, there were some confusions, followed by the delay in progress. However, little by little, the Bangladeshi contractor and the private consultant started grasping the purpose and methods of the retrofitting works, which are positive signs, though there are still some issues to be addressed in each construction phase.

Furthermore, the project was able to identify several missing items in Bangladeshi's construction management, meaning that project got crucial lessons learnt for the future development of the project. Considering the aforementioned points, it is concluded that the project achieved its intended outcomes to some extent.

4.4 **Quality Control**

Output 4 is "Quality control process is developed."

Table 4.4.1 Indicator and status of achievement of Output 4

Indicator	Status of achievement
4-1: Checklist and judgment guidelines for quality control are prepared.	"Checklist" and "Quality Control Guidelines" were developed and completed under this project.
4-2: Training materials for quality control are prepared.	A seminar on construction of "Construction supervision" and "quality control" was organized by PWD. For its training, PWD has developed the training materials related to quality control.
4-3: Monitoring database is prepared.	In the "The support of design documentation, seismic retrofitting works and relocation works on seismic evaluation and seismic retrofitting for the buildings of Ready Made Garment industry" which is newly added item from the third annual, the test operation of ledger forms was carried out by the private consultants under the guidance of PWD

1) Prepared quality control checklist and judgment guidelines

Based on the building construction circumstances of PWD, the subdivision engineer supervises the building construction, but they don't have a habit to keep working records. Therefore, there is no evidence to certify the construction quality. As a matter of fact, the construction quality depends on the engineer's skills. Therefore this project produced two types of Checklists and Guidelines for Quality Control. First one is a "Judgment Guidelines for Quality Control during Design Work (Part A: New Buildings)" which contains 106 items in 6 steps. Another one is "Judgment Guidelines for Quality Control during Construction Work (Part A: New Buildings, Part B: Retrofitting)", which contains 147 items in 20 steps.

WT-4 carried out the trial of the checklist in the three cases of supervising construction works so

that they can be revised. And, other guidelines and checklists of design and construction for retrofitting work will be produced after completion of “Management Manual for Seismic Retrofitting Works” by the project. Therefore, Output 4 had been produced.

2) Prepared training materials for quality control

A seminar on construction of "Construction supervision" and "quality control" was organized by PWD. For its training, PWD has developed the training materials related to quality control. Thus, indicator 4-2 has been achieved.

3） Prepared monitoring database

In the "The support of design documentation, seismic retrofitting works and relocation works on seismic evaluation and seismic retrofitting for the buildings of Ready Made Garment industry” which is a newly added item from the third annual, the test operation of ledger forms was carried out by the private consultants under the guidance of PWD

As the result, daily, weekly, and monthly records, as well as the regular meeting records, the records of inspections have been accumulated as a database.

Based on the accumulated data, the followings are desired to be conducted in the future.

i) Work Schedule Control

Though initially PWD set the construction period as 6 months based on the experience of the Pilot Project, in fact it took12 months. Although the initial estimates of the construction period had loose part, it is desired to review the process whether there was any wasted portion of the time in order to set more appropriate construction period in the future.

ii) Quality Inspection

Generally, documents of quality inspection are not found when visiting the construction sites of Bangladesh. The evidence of the quality inspection were established through this project and can be evaluated. However, there are some issues remain, such as whether timing, items and quantity of them were appropriate or not. According to such results, timing, items and quantity of quality inspection also need to be appropriate in the future.

iii) Bangladeshi Specification

Since the checklist, guidelines prepared this time are mainly what diverted the samples of Japan, there would be some portions that do not meet the Bangladeshi situations. Therefore, based on the applied example in the field in this project, it is necessary to develop the guidelines and check items that are suitable for actual situation of construction in Bangladesh.

4.5 Planning Local Training & Seminar

A training session was planned for achieving the project goal “The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.”

To check the achievement of the capacity of the engineers, it is a good way to teach other engineers.

Regarding present status of Output 5“The technologies on construction and retrofitting for new building design and retrofitting design of public buildings which PWD gained from the project were

disseminated within PWD as well as disseminated to relevant engineers of other organizations.", indicators have been shown in Table 4.5.1. Output 5 has been achieved, except budget issue for the future.

Table 4.5.1 Present status of achievement of each indicator of Output 5

Indicator	Status of achievement
5-1: Training curriculum, materials, plan (budget) and schedule are prepared.	Training curriculum and materials were made for local training courses. Training Academy intended to utilize them for the training course in next year. However, budget plan and schedule have not completed yet.
5-2: Number of seminars for dissemination to outside	Three seminars were organized for other stakeholders, related parties and staff of PWD. More than 790 participants attended the seminars.
5-3: Number of certificates given to the trainees who completed the seismic evaluation course, new building design as well as retrofitting design of the public buildings	Training courses of "Seismic evaluation, new building design and retrofitting design for existing RC building" were organized twice in PWD. In total 60 engineers participated to learn seismic evaluation, seismic design and retrofitting design. Out of 60 participants 28 belonged to PWD.
5-4: Number of certificates given to the trainees who completed the management of retrofitting works and quality control courses of the public buildings	Training courses of "Techniques of retrofit construction and quality control for R.C. buildings" were organized twice in PWD. In total, 74 engineers participated to learn seismic evaluation, seismic design and retrofitting design. Out 74 participants, 17 were from PWD.

The above statements show that training materials, implementation of the training or seminar were done according to the plan. Besides the engineers of CNCRP (the engineers who involved in this project) learned the technology from Japanese experts, and later they could disseminate the technology to other engineers.

Considering this fact, the project goal was achieved.

4.6 **Others**

1) Public Relations

Through DRR awareness and PR activities through media, people from the government, administrative organizations, aid organizations and general citizens have developed awareness of earthquake-proof construction and retrofit of public buildings by PWD through CNCRP project.

Experiences of the Rana Plaza collapse as well as Nepal earthquake were considered as one of the factors that made people more aware of the CNCRP project as those experiences heightened people's awareness of DRR. It can be thought that DRR and PR activities contributed to project achievements.

2) RMG Project

Basic techniques mentioned in the PDM, have been transferred to the Bangladeshi C/Ps through the test works and the pilot project. But, there is still much room for them to improve in seismic retrofitting techniques. In this sense, "Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings," one of the outputs of the project, and "Quality Management Guidelines" are useful materials for them to refer to.

In the RMG sector project, a component added in the third year of the project following the collapse of Rana Plaza. Under the supervision of PWD, a private consultant was engaged to start the using of sample inspection sheets with the minimum requirements which are introduced in the above-mentioned manual and guidelines. It is a huge step forward for the project that a private consultant is now exposed to the supervision manuals and seismic retrofitting works.

Earlier, due to ill-preparation and poor understanding of the contractor about the seismic retrofitting works, there were some confusions, followed by the delay in progress. However, little by little, the Bangladeshi contractor and the private consultant started grasping the purpose and methods of the retrofitting works, which are positive signs, though there are still some issues to be addressed in each construction phase.

Furthermore, the project was able to identify several missing items in Bangladesh's construction management, meaning that project got crucial lessons learnt for the future development of the project.

Considering the aforementioned points, it is concluded that the project achieved its intended outcomes to some extent.

Chapter.5 Recommendation for Achievement of the Overall Goal

The recommendation for achievement of the overall goal of this project “Construction and retrofitting of public buildings which are strong against natural disasters are promoted.”

Table 5.1 Present achievement of each indicator of Overall Goal

Indicator	Status of achievement
1: Number of seismic projects for public buildings including retrofitting will increase by 2020 comparing with that at the time of the project termination.	Rana Plaza collapse accident and Kathmandu earthquake are as triggers that JICA has started the support of "Building Safety of the Ready Made Garment industry." Further, the JICA’s loan support of “RMG factory" and "Fire Stations" was signed in December 2015. In addition, WB, ILO and buyers Union of RMG industry are planning to support the safety. Before this technical cooperation project, there was no seismic project. Therefore, seismic projects are increasing at the present moment.
2: Manuals and the concepts prepared through the Project are incorporated in future edition of Bangladesh National Building Code (BNBC)	Since the timing of the revision process of BNBC and the start of this project was similar, the new BNBC will be issued in 2016. The new BNBC describes the seismic design of new building, but there is no description on the retrofitting design. However, the manuals developed by this project were approved by Ministry of Housing and Public Works, and will be disseminated. Therefore, the ripple effect is expected to public and private engineers. The concept of these manuals has a possibility to be incorporated into future versions of Bangladesh National Building Standards (BNBC).

In the PDM of this project, the project purpose is “The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.” Therefore, in order to achieve the overall goal, it is inevitable to improve the retrofitting capacity of PWD as the main player. However, PWD has no place to show its abilities, because PWD does not have its own specific budget for design and construction, as well as the Government of Bangladesh has no plan to promote the earthquake resistance of public buildings.

In addition, there is a problem in Bangladesh that buildings are not always constructed as design document. And PWD also is outsourcing the construction work itself to the private sector. It is also essential to improve technical capacity building for not only PWD engineers, but also the general private engineers.

In addition, in this technical cooperation project, regarding the pilot project as well as the RMG factory building safety support case, the problems faced were different building by building. From this fact, PWD engineers are still necessary the support of Japanese experts. And in order to acquire the ability to practice on their own, they need a further capacity development.

Therefore, to achieve the overall goal, the following three items are necessary, "capacity building of PWD", "capacity improvement for whole Bangladesh engineers by education" and "support from the

Government of Bangladesh as well as social support." In this way, to reach the overall goal, in addition to the achievement of this project purpose, there are several issues that should be carried out in Bangladesh. Figure 5.1 pictures one draft idea of necessary items to achieve the overall goal.

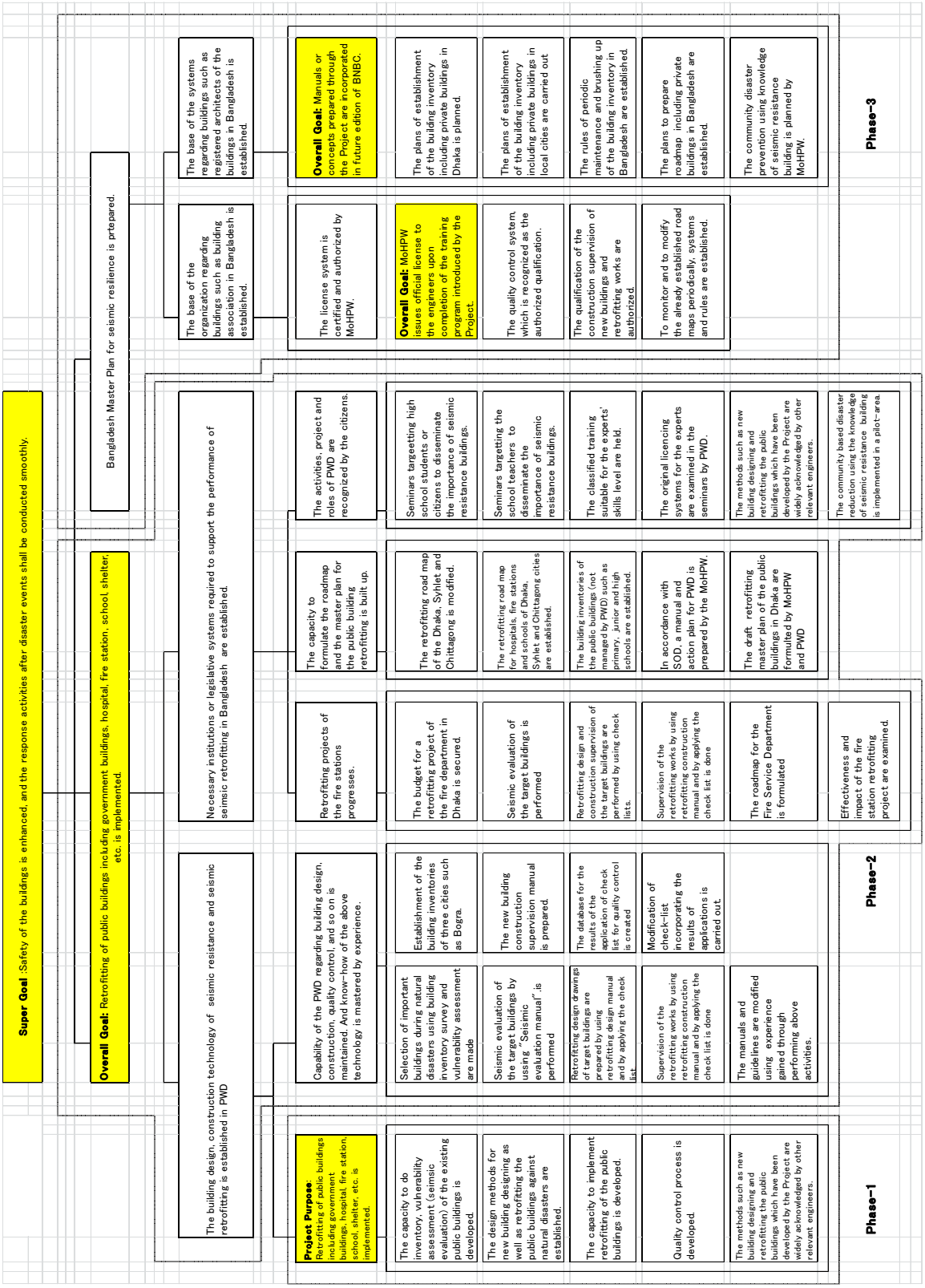


Figure5.1 Issues of the Government of Bangladesh to achieve the overall goal (draft)

5.1 **Building inventory**

The building inventory is the basic data to make a plan of the construction a new public building or retrofitting. Therefore, it is a very useful item for PWD and to consider overall Goal, “the Construction and retrofitting of public buildings, which are strong against natural disasters are promoted.”. However considering the sustainability, the following issues are needed to be addressed.

a) A new inventory should be established for whole Bangladesh.

b) The data in the inventory that has been established for Dhaka, should be updated in every year.

Regarding the issue mentioned in b), head quarter showed strong leadership to sub-division engineer to establish the building inventory. This leadership was necessary to establish a new database, but if we consider the maintenance the database, the sub-divisional engineers should know the importance of a building inventory and their hard works are needed. Besides, to support the activity of the subdivision, a system for maintenance of the data, an authorization by MoHPW is necessary.

5.2 **Seismic Evaluation (Fragility Evaluation)**

It is necessary to further accumulation of knowledge and information obtained through this project in order to adopt the Seismic Design Manual at an even higher level in the future. In the case of design standards for new buildings, United States design standards partially modified to suit the Bangladeshi environment have been adopted. In fact the contents are not adapted to the structural and construction level of the country. Therefore, it is very essential to produce standards suitable for Bangladesh. Table 2.4.2-1 summarizes the issues with the Seismic Evaluation Manual produced and the issues related to further study. The table indicates the inherent structural problems in Bangladesh. Solutions of these problems are important for technical aspects of evaluation and adoption of the seismic evaluation method in Bangladesh. Also, it is a commonly known fact that there are many buildings with problems in terms of seismic performance. Seismic or structural evaluation of these buildings must be carried out. For this purpose it is considered as indispensable to establish evaluation methods that are capable of easily, accurately, and rapidly identifying and evaluating the issues. As a forerunner to this, in the RMG sector project, a simple evaluation method was developed based on drawings, and taking the site into consideration.

In the case of matters other than technical aspects, the general public have no concerns regarding earthquakes and seismic structures. This may be an obstacle to disseminate seismic evaluation in Bangladesh in the future. It is considered that this is also a point that requires improvement.

5.3 **Retrofitting Design / New building design**

The capacity of the PWD engineers regarding the retrofitting design or new building design had been raised up that was mentioned in Chapter 4.

Considering overall goal, “Construction and retrofitting of public buildings which are strong against natural disasters are promoted”, it can be not achieved by only design technology. Incidentally, the indicators of overall goals are followings. To achieve them, the political support are needed such as establishment of the national plan for public buildings retrofitted. Considering political issue, the leadership of MoHPW is necessary.

5.4 Construction Supervision

Supervision work on public building construction in Bangladesh is left to sub-divisional engineers of PWD, who refer to BNBC regardless of construction work types. And each engineer refers to his/her own past experiences when supervising, as there is no standard test sheets or manuals. This is true to "seismic retrofitting work" supervision, and thus, the "Manual for Retrofit Construction and Supervision of Reinforced Concrete Buildings" compiled by this project will be their useful reference for techniques as well as general supervision work.

It seems difficult for each divisional engineer to carry out both supervision work with new techniques and conventional work. Thus it seems necessary to establish a new independent organization with engineers who are trained with the new techniques through this project, as the techniques must be further disseminated in Bangladesh.

Since public buildings serve as a shelter at a time of disaster, it is beneficial for all Bangladeshi nationals.

5.5 Quality Control

Under this project, the check list and guidelines of check list were prepared. This is the important first step to keep the minimum construction quality. Then if this way becomes the habit as the supervising work, the new buildings are expected as they have BNBC performance.

However, CNCRP tried to use at the RMG project, unfortunately, the supervisor get swamped to do record, therefore, the instructions of the contractor was not smooth. Besides, the quality test could not be done timely. Therefore, more efforts are necessary to make the quality control a common sense in Bangladesh.

Anyhow, the experience of RMG sector project to apply the CNCRP quality control method is the first step to establish construction quality control, there is a necessity to step up the skills supervisors. Therefore, PWD has to consider dissemination of the skill to the all Bangladeshi engineers. For example, PWD should encourage to supervise the building construction by the supervisors who learned the CNCRP quality control method.

If the supervising method and results are documented, and become a habit as a common sense, constructed buildings have resistance against natural disasters.

5.6 Training /Seminar Plan

Considering the building design/ construction, actual construction seems to be the economic issue rather than the qualities. Regarding the design, there is no penalty in case of not obeying the BNBC. Therefore, the quality of the building depend on the quality of the engineers.

In other words, to achieve the overall goal, "Safety of the buildings is secured by following BNBC", the qualities of engineers should be progressed. Therefore, it is necessary to continue the engineering training that was implemented by PWD.

The training should be on various courses such as preliminary class course, middle class course or high class course to match the engineer's skill or experience. The training course should be established, that even if the engineer has experience, he can join the class to know the new technology.

Anyhow, PWD should take a leadership to progress engineer's quality as a leader of building

structure engineer and the supervising engineer. Therefore, it is necessary to make an engineer training plan. In this plan, the curriculum, substantial training materials, ensuring the trainer and ensuring budget should be included. Besides, the trainings should be implemented on the basis of the training plan.

If the training system is established, the overall goal would be achieved.

5.7 **Public Relations**

In order to promote construction and retrofit of natural disaster resilient public buildings, it's important to have not only experts and related people gain more technical knowledge and knowhow in design and construction, but also general citizens understand more about disaster risks and the importance of DRR so that the needs of safe public building construction will be felt. It's because general citizens' demand will act as a promotion force to push the construction and retrofit of safe public buildings. Preventing public buildings from being damaged in disasters are important for both emergency aid and recovery times. Besides, schools can also be used as evacuation shelters for the local area. In addition to technical support, it is hoped that continuous DRR education and activities will be promoted further in the future. Moreover, it's also important to publicize about newly constructed and reinforced buildings and to cooperate with Ministry of Disaster Management and Relief and other government offices in PR to disseminate the importance of safe public buildings.

5.8 **RMG project.**

Overall Goal is "the Construction and retrofitting of public buildings, which are strong against natural disasters are promoted". The RMG sector project is the target of the private buildings, therefore the activity of RMG sector project doesn't lead directly to the overall goals. However, this project is to construct actually, then the safety building of the urban area of Dhaka city increases one by one. This activity makes PWD's skill up and also disseminate the retrofitting technology in Bangladesh. In fact, Japanese school in Dhaka has contacted PWD and PWD agreed to conduct the seismic assessment.

Through the experience of the RMG sector project, the necessity of retrofitting works are recognized. However, the common owner hesitates to do it because the high cost. To construct a safe building is not cheap. Therefore, owners should prepare the sufficient money for construction.

Fortunately, JICA made a plan of Yen loan project. Based on this budget, the fire station retrofitting will be under taken. Anyhow to achieve overall, it is necessary to make a budget based on the retrofitting plan.

＜Appendix＞

1. PDM (Project Design Matrix)
2. Flowchart of Work
3. Plan of Operation
4. Actual Assignment Schedule of JET
5. Acceptance results of Training in Japan
6. Procurement of Equipment
7. JCC (Joint Coordinating Committee)
8. Other Activities Achievements

1. Project Design Matrix (PDM)

PDM

The Initial Time

Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Version 0

Area: Dhaka, Sylhet, Chittagong | Period: March 2011- February 2015 | Counterparts: PWD Engineers | Date: December 2010

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal			
Safety of the buildings is enhanced, and the response activities after disaster events shall be conducted smoothly.	Cases where the natural disasters have not caused buildings to collapse and the buildings users as well as residents near buildings have escaped from their collapse.	MoFDM or other relevant organizations' reports or newspaper articles on these cases	
Overall Goal			
1 Retrofitting of public buildings including government buildings, hospital, fire station, school, shelter, etc. is implemented.	1 Number of the retrofitting works	1 Interview with PWD and relevant organizations	The trained engineers appropriately apply what they learned at the Project
2 Ministry of Housing and Public Works issues official license to the engineers upon completion of the training program introduced by the Project	2 Number of the licensed engineers	2 MoHPW	
3 Manuals and the concepts prepared through the Project are incorporated in future edition of Bangladesh National Building Code.	3 The manuals are incorporated in BNBC	3 BNBC	
Project Purpose			
The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters, such as earthquake, cyclone, flood and high tide is developed.	Status of PWD: 1 Number of the trained personnel as well as C/Ps who can conducted the training on the techniques developed by the Project. 2 Quality assurance system of PWD 3 PWD's future activity plan on retrofitting	Project report	1. Other relevant organizations owing the public buildings finance retrofitting works. 2. Relevant organizations adopt a serious stance on building disaster.
Outputs			1. Trained C/P remain active for the Project.
1 The capacity to do vulnerability assessment of the existing public buildings is developed.	1-1 Volume of building inventory data	1-1 Building inventory data	2. Fund for the pilot projects is produced as scheduled.
	1-2 Vulnerability assessment manual is prepared	1-2 Vulnerability assessment manual	
	1-3 Roadmap for retrofitting public buildings is prepared.	1-3 Roadmap for retrofitting public buildings	
2 The design methods for designing as well as retrofitting the public buildings against natural disasters are established.	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters is prepared.	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters	
	2-2 Design documents for retrofitting the selected buildings are prepared.	2-2 Design documents for retrofitting the selected buildings	
3 The capacity to implement retrofitting of the public buildings is developed.	3-1 Manual for retrofitting works is prepared.	3-1 Manual for retrofitting works	
4 Quality assurance system is established.	4-1 Checklist and judgment guidelines for quality assurance are prepared.	4-1 Checklist and judgment guidelines for quality assurance	
	4-2 Training materials on quality assurance are prepared.	4-2 Training materials on quality assurance	
	4-3 Monitoring database is prepared.	4-3 Monitoring database	
5 The methods such as designing and retrofitting the public buildings which have been developed by the Project are widely acknowledged by other relevant engineers.	5-1 Training curriculum, materials, plan(budget) and schedule are prepared.	5-1 Training curriculum, materials, plan(budget) and schedule	
	5-2 Number of seminars on the training	5-2 Project report	
	5-3 Number of certificates given to the trainees who completed the vulnerability assessment course	5-3 Project report	
	5-4 Number of certificates given to the trainees who completed training for designing as well as retrofitting of the public buildings	5-4 Project report	
Activities			
1-1 To produce building inventory with GIS			
1-2 To categorize (rank up) existing public buildings			
1-3 To select buildings and to collect/ prepare documents such as design drawings			
1-4 To study BNBC, foreign codes, and to develop criteria and index for vulnerability assessment			
1-5 To establish the method for assessing vulnerability			
1-6 To prepare the manual for doing vulnerability assessment of the existing public buildings			
1-7 To do vulnerability assessment of the existing public buildings			
1-8 To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings			
2-1 To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design.			**Pre-conditions**
2-2 To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods.			Great earthquake, cyclone, flood or high tide does not occur before the Project is completed.
2-3 To prepare the design manual for designing as well as retrofitting the public buildings against natural disasters			
2-4 To select the buildings to be retrofitted			
2-5 To prepare the retrofitting plan for the selected buildings and prepare their design documents.			
3-1 To conduct theoretical training on retrofitting works to C/P.			
3-2 To study current experience on retrofitting works.			
3-3 To develop more appropriate method for retrofitting work.			
3-4 To do test work and to test material.			
3-5 To prepare manual for retrofitting works.			
4-1 To prepare check list and judgment guidelines for quality assurance.			
4-2 To prepare training materials on quality assurance.			
4-3 To prepare monitoring database.			
4-4 To do monitoring of the retrofitting works.			
4-5 To review and feedback the monitoring results.			
5-1 To prepare curriculum, materials, plan (budget) and schedule for the training courses on vulnerability assessment and designing as well as retrofitting of the public buildings against disasters.			
5-2 To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.			
5-3 To conduct the training.			
5-4 To review the training through course evaluation by the trainees.			
5-5 To issue certificate to the trainees who completed training .			

PDM

The First Revision

Date: February 20, 2013

Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Version 0 Version 1 Draft

Area: Dhaka, Sylhet, Chittagong | Period: March 2011- February 2015 | Counterparts: PWD Engineers | Date: December 2010 Rev. February 2013

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal			
Safety of the buildings is enhanced, and the response activities after disaster events shall be conducted smoothly.	Cases where the natural disasters have not caused buildings to collapse and the buildings users as well as residents near buildings have escaped from their collapse.	MoFDM or other relevant organizations' reports or newspaper articles on these cases	
Overall Goal			
1 Retrofitting of public buildings including government buildings, hospital, fire station, school, shelter, etc. is implemented.	1 Number of the retrofitting works	1 Interview with PWD and relevant organizations	The trained engineers appropriately apply what they learned at the Project
2 Ministry of Housing and Public Works issues official license to the engineers upon completion of the training program introduced by the Project	2 Number of the licensed engineers	2 MoHPW	
3 Manuals and the concepts prepared through the Project are incorporated in future edition of Bangladesh National Building Code.	3 The manuals are incorporated in BNBC	3 BNBC	
Project Purpose			
The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters, such as earthquake, cyclone, flood and high tide is developed.	Status of PWD: 1 Number of the trained personnel as well as C/Ps who can conducted the training on the techniques developed by the Project. 2 Quality assurance system of PWD 2 **Quality control** system of PWD 3 PWD's future activity plan on retrofitting	Project report	1. Other relevant organizations owing the public buildings finance retrofitting works. 2. Relevant organizations adopt a serious stance on building disaster.
Outputs			1. Trained C/P remain active for the Project. 2. Fund for the pilot projects is produced as scheduled.
1 The capacity to do vulnerability assessment of the existing public buildings is developed.	1-1 Volume of building inventory data	1-1 Building inventory data	
1 The capacity to do **inventory,** vulnerability assessment **(seimsic evaluation)** of the existing public buildings is developed.	1-2 Vulnerability assessment manual is prepared **1-2** Vulnerability assessment **(Seismic evaluation)** manual is prepared	1-2 Vulnerability assessment manual **1-2** Vulnerability assessment **(Seismic evaluation)** manual	
	1-3 Roadmap for retrofitting public buildings is prepared.	1-3 Roadmap for retrofitting public buildings	
2 The design methods for designing as well as retrofitting the public buildings against natural disasters are established 2 The methods for designing, **evaluating** as well as retrofitting the public buildings against natural disasters are established	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters is prepared. **2-1** Design manual for designing, **evaluating** as well as retrofitting the public buildings against natural disasters is prepared.	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters **2-1** Design manual for designing, **evaluating** as well as retrofitting the public buildings against natural disasters	
	2-2 Design documents for retrofitting the selected buildings are prepared.	2-2 Design documents for retrofitting the selected buildings	
3 The capacity to implement retrofitting of the public buildings is developed.	3-1 Manual for retrofitting works is prepared. **3-1** Manual for **managing** retrofitting works is prepared.	3-1 Manual for retrofitting works **3-1** Manual for **managing** retrofitting works	
4 Quality assurance system is established. 4 **Quality control** system is developed.	4-1 Checklist and judgment guidelines for quality assurance are prepared. **4-1** Checklist and judgment guidelines for **quality control** are prepared. 4-2 Training materials on quality assurance are prepared. **4-2** Training materials on **quality control** are prepared.	4-1 Checklist and judgment guidelines for quality assurance **4-1** Checklist and judgment guidelines for **quality control** 4-2 Training materials on quality assurance **4-2** Training materials on **quality control**	
	4-3 Monitoring database is prepared.	4-3 Monitoring database	
5 The methods such as designing and retrofitting the public buildings which have been developed by the Project are widely acknowledged by other relevant engineers. **5** The methods such as designing, **evaluating** and retrofitting the public buildings which have been developed by the Project are widely acknowledged by other relevant engineers	5-1 Training curriculum, materials, plan(budget) and schedule are prepared. 5-2 Number of seminars on the training 5-3 Number of certificates given to the trainees who completed the vulnerability assessment course **5-3** Number of certificates given to the trainees who completed the **seismic evaluation** course 5-4 Number of certificates given to the trainees who completed training for designing as well as retrofitting of the public buildings **5-4** Number of certificates given to the trainees who completed training for designing, **evaluating** as well as retrofitting of the public buildings	5-1 Training curriculum, materials, plan(budget) and schedule 5-2 Project report 5-3 Project report 5-4 Project report	
Activities	**Inputs**		
1-1 To produce building inventory with GIS 1-2 To categorize (rank up) existing public buildings 1-3 To select buildings and to collect/ prepare documents such as design drawings **1-3** To select buildings **for vulnerability assessment (seismic evaluation)** and to collect/ prepare documents such as design drawings 1-4 To study BNBC, foreign codes, and to develop criteria and index for vulnerability assessment **1-4** To study BNBC, foreign codes, and to develop criteria and index for **seismic evaluation** 1-5 To establish the method for assessing vulnerability **1-5** To establish the method for **seismic evaluation** 1-6 To prepare the manual for doing vulnerability assessment of the existing public buildings **1-6** To prepare the manual for **seismic evaluation** of the existing public buildings 1-7 To do vulnerability assessment of the existing public buildings **1-7** To **conduct seismic evaluation** of the existing public buildings 1-8 To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings	**Japanese Side** 1 Jaoanese Experts Dispatch 1-1 GIS Database Management 1-2 Seismic Resistant Design 1-3 Construction Plan, Management 1-4 Existing Building Evaluation (Seismic Resistant Inspection) 1-5 Existing Building Retrofit (Seismic Retrofit) 1-6 Public Building Management 1-7 Training Planning 2 Training in Japan 2-1 Genral Training Course; Field (Seismic Resisitant Design, Existing Building Inspection (Seismic Evaluation) Existing building retrofitting (Seismic Retrofitting)) Duration: aroudn 2 to 4 weeks 2-2 Senior Offoicers Course; Field (Building Adni\ministration) Duration: around 1 to 3 weeks 3 Donating equipment 3-1 Equipment required to operate GIS 3-2 Required equipments for structural investigation 3-3 Required equipments to operate structural calculation software 3-4 PC operation 4 Test construction cost 5 Structural test cost 6 Cost for Dissemination materials of manuals, training handouts, pamphlets etc. 7 Cost for Editorial Board of Manuals	**Bangladesh Side** 1 Placement of Counterparts (C / P) Project director Project manager PC1: GIS Building inventory database PC2: Vulnerability assessment and retrofitting design PC3: Retrofitting construction PC4: Quality Assurance **PC4: Quality control** PC5: Training PC: Project Components Note Clerk 2 Provide office space Project office space (furnished) Maintenance costs of the equipment provided 3 Pilot project budget 4 Other Expenses 4-1 Training facilities, lecturer, materials for Domestic training 4-2 Dissemination materials like Web Page 4-3 Other Domestic Expenses	
2-1 To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design. 2-2 To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods. 2-3 To prepare the design manual for designing as well as retrofitting the public buildings against natural disasters **2-3** To prepare the manual for designing, **evaluating** as well as retrofitting the public buildings against natural disasters 2-4 To select the buildings to be retrofitted **2-4** To select the buildings **for seismic retrofitting design** 2-5 To prepare the retrofitting plan for the selected buildings and prepare their design documents.			**Pre-conditions** Great earthquake, cyclone, flood or high tide does not occur before the Project is completed.
3-1 To conduct theoretical training on retrofitting works to C/P. 3-2 To study current experience on retrofitting works. 3-3 To develop more appropriate method for retrofitting work. 3-4 To do test work and to test material. **3-4** To **manage** test work and to test **materials.** 3-5 To prepare manual for retrofitting works. **3-5** To prepare manual for **managing** retrofitting works.			
4-1 To prepare check list and judgment guidelines for quality assurance. **4-1** To prepare check list and judgment guidelines for **quality control**. 4-2 To prepare training materials on quality assurance. **4-2** To prepare training materials on **quality control** 4-3 To prepare monitoring database. 4-4 To do monitoring of the retrofitting works. 4-5 To review and feedback the monitoring results.			
5-1 To prepare curriculum, materials, plan (budget) and schedule for the training courses on vulnerability assessment and designing as well as retrofitting of the public buildings against disasters. **5-1** To prepare curriculum, materials, plan (budget) and schedule for the training courses on **seismic evaluation** and designing as well as retrofitting of the public buildings against disasters. 5-2 To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training. 5-3 To conduct the training. **5-3** To **coordinate and arrange** the training. 5-4 To review the training through course evaluation by the trainees. 5-5 To issue certificate to the trainees who completed training . **5-6 To produce and disseminate the materials of the project and training**			

PDM

The Second Revision

Date: August 05, 2013

Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Version 2

Area: Dhaka, Sylhet, Chittagong | Period: March 2011- February 2015 | Counterparts: PWD Engineers | Date: August 2013 (Rev.)

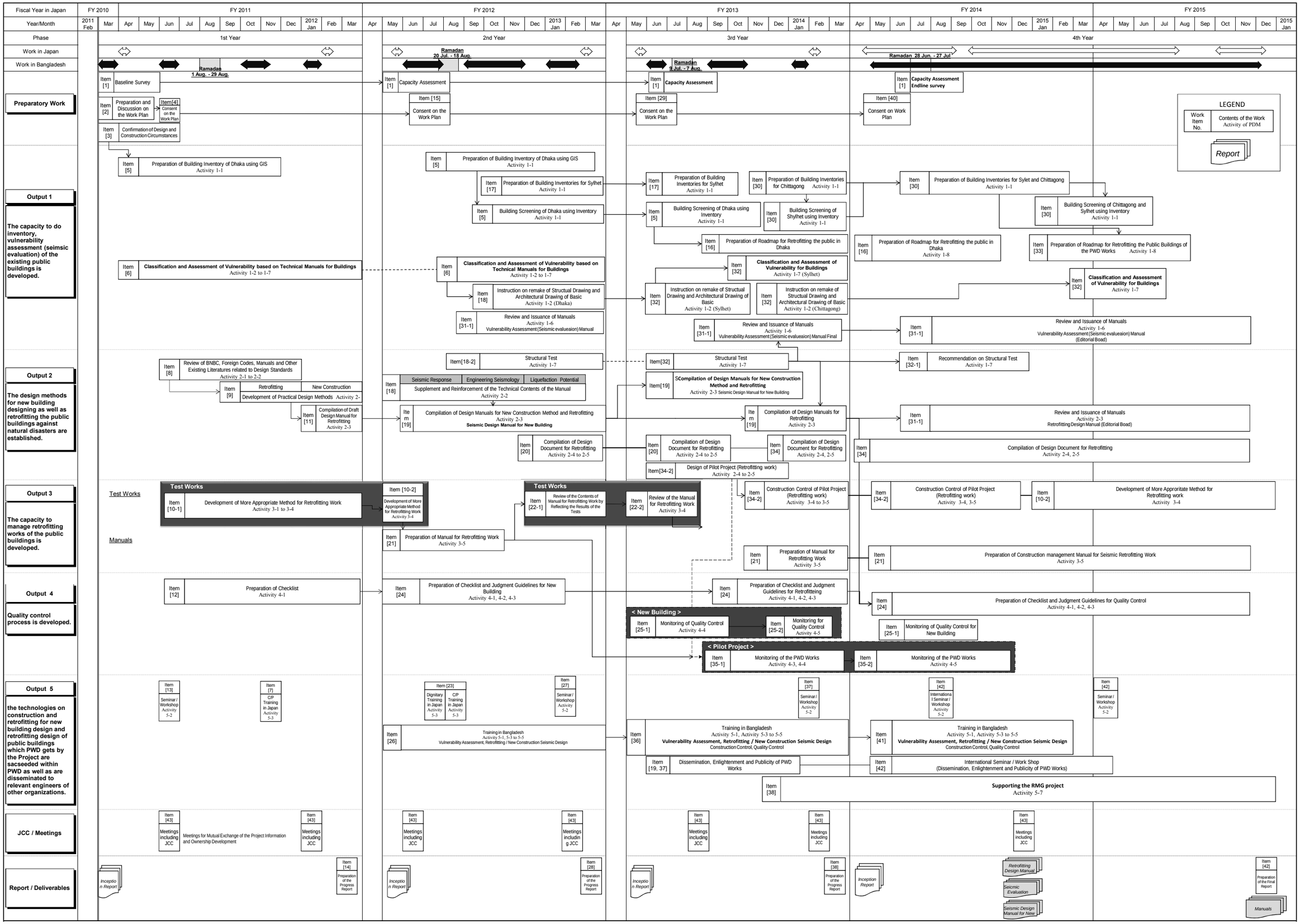
Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal			
Safety of the buildings is secured by following BNBC.	Cases where the natural disasters have not caused buildings to collapse.	MoFDM or other relevant organizations' reports or newspaper articles on these cases	
Overall Goal			**<Overall Goal to Super Goal>**
1 Construction and retrofitting of public buildings which are strong against natural disasters are promoted.	1 Number of seismic projects for public buildings including retrofitting will increase by 2020 comparing with that at the time of the project termination. 2 Manuals and the concepts prepared through the Project are incorporated in future edition of Bangladesh National Building Code (BNBC)	1 Interview with PWD and relevant organizations 2 Interview with MoHPW and PWD.	1 Government of Bangladesh prepares the action plan for disaster management including seismic strengthening of buildings based on the revision of the National Disaster Management Basic Plan. 2 The trained engineers appropriately apply what they learned at the Project
Project Purpose			**<Project Goal to Overall Goal>**
The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters is developed.	1 Number of engineers in PWD who can execute the activities of Output 1 to Output 4 by the Project is more than half of the counterparts (C/P), and number of engineers in PWD who are trained by the Project trainees is more than 100. 2 Action plans of seismic retrofitting program are prepared by PWD	1 Final Report of the project 2 Action plans of seismic retrofitting program preprared by PWD	1 Other relevant organizations owning public buildings implement the construction and retrofitting programs. 2 PWD follows BNBC.
Outputs			**<Project Activities to Project Goal>**
1 The capacity to do inventory, vulnerability assessment (seimsic evaluation) of the existing public buildings is developed.	1-1 Volume of building inventory data 1-2 Vulnerability assessment (Seismic evaluation) manual is prepared 1-3 Roadmap for retrofitting public buildings is prepared.	1-1 Building inventory data 1-2 Final Report of the project 1-3 Final Report of the project	1 Direction of PWD as the organization do not change 2 Trained C/P remain active for the Project. 3 Budget for the pilot projects is prepared as scheduled.
2 The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established	2-1 Design manual for new building designing as well as evaluating and retrofitting the public buildings against natural disasters is prepared. 2-2 Design documents for retrofitting the selected buildings are prepared.	2-1 Final Report of the project 2-2 Design documents for retrofitting the selected buildings	
3 The capacity to manage retrofitting works of the public buildings is developed.	3-1 Construction management manual for seismic retrofitting works is prepared.	3-1 Final Report of the project	
4 Quality control process is developed.	4-1 Checklist and judgment guidelines for quality control are prepared. 4-2 Training materials on quality control are prepared. 4-3 Monitoring database is prepared.	4-1 Final Report of the project 4-2 Final Report of the project 4-3 Monitoring database	
5 The technologies on construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well as are disseminated to relevant engineers of other organizations.	5-1 Training curriculum, materials, plan(budget) and schedule are prepared. 5-2 Number of seminars for dissemination to outside 5-3 Number of certificates given to the trainees who completed the seismic evaluation course, new building design as well as retrofitting design of the public buildings 5-4 Number of certificates given to the trainees who completed the management of retrofitting works and quality control courses of the public buildings	5-1 Final Report of the project 5-2 Final Report of the project 5-3 Final Report of the project 5-4 Final Report of the project	

Activities	Inputs		
	Japanese Side	Bangladesh Side	
1-1 To produce building inventory with GIS 1-2 To categorize (rank up) existing public buildings 1-3 To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings 1-4 To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation 1-5 To establish the method for seismic evaluation 1-6 To prepare the manual for seismic evaluation of the existing public buildings 1-7 To conduct seismic evaluation of the existing public buildings 1-8 To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings	1 Japanese Experts Dispatch 1-1 GIS Database Management 1-2 Seismic Resistant Design 1-3 Construction Plan, Management 1-4 Existing Building Evaluation (Seismic Resistant Inspection) 1-5 Existing Building Retrofit (Seismic Retrofit) 1-6 Public Building Management 1-7 Training Planning	1 Placement of Counterparts (C / P) Project director Project manager PC1: GIS Building inventory database PC2: Vulnerability assessment and retrofitting design PC3: Retrofitting construction control PC4: Quality control PC5: Training PC: Project Components Note Clerk	
2-1 To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design. 2-2 To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods. 2-3 To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters 2-4 To select the buildings for seismic retrofitting design 2-5 To prepare the retrofitting plan for the selected buildings and prepare their design documents.	2 Training in Japan 2-1 Genral Training Course; Field (Seismic Resisitant Design, Existing Building Inspection (Seismic Evaluation) Existing building retrofitting (Seismic Retrofitting)) Duration: aroudn 2 to 4 weeks 2-2 Senior Offoicers Course; Field (Building Adni\ministration) Duration: around 1 to 3 weeks	2 Provide office space Project office space (furnished) Maintenance costs of the equipment provided	
3-1 To conduct training on theory of retrofitting works to C/P 3-2 To study current experience on retrofitting works. 3-3 To develop more appropriate method for retrofitting work. 3-4 To manage test work and to test materials. 3-5 To prepare construction management manual for seismic retrofitting works.	3 Donating equipment 3-1 Equipment required to operate GIS 3-2 Required equipments for structural investigation 3-3 Required equipments to operate structural calculation software 3-4 PC operation	3 Pilot project budget	**Pre-conditions** Great damage to buildings due to natural disasters does not occur.
4-1 To prepare check list and judgment guidelines for quality control. 4-2 To prepare training materials on quality control 4-3 To prepare monitoring database. 4-4 To do monitoring of pilot project for Retrofitting. 4-5 To review and feedback the monitoring results.	4 Test construction cost 5 Structural test cost	4 Other Expenses 4-1 Training facilities, lecturer, materials for Domestic training 4-2 Dissemination materials like Web Page 4-3 Other Domestic Expenses	
5-1 To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters. 5-2 To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training. 5-3 To coordinate and arrange the training. 5-4 To review the training through course evaluation by the trainees. 5-5 To issue certificate to the trainees who completed training . 5-6 To produce and disseminate the materials of the project and training 5-7 To assisit seismic assessment and retrofit planning of existing buildings for technique dissemination	6 Cost for Dissemination materials of manuals, training handouts, pamphlets etc. 7 Cost for Editorial Board of Manuals		

2. Flowchart of Work Item

Flowchart of Work Item

Project for Capacity Development on Natural Disaster-Resistant Technique of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh



3. Plan of Operation

Plan of Operation

Project for Capacity Development on Natural Disaster-Resistant Technique of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Activity	Period	1st Year（2011～2012）												
	Month	2	3	4	5	6	7	8	9	10	11	12	1	2
	Elapsed Month	1	2	3	4	5	6	7	8	9	10	11	12	13
Preparatory Works														
1 Baseline Survey														
1-1 Capacity Assessment														
2 Work Plan														
3 Confirmation of Design and Construction Circumstances for Public Buildings by PWD														
Output1：The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed.														
Activity 1-1) To produce building inventory with GIS														
Activity 1-2) To categorize (rank up) existing public buildings														
Activity 1-3) To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings														
Activity 1-4) To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation														
Activity 1-5) To establish the method for seismic evaluation														
Activity 1-6) To prepare the manual for seismic evaluation of the existing public buildings														
Activity 1-7) To conduct seismic evaluation of the existing public buildings														
Activity 1-8) To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings														
Output2: The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established.														
Activity 2-1) To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design														
Activity 2-2) To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods														
Activity 2-3) To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters														
Activity 2-4) To select the buildings for seismic retrofitting design														
Activity 2-5) To prepare the retrofitting plan for the selected buildings and prepare their design documents														
Output3：The capacity to implement retrofitting of the public buildings is developed.														
Activity 3-1) To conduct theoretical training on retrofitting works to C/P														
Activity 3-2) To study current experience on retrofitting works														
Activity 3-3) To develop more appropriate method for retrofitting work														
Activity 3-4) To manage test work and to test materials														
Activity 3-5) To prepare construction management manual for seismic retrofitting works														
Output4：Quality control process is developed.														
Activity 4-1) To prepare check list and judgment guidelines for quality control														
Activity 4-2) To prepare training materials on quality control														
Activity 4-3) To prepare monitoring database														
Activity 4-4) To do monitoring of pilot project for Retrofitting														
Activity 4-5) To review and feedback the monitoring results														
Output5：The technologies construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well are disseminated to relevant engineers of the organizations														
Activity 5-1) To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters.														
Activity 5-2) To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.														
Activity 5-3) To coordinate and arrange the training														
Activity 5-4) To review the training through course evaluation by the trainees														
Activity 5-5) To issue certificate to the trainees who completed training														
Activity 5-6) To produce and disseminate the materials of the project and training														
Activity 5-7) To assist seismic assessment and retrofit planning of existing buildings for technique dissemination														

Activity	Period	2nd Year（2012～2013）												
	Month	3	4	5	6	7	8	9	10	11	12	1	2	3
	Elapsed Month	14	15	16	17	18	19	20	21	22	23	24	25	26
Preparatory Works														
1 Baseline Survey														
1-1 Capacity Assessment														
2 Work Plan														
3 Confirmation of Design and Construction Circumstances for Public Buildings by PWD														
Output1：The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed.														
Activity 1-1) To produce building inventory with GIS											Dhaka			
Activity 1-2) To categorize (rank up) existing public buildings											Dhaka			
Activity 1-3) To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings											Creation Dhaka			
Activity 1-4) To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation														
Activity 1-5) To establish the method for seismic evaluation														
Activity 1-6) To prepare the manual for seismic evaluation of the existing public buildings														
Activity 1-7) To conduct seismic evaluation of the existing public buildings											Dhaka			
Activity 1-8) To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings														
Output2: The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established.														
Activity 2-1) To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design														
Activity 2-2) To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods														
Activity 2-3) To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters														
Activity 2-4) To select the buildings for seismic retrofitting design												Sylhet		
Activity 2-5) To prepare the retrofitting plan for the selected buildings and prepare their design documents											Dhaka			
Output3：The capacity to implement retrofitting of the public buildings is developed.														
Activity 3-1) To conduct theoretical training on retrofitting works to C/P														
Activity 3-2) To study current experience on retrofitting works														
Activity 3-3) To develop more appropriate method for retrofitting work														
Activity 3-4) To manage test work and to test materials														
Activity 3-5) To prepare construction management manual for seismic retrofitting works														
Output4：Quality control process is developed.														
Activity 4-1) To prepare check list and judgment guidelines for quality control														
Activity 4-2) To prepare training materials on quality control														
Activity 4-3) To prepare monitoring database														
Activity 4-4) To do monitoring of pilot project for Retrofitting														
Activity 4-5) To review and feedback the monitoring results														
Output5：The technologies construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well are disseminated to relevant engineers of the organizations														
Activity 5-1) To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters.														
Activity 5-2) To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.														
Activity 5-3) To coordinate and arrange the training														
Activity 5-4) To review the training through course evaluation by the trainees														
Activity 5-5) To issue certificate to the trainees who completed training														
Activity 5-6) To produce and disseminate the materials of the project and training														
Activity 5-7) To assist seismic assessment and retrofit planning of existing buildings for technique dissemination														

Activity	Period	3rd Year（2013～2014）												
	Month	4	5	6	7	8	9	10	11	12	1	2	3	4
	Elapsed Month	27	28	29	30	31	32	33	34	35	36	37	38	39
Preparatory Works														
1 Baseline Survey														
1-1 Capacity Assessment														
2 Work Plan														
3 Confirmation of Design and Construction Circumstances for Public Buildings by PWD														
Output1：The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed.														
Activity 1-1) To produce building inventory with GIS		Sylhet & Chittagong Preparation of Building Inventories and Building Screening												
Activity 1-2) To categorize (rank up) existing public buildings			Sylhet											
Activity 1-3) To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings		Sylhet		Creation Sylhet										
Activity 1-4) To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation														
Activity 1-5) To establish the method for seismic evaluation														
Activity 1-6) To prepare the manual for seismic evaluation of the existing public buildings														
Activity 1-7) To conduct seismic evaluation of the existing public buildings		Sylhet		Structural Test 2										
Activity 1-8) To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings														
Output2: The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established.														
Activity 2-1) To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design		Technical Transfer of "Seismic Response Analysis", "Engineering Seismology", "Liquefaction Potential"												
Activity 2-2) To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods														
Activity 2-3) To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters		Seismic Design Manual for New Building				Review,Editorial board								
Activity 2-4) To select the buildings for seismic retrofitting design														
Activity 2-5) To prepare the retrofitting plan for the selected buildings and prepare their design documents														
Output3：The capacity to implement retrofitting of the public buildings is developed.														
Activity 3-1) To conduct theoretical training on retrofitting works to C/P														
Activity 3-2) To study current experience on retrofitting works														
Activity 3-3) To develop more appropriate method for retrofitting work														
Activity 3-4) To manage test work and to test materials		Test Works 1		Test Works 2		Test Works 3(cancellation)								
Activity 3-5) To prepare construction management manual for seismic retrofitting works														
Output4：Quality control process is developed.														
Activity 4-1) To prepare check list and judgment guidelines for quality control														
Activity 4-2) To prepare training materials on quality control														
Activity 4-3) To prepare monitoring database														
Activity 4-4) To do monitoring of pilot project for Retrofitting														
Activity 4-5) To review and feedback the monitoring results														
Output5：The technologies construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well are disseminated to relevant engineers of the organizations														
Activity 5-1) To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters.														
Activity 5-2) To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.														
Activity 5-3) To coordinate and arrange the training														
Activity 5-4) To review the training through course evaluation by the trainees														
Activity 5-5) To issue certificate to the trainees who completed training														
Activity 5-6) To produce and disseminate the materials of the project and training														
Activity 5-7) To assist seismic assessment and retrofit planning of existing buildings for technique dissemination														

Activity	Period	4th Year（2014～2016）												
	Month	5	6	7	8	9	10	11	12	1	2	3	4	5
	Elapsed Month	40	41	42	43	44	45	46	47	48	49	50	51	52
Preparatory Works														
1 Baseline Survey														
1-1 Capacity Assessment														
2 Work Plan														
3 Confirmation of Design and Construction Circumstances for Public Buildings by PWD														
Output1：The capacity to do inventory, vulnerability assessment (seismic evaluation) of the existing public buildings is developed.														
Activity 1-1) To produce building inventory with GIS														
Activity 1-2) To categorize (rank up) existing public buildings											Chittagong			
Activity 1-3) To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings														
Activity 1-4) To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation														
Activity 1-5) To establish the method for seismic evaluation														
Activity 1-6) To prepare the manual for seismic evaluation of the existing public buildings														
Activity 1-7) To conduct seismic evaluation of the existing public buildings		Final Vulnerability Assessment(Seismic Evaluation) Manual								Chittagong		Review,Editorial board		
Activity 1-8) To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings														
Output2: The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established.														
Activity 2-1) To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design		Preparation and Practice of Liquefaction Potential Guide Book												
Activity 2-2) To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods														
Activity 2-3) To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters		Final Version Manual for Retrofitting Review,Editorial board												
Activity 2-4) To select the buildings for seismic retrofitting design														
Activity 2-5) To prepare the retrofitting plan for the selected buildings and prepare their design documents														
Output3：The capacity to implement retrofitting of the public buildings is developed.														
Activity 3-1) To conduct theoretical training on retrofitting works to C/P														
Activity 3-2) To study current experience on retrofitting works														
Activity 3-3) To develop more appropriate method for retrofitting work														
Activity 3-4) To manage test work and to test materials														
Activity 3-5) To prepare construction management manual for seismic retrofitting works		Final Version Manual for Retrofitting Work Review												
Output4：Quality control process is developed.														
Activity 4-1) To prepare check list and judgment guidelines for quality control		Final Version Check list and Guideline for Quality Control Review												
Activity 4-2) To prepare training materials on quality control														
Activity 4-3) To prepare monitoring database														
Activity 4-4) To do monitoring of pilot project for Retrofitting														
Activity 4-5) To review and feedback the monitoring results		Target the Pilot Project												
Output5：The technologies construction and retrofitting for new building design and retrofitting design of public buildings which PWD gets by the Project are succeeded within PWD as well are disseminated to relevant engineers of the organizations														
Activity 5-1) To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters.														
Activity 5-2) To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.														
Activity 5-3) To coordinate and arrange the training														
Activity 5-4) To review the training through course evaluation by the trainees														
Activity 5-5) To issue certificate to the trainees who completed training														
Activity 5-6) To produce and disseminate the materials of the project and training		Preparation of Materials												
Activity 5-7) To assist seismic assessment and retrofit planning of existing buildings for technique dissemination														

4. Actual Assignment Schedule of JICA Expert Team

Actual Assignment Schedule of JICA Expert Team

Project for Capacity Development on Natural Disaster-Resistant Technique of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Work in Bangladesh

Assignment	Name	Firm	Grde	Plan/actual	1st Year (2011~2012)	2nd Year (2012~2013)	3rd Year (2013~2014)	4th Year (2014~2016)	MM 1st Year BD	1st Year JP	2nd Year BD	2nd Year JP	3rd Year BD	3rd Year JP	4th Year BD	4th Year JP	Total BD	Total JP
Team Leader/Plan of Training	Fumio KANEKO	OYO International	2	Plan	9(0.30) 7 + 9(0.30) 16(0.53) 16(0.53)	21(0.70) 2+21(0.70) 7+16(0.53)+3	16(0.53)+6 16(0.53) 10(0.33) 14(0.47)+5	16(0.53) 30(1.00) 16(0.53) 16(0.53) 23(0.77) 23(0.77) 8(0.27) 16(0.53)	1.67		1.93		1.87		4.93		10.40	
Team Leader/Plan of Training	Fumio KANEKO	OYO International	2	Actual	9(0.30) 7 + 9(0.30) 16(0.53) 16(0.53)	21(0.70) 2+21(0.70) 7+16(0.53)+3	16(0.53)+6 16(0.53) 10(0.33) 14(0.47)+5	16(0.53) 10(0.33) 28(0.93) 15(0.50) 23(0.77) 14(0.47) 7(0.23) 9(0.30)+16 9(0.30)+4 17(0.57)	1.67		1.93		1.87		4.93		10.40	
Deputy Team Leader	Ryo MIYAZAKI	OYO International	4	Plan	23(0.77) 16(0.53 16(0.53) 16(0.53) 23(0.77)				3.13		0.00		0.00		0.00		3.13	
Deputy Team Leader	Ryo MIYAZAKI	OYO International	4	Actual	23(0.77) 16(0.53 16(0.53) 16(0.53) 23(0.77)				3.13		0.00		0.00		0.00		3.13	
Deputy Team Leader	Jun MATSUO	OYO International	4	Plan		23(0.77) 28(0.93)+4 7+30(1.00)+6	12(0.42) 37(1.23) 26(0.87) 8(0.27) 14(0.47) 21(0.70)+16	21(0.70) 21(0.70) 21(0.70) 21(0.70) 21(0.70) 30(1.00) 23(0.77) 23(0.77) 35(1.17)	0.00		2.70		3.93		7.90		14.53	
Deputy Team Leader	Jun MATSUO	OYO International	4	Actual		23(0.77) 28(0.93)+4 7+30(1.00)+6	12(0.42) 37(1.23) 26(0.87) 8(0.27) 14(0.47) 21(0.70)+16	21(0.70) 37(1.23) 21(0.70) 8(0.27) 13(0.43) 26(0.87) 16(0.53) 23(0.77) 33(1.10) 4(0.13) 35(1.17)	0.00		2.70		3.93		7.90		14.53	
Seismic Design	Akira INOUE	OYO International	3	Plan	14(0.47) 25(0.83) 25 (0.83) 23(0.77) 7+23(0.77)	30(1.00) 22(0.77) 37(1.20) 3+27(0.90)	15(0.50) 15(0.50) 30(1.00)		3.67		3.87		2.00		0.00		9.54	
Seismic Design	Akira INOUE	OYO International	3	Actual	14(0.47) 25(0.83) 25 (0.83) 23(0.77) 7+23(0.77)	30(1.00) 22(0.77) 37(1.20) 3+27(0.90)	15(0.50) 15(0.50) 30(1.00)		3.67		3.87		2.00		0.00		9.54	
Retrofitting of Existing Buildings (1)	Akira INOUE	OYO International	3	Plan			29(0.97) 16(0.53) 14(0.47) 14(0.47) 15(0.50)	30(1.00) 30(1.00) 23(0.77)	0.00		0.00		2.93		2.77		5.70	
Retrofitting of Existing Buildings (1)	Akira INOUE	OYO International	3	Actual			29(0.97) 16(0.53) 14(0.47) 14(0.47) 15(0.50)	30(1.00) 30(1.00) 23(0.77)	0.00		0.00		2.93		2.77		5.70	
Seismic Retrofitting(1)	Akira INOUE	OYO International	3	Plan			29(0.97)	14(0.47) 14(0.47) 23(0.76) 16(0.53) 21(0.70) 23(0.77) 23(0.77)	0.00		0.00		0.97		4.47		5.44	
Seismic Retrofitting(1)	Akira INOUE	OYO International	3	Actual			29(0.97)	14(0.47) 14(0.47) 31(1.03) 13(0.43)+1 18(0.60) 23(0.77) 21(0.70)	0.00		0.00		0.97		4.47		5.44	
Retrofitting of Existing Buildings (2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Plan	14(0.47) 14(0.47) 14(0.47) 14(0.47) 14(0.47)	14(0.47) 14(0.47) 14(0.47)	14(0.47)		2.33		1.40		0.47		0.00		4.20	
Retrofitting of Existing Buildings (2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Actual	14(0.47) 14(0.47) 14(0.47) 14(0.47) 14(0.47)	14(0.47) 14(0.47) 14(0.47)	14(0.47)		2.33		1.40		0.47		0.00		4.20	
Seismic Retrofitting(2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Plan				14(0.47)+2	0.00		0.00		0.47		0.00		0.47	
Seismic Retrofitting(2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Actual				14(0.47)+2	0.00		0.00		0.47		0.00		0.47	
Construction Management	Hiroshi OHIRA	Mohri Architect	3	Plan	14(0.47) 22				0.47		0.00		0.00		0.00		0.47	
Construction Management	Hiroshi OHIRA	Mohri Architect	3	Actual	14(0.47) 22				0.47		0.00		0.00		0.00		0.47	
Construction Management	Takeshi TAKESHITA	Mohri Architect	3	Plan	25(0.83) 25(0.83) 23(0.77)	25(0.83) 30(1.00)			2.43		1.83		0.00		0.00		4.26	
Construction Management	Takeshi TAKESHITA	Mohri Architect	3	Actual	25(0.83) 25(0.83) 23(0.77)	25(0.83) 30(1.00)			2.43		1.83		0.00		0.00		4.26	
Construction Management	Seiichi HORIKOSHI	Mohri Architect OYO International	3	Plan		23(0.77)	27(0.90) 30(1.00)	23(0.77) 30(1.00) 23(0.77)	0.00		0.77		1.90		7.13		10.83	
Construction Management	Kazuna KOIZUMI	Mohri Architect	3	Plan			31(1.03)	23(0.77) 30(1.00) 23(0.77) 16(0.53) 30(1.00)	0.00		0.00		1.03					
Construction Management	Seiichi HORIKOSHI	Mohri Architect OYO International	3	Actual		23(0.77)	27(0.90) 30(1.00)	10(0.33) 31(1.03) 30(1.00) 2(0.07) 37(1.23) 34(1.13) 29(0.96) 16(0.53) 16(0.53) 2+9(0.30)	0.00		0.67		1.90		7.13		10.73	
Construction Management	Kazuna KOIZUMI	Mohri Architect	3	Actual			31(1.03)		0.00		0.00		1.03					
Evaluation of Existing Buildings	Yosuke NAKAJIMA	OYO International (ERS)	4	Plan	14(0.47) 25(0.83) 25(0.83) 23(0.77) 14(0.47)	25(0.83) 30(1.00) 23(0.77)	30(1.00) 45(1.50) 43(1.43)+1	23(0.77) 51(1.70) 37(1.23) 44(1.47) 16(0.53) 16(0.53) 30(1.00)	3.37		2.60		3.93		7.23		17.13	
Evaluation of Existing Buildings	Yosuke NAKAJIMA	OYO International (ERS)	4	Actual	14(0.47) 25(0.83) 25(0.83) 23(0.77) 14(0.47)	25(0.83) 30(1.00) 23(0.77)	30(1.00) 45(1.50) 43(1.43)+1	7(0.23) 16(0.53) 14(0.47) 30(1.00) 44(1.47) 37(1.23) 30(1.00) 23(0.77) 16(0.53)+1	3.37		2.60		3.93		7.23		17.13	
Building Administration	Masayuki TAKAZAWA	OYO International (Kokusai Kogyo)	3	Plan	25(0.83) 23(0.77)				1.60		0.00		0.00		0.00		1.60	
Building Administration	Masayuki TAKAZAWA	OYO International (Kokusai Kogyo)	3	Actual	25(0.83) 23(0.77)				1.60		0.00		0.00		0.00		1.60	
Building Administration	Yukio KATAYANAGI	OYO International (Kokusai Kogyo)	3	Plan		25(0.83) 23(0.77) 23(0.77)	30(1.00) 30(1.00) 30(1.00)	30(1.00) 30(1.00) 30(1.00) 16(0.53) 16(0.53)	0.00		2.37		3.00		4.07		9.44	
Building Administration	Yukio KATAYANAGI	OYO International (Kokusai Kogyo)	3	Actual		25(0.83) 23(0.77) 23(0.77)	30(1.00) 30(1.00) 30(1.00)	30(1.00) 30(1.00) 30(1.00) 16(0.53) 16(0.53) 16(0.53)	0.00		2.37		3.00		4.07		9.44	
Management of GIS Database	Koichi HASEGAWA	OYO International	4	Plan	25(0.83) 23(0.77)	30(1.00) 23(0.77)	30(1.00)		1.60		1.77		1.00		0.00		4.37	
Management of GIS Database	Koichi HASEGAWA	OYO International	4	Actual	25(0.83) 23(0.77)	30(1.00) 23(0.77)	30(1.00)		1.60		1.77		1.00		0.00		4.37	
Earthquake Motion/ Liquefaction	Nozomu YOSHIDA	OYO International (Tohoku Gakuin Univ.)	3	Plan	9(0.30)				0.00		0.30		0.00		0.00		0.30	
Earthquake Motion/ Liquefaction	Nozomu YOSHIDA	OYO International (Tohoku Gakuin Univ.)	3	Actual	9(0.30)				0.00		0.30		0.00		0.00		0.30	
Dynamic response Analysis	Taiki SAITO	OYO International (Toyohashi University of Technology)	3	Plan			15(0.50		0.00		0.00		0.53		0.00		0.53	
Dynamic response Analysis	Taiki SAITO	OYO International (Toyohashi University of Technology)	3	Actual			15(0.50		0.00		0.00		0.53		0.00		0.53	
	Fumio KANEKO	OYO International		Actual				1(0.3)										
Community Disaster/ Plan of Training	Mahbub REZA	OYO International	4	Plan			15(0.50)+24 30(1.00)+15 15(0.50)+28	23(0.77) 23(0.77) 23(0.77)+7	0.00		0.00		2.00		2.30		4.30	
Community Disaster/ Plan of Training	Mahbub REZA	OYO International	4	Actual			15(0.50)+24 30(1.00)+15 15(0.50)+28	23(0.77) 23(0.77) 23(0.77)+7	0.00		0.00		2.00		2.30		4.30	
Project Publicity	Yuko NAKAGAWA	NPO SEEDS Asia	4	Plan			11(0.37) 8(0.37)	9(0.30) 9(0.30)	0.00		0.00		3.33		2.50		5.83	
Project Publicity	Eriko KOBAYASHI	NPO SEEDS Asia	4	Plan			16(0.53) 14(0.47) 15(0.50) 13(0.43) 10(0.33) 13(0.43)	9(0.30) 9(0.30) 12(0.40) 9(0.30) 9(0.30)	0.00		0.00		3.33		2.50		5.83	
Project Publicity	Yuko NAKAGAWA	NPO SEEDS Asia	4	Actual			11(0.37) 8(0.37)	4(0.13) 7(0.23)	0.00		0.00		3.33		2.50		5.83	
Project Publicity	Eriko KOBAYASHI	NPO SEEDS Asia	4	Actual			16(0.53) 14(0.47) 15(0.50) 13(0.43) 10(0.33) 13(0.43)	8(0.27) 12(0.40) 9(0.30) 11(0.37) 9(0.30) 6(0.20) 9(0.30)	0.00		0.00		3.33		2.50		5.83	
Building Application System /Dissemination and Enlightenment	Tetsuya SUZUKI	OYO International (Kokusai Kogyo)	5	Plan			30(1.00)+21 30(1.00) 30(1.00)	16(0.53) 30(1.00) 23(0.77)	0.00		0.00		3.00		2.30		5.30	
Building Application System /Dissemination and Enlightenment	Tetsuya SUZUKI	OYO International (Kokusai Kogyo)	5	Actual			30(1.00)+21 30(1.00) 30(1.00)	16(0.53) 30(1.00) 23(0.77)	0.00		0.00		3.00		2.30		5.30	
Seismic Evaluation/Vulnerability Assess	Matsutaro SEKI	OYO International (Personal)	3	Plan			16(0.53) 37(1.23)	16(0.53) 30(1.00) 16(0.53) 30(1.00) 23(0.77) 16(0.53) 16(0.53)	0.00		0.00		1.77		4.90		6.67	
Seismic Evaluation/Vulnerability Assess	Matsutaro SEKI	OYO International (Personal)	3	Actual			16(0.53) 37(1.23)	16(0.53) 16(0.53) 15(0.50) 28(0.93) 17(0.57) 16(0.53) 23(0.77) 16(0.53)	0.00		0.00		1.77		4.90		6.67	
Architectural Design (Fire Safety)	Kyoichi KOBAYASHI	Mohri Architect (Tokyo University of Science)	4	Plan				14(0.47)	0.00		0.00		0.00		0.47		0.47	
Architectural Design (Fire Safety)	Kyoichi KOBAYASHI	Mohri Architect (Tokyo University of Science)	4	Actual				7(0.23)	0.00		0.00		0.00		0.23		0.23	
Fire safefty Design	Taku SHIMADA	OYO International (Akeno Facility Resilience)	3	Plan				16(0.53) 16(0.53) 16(0.53) 16(0.53)	0.00		0.00		0.00		2.13		2.13	
Fire safefty Design	Taku SHIMADA	OYO International (Akeno Facility Resilience)	3	Actual				16(0.53) 16(0.53) 16(0.53) 16(0.53)	0.00		0.00		0.00		2.13		2.13	
Operational coordination	Masaaki AIZAWA	OYO International	6	Plan	30(1.00)+40 40(1.33)+30 30(1.00)+13	30(1.00)+42 30(1.00)+22 22(0.73)+29	40(1.33)+11 33(1.11)+11 30(1.00) 37(1.23)+7 30(1.00) 16(0.53) 9(0.30)		0.00		3.33		2.73		7.83		13.89	
Operational coordination	Masaaki AIZAWA	OYO International	6	Actual	30(1.00)+40 40(1.33)+30 30(1.00)+13	30(1.00)+42 30(1.00)+22 22(0.73)+29	47(1.57)+11 34(1.13) 26(0.87)+11 43(1.43)+6 13(0.43) 7+30(1.00) 22(0.73) 3(0.10)+16		0.00		3.33		2.73		7.83		13.89	
Operational coordination	Seiichi HORIKOSHI	OYO International	6	Actual			17(0.57)											
								Sub-total of Work in Bangladesh (Initial Plan)	14.73		16.87		16.72		9.57		57.89	
								Sub-total of Work in Bangladesh(Plan)	20.27		22.87		36.86		60.93		140.93	
								Sub-total of Work in Bangladesh(Actual)	20.27		22.77		36.86		60.69		140.59	

Actual Assignment Schedule of JICA Expert Team

Project for Capacity Development on Natural Disaster-Resistant Technique of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

	Assignment	Name	Firm	Grde	Plan/actual	1st Year (2011~2012)	2nd Year (2012~2013)	3rd Year (2013~2014)	4th Year (2014~2016)	MM 1st Year BD	1st Year JP	2nd Year BD	2nd Year JP	3rd Year BD	3rd Year JP	4th Year BD	4th Year JP	Total BD	Total JP
						2 3 4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3	4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1										
Work in Japan	Team Leader/Plan of Training	Fumio KANEKO	OYO International	2	Plan	1(0.03) 2(0.07)	2(0.07) 2(0.07)	3(0.15) 4(0.20)	3(0.15) 4(0.20) 5(0.25)		0.10		0.13		0.35		0.60		1.18
	Team Leader/Plan of Training	Fumio KANEKO	OYO International	2	Actual	1(0.03) 2(0.07)	2(0.07) 2(0.07)	3(0.15) 4(0.20)	3(0.15) 4(0.20) 5(0.25)		0.10		0.13		0.35		0.60		1.18
	Deputy Team Leader	Ryo MIYAZAKI	OYO International	4	Plan	2(0.07) 3(0.10)					0.17		0.00		0.00		0.00		0.17
	Deputy Team Leader	Ryo MIYAZAKI	OYO International	4	Actual	2(0.07) 3(0.10)					0.17		0.00		0.00		0.00		0.17
	Deputy Team Leader	Jun MATSUO	OYO International	4	Plan	3(0.10) 3(0.10)	3(0.15) 3(0.15)	6(0.30) 6(0.30) 5(0.25)			0.00		0.20		0.30		0.85		1.35
	Deputy Team Leader	Jun MATSUO	OYO International	4	Actual	3(0.10) 3(0.10)	3(0.15) 3(0.15)	6(0.30) 6(0.30) 2(0.10) 3(0.15)			0.00		0.20		0.30		0.85		1.35
	Seismic Design	Akira INOUE	OYO International	3	Plan	2(0.07) 3(0.10)	6(0.10) 6(0.10)				0.17		0.40		0.00		0.00		0.57
	Seismic Design	Akira INOUE	OYO International	3	Actual	2(0.07) 3(0.10)	6(0.10) 6(0.10)				0.17		0.40		0.00		0.00		0.57
	Retrofitting of Existing Buildings (1)	Akira INOUE	OYO International	3	Plan		6(0.30) 4(0.20)	3(0.15) 6(0.30)			0.00		0.00		0.50		0.45		0.95
	Retrofitting of Existing Buildings (1)	Akira INOUE	OYO International	3	Actual		6(0.30) 4(0.20)	3(0.15) 6(0.30)			0.00		0.00		0.50		0.45		0.95
	Seismic Retrofitting(1)	Akira INOUE	OYO International	3	Plan			7(0.35) 5(0.25) 5(0.25) 20(1.00)			0.00		0.00		0.00		1.85		1.85
	Seismic Retrofitting(1)	Akira INOUE	OYO International	3	Actual			7(0.35) 5(0.25) 5(0.25) 15(0.75) 5(0.25)			0.00		0.00		0.00		1.85		1.85
	Retrofitting of Existing Buildings (2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Plan	2(0.07) 2(0.07)	2(0.07) 2(0.07)	30(1.50) 10(0.50)	10(0.50		0.13		0.13		2.00		0.50		2.76
	Retrofitting of Existing Buildings (2)	Osamu MIYOSHI	Mohri Architect (OM)	3	Actual	2(0.07) 2(0.07)	2(0.07) 2(0.07)	30(1.50) 10(0.50)	10(0.50		0.13		0.13		2.00		0.50		2.76
	Evaluation of Existing Buildings	Yosuke NAKAJIMA	OYO International (ERS)	4	Plan			4(0.20) 19(0.20) 7(0.35)	10(0.50 5(0.25) 5(0.25) 5(0.25)		0.00		1.00		1.50		1.25		3.75
	Evaluation of Existing Buildings	Yosuke NAKAJIMA	OYO International (ERS)	4	Actual		30(1.00)	4(0.20) 19(0.20) 7(0.35)	10(0.50 5(0.25) 5(0.25) 5(0.25)		0.00		1.00		1.50		1.25		3.75
	Earthquake Motion/ Liquefaction	Nozomu YOSHIDA	OYO International (Tohoku Gakuin Univ.)	3	Plan		2(0.07) 2(0.07)				0.00		0.13		0.00		0.00		0.13
	Earthquake Motion/ Liquefaction	Nozomu YOSHIDA	OYO International (Tohoku Gakuin Univ.)	3	Actual		2(0.07) 2(0.07)				0.00		0.13		0.00		0.00		0.13
	Construction Management	Hiroshi OHIRA	Mohri Architec	3	Plan	2(0.07)					0.07		0.00		0.00		0.00		0.07
	Construction Management	Hiroshi OHIRA	Mohri Architec	3	Actual	2(0.07)					0.07		0.00		0.00		0.00		0.07
	Construction Management	Takeshi TAKESHITA	Mohri Architec	3	Plan	2(0.07)	2(0.07)				0.07		0.07		0.00		0.00		0.14
	Construction Management	Takeshi TAKESHITA	Mohri Architec	3	Actual	2(0.07)	2(0.07)				0.07		0.07		0.00		0.00		0.14
	Construction Management	Seiichi HORIKOSHI	Mohri Architect OYO International	3	Plan			4(0.20) 2(0.10) 6(0.30) 2(0.10)	2(0.10) 10(0.50) 5(0.25) 5(0.25) 5(0.25) 5(0.25)		0.00		0.07		0.70		1.60		2.37
	Construction Management	Seiichi HORIKOSHI	Mohri Architect OYO International	3	Actual		2(0.07)	4(0.20) 2(0.10)	5(0.25) 5(0.25) 5(0.25)		0.00		0.07						
		Kazuna KOIZUMI	Mohri Architec	3	Actual		2(0.07)	6(0.30) 2(0.10)	2(0.10) 5(0.25) 5(0.25) 5(0.25)		0.00		0.00		0.70		1.60		2.37
	Building Administration	Yukio KATAYANAGI	OYO International (Kokusai Kogyo)	3	Plan				10(0.50)		0.00		0.00		0.00		0.50		0.50
	Building Administration	Yukio KATAYANAGI	OYO International (Kokusai Kogyo)	3	Actual				8(0.40) 2(0.10)		0.00		0.00		0.00		0.50		0.50
	Architectural Design (Fire Safety)	Kyoichi KOBAYASHI	Mohri Architect (Tokyo University of Science)	4	Plan				10(0.50)		0.00		0.00		0.00		0.00		0.00
	Architectural Design (Fire Safety)	Kyoichi KOBAYASHI	Mohri Architect (Tokyo University of Science)	4	Actual				3(0.15) 2(0.10)		0.00		0.00		0.00		0.50		0.50
	Support of Manual preparation	Koichi HASEGAWA	OYO International	3	Plan				10(0.50)		0.00		0.00		0.00		0.50		0.50
	Support of Manual preparation	Koichi HASEGAWA	OYO International	3	Actual				5(0.25) 5(0.25)		0.00		0.00		0.00		0.24		0.24
	Training in Japan	Traveling companion	* * * *	5	Plan		9(0.30) 20(0.67)				0.00		0.97		0.00		0.00		0.97
	Training in Japan	Traveling companion	* * * *	5	Actual		9(0.30) 20(0.67)				0.00		0.97		0.00		0.00		0.97
	Operational training	Before,After	* * * *	5	Plan		5(0.17) 5(0.17)				0.00		0.33		0.00		0.00		0.33
	Operational training	Before,After	* * * *	5	Actual		5(0.17) 5(0.17)				0.00		0.33		0.00		0.00		0.33
									Sub-total of Work in Bangladesh (Initial Plan)		0.70		0.76		0.89		1.06		3.41
									Sub-total of Work in Bangladesh(Plan)		0.70		3.43		5.35		8.10		17.58
									Sub-total of Work in Bangladesh(Actual)		0.70		3.43		5.35		8.34		16.02
	Reporting	Submisshon Time (△:Report Submission)				Inception Report(1) Work Plan(1) Progress Report(1)	Inception Report(2) Work Plan(2) Progress Report(2)	Inception Report(3) Work Plan(3) Progress Report(3)	Inception Report(4) Work Plan(4) Final Report										
									Grand-total of Work in Bangladesh (Initial Plan)	1st Year	15.43	2nd Year	17.63	3rd Year	17.61	4th Year	10.63	Tatal MM	61.30
									Grand-total of Work in Bangladesh (Plan)	1st Year	20.97	2nd Year	26.90	3rd Year	42.21	4th Year	69.03	Tatal MM	131.10
									Sub-total of Work in Bangladesh(Actual)	1年次	20.97	2年次	26.20	3年次	42.21	4年次	69.03	Tatal MM	156.61
	Stage					Site Survey Reporting; Site Survey; Site Survey; Site Survey Reporting; Training in Japan	Site Survey Reporting; Site Survey; Site Survey Reporting; Training in Japan	Site Survey Reporting; Site Survey; Site Survey Reporting	Site Survey Reporting Reporting										

Legend: Work in Bangladesh; Work in Japan; Expense of Company

5. Training in Japan

1st year Training in Japan

General Training

Duration: Feb 4, 2012 to Feb 17, 2012

Training in Japan (1st year) General Training

(a) Schedule and Syllabus

Date	Week	AM/PM	Time	Duration	Activity	Purpose / Contents	Person in Charge
4-Feb-2012	Sat	PM	13:40～17:10	2.5	Dhaka > Bangkok	Move	
5-Feb-2012	Sun	AM	23:50(-1)～7:30	5.5	Bangkok > Narita	Move	
			9:00～12:00	3.0	Narita > JICA Tokyo	Move and Check-in	
		PM	Holiday				
6-Feb-2012	Mon	AM	9:30～14:30	4.0	JICA Tokyo (Hatagaya)	Briefing and Orientation	JICA Tokyo Mr. Tatsuaki INOUE
		PM	15:00～19:00	4.0	JICA Tokyo (Hatagaya)	Lecture 1: 1-1 Building regulation and code in Japan 1-2 Promotion of retrofitting in Japan 1-3 Summary of Tohoku Earthquake and Tsunami / building damage and the future measures	Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Director for International Building Analysis Housing Bureau Mr. Tomohiro HASEGAWA
7-Feb-2012	Tue	AM	10:00～10:45	1.0	Central Government Building No.2 Meeting room of Government Buildings Services in 13th Floor	Lecture 2: Preparation and utilization of public building inventory / database	MLIT, Government Building Projecting Officer for Planning Division, Government Buildings Department Mr. KOIZUMI
			11:00～12:00	1.0		Lecture 3: Capacity development of engineers with training	College of Land. Infrastructure, Transport and Tourism Mr. WAKABAYASHI
			13:30～15:00	1.5	Central Government Building No.3 (Seismic isolation)	Site Visit 1: Quality management and assurance of the retrofitting design (1) Existing seismic isolation (2) Retrofitting construction site	MLIT, Government Building Disaster Prevention Officer for Architecture and Building Engineering Division, Government Buildings Department Mr. YAMADA
			15:30～17:00	1.5	National Diet Library (Retrofitting)		
8-Feb-2012	Wed	AM	9:30～13:30	1.5	JICA Tokyo (Hatagaya)	Lecture 4: Fire Prevention for RC Buildings 4-1 Some Important Aspects of Fire Safety Regulations 4-2 Management of Great East Japan Earthquake & Tsunami by Fire Service in Japan	Tokyo University of Science Prof. Kyoichi KOBAYASHI Mr. Muhammad Mamum
		PM	14:00～17:00	3.0	Public school in Chiba Prefecture	Site Visit 2: Retrofitted schools	SPC Design (limited private company), General Director Mr. Takao SONOBE
9-Feb-2012	Thu	AM	9:00～11:30	2.5	Honjo Life Safety Learning Center	Site Visit 3: Display and demonstration of disaster prevention measures	
		PM	13:00～14:00	1.0	JICA Tokyo (Hatagaya)	Discussion on issues and foresight to disseminate the seismic resistant buildings in Bangladesh	Tokyo University Prof. Emeritus Syunsuke OTANI
			14:30～18:00	3.5		Making action plan 1	JICA Senior Advisor Dr. Tatsuo NARAFU Penta-Ocean Construction Co., LTD., Operating Officer Mr. Toyokazu SHIMIZU
10-Feb-2012	Fri	AM	8:30～11:30	3.0	JICA Tokyo > Sendai	Check-out and Move	
		PM	13:30～16:00	2.5	Tohoku University	Lecture 5: Damage due to earthquake, and retrofitting effect Site Visit 4: Observation of damage conditions	Tohoku University Prof. Masato MOTOSAKA
			16:00～17:30	1.5	Sendai > Ishinomaki	Move	
11-Feb-2012	Sat	AM	9:00～12:00	3.0	Ishinomaki and Onagawa	Site Visit 5: Observation of damage due to Higashihnihon earthquake and tsunami on last 11-March	Tohoku University Prof. Masato MOTOSAKA Yamagata University Associate Prof. Kazuya MITSUJI
		PM	13:00～16:00	3.0	Onagawa > Sendai airport	Move and observation	
			16:55～18:30	1.5	Sendai airport > Itami airport	Move	
			19:00～20:00	1.0	Itami airport > JICA Hyogo	Move and Check-in	
12-Feb-2012	Sun	AM	9:00～12:00	3.0	Kyoto	Morning Tour	
		PM	13:00 ～18:00	5.0	Kyoto and Osaka	Site Visit 6: Seismic resistance technique of the traditional construct and New building	
13-Feb-2012	Mon	AM	10:00～10:50 11:00～11:50	2.0	Hyogo Prefecture, Center for Disaster Management	Lecture 6: Damage conditions of Hansin-Awaji Earthquake in 1995 and its recovery / reconstruction	Hyogo Prefectural Government Project Planning & Coordination Division, Disaster management & Planning Bureau Mr. Shinichiro OOE
		PM	13:30～14:15 14:25～15:10 15:40～16:40	3.5	JICA Hyogo Shoin secondary and high school in Hyogo Prefecture	Lecture 7: Example of Retrofitting 7-1 A Background of Retrofitting and Examples in Japan (1) 7-2 A Background of Retrofitting and Examples in Japan (2) Site Visit 7: Retrofitted schools	Takenaka Corporation Mr. Takaaki SHIRATORI
14-Feb-2012	Tue	AM	9:30～12:00	2.5	Disaster Reduction and Human Renovation Institute	Site Visit 8: Lesson learned from the Great Hansin-Awaji Earthquake and disaster prevention awareness	Disaster Reduction and Human Renovation Institute Mr. KISHI
		PM	14:00～16:00	2.0	Hokudan Earthquake Memorial Park Awaji Island Park	Site Visit 9: Actual situation of the Great Hanshin-Awaji Earthquake and Technique of Brige Construction	
15-Feb-2012	Wed	AM	9:30～12:00	2.5	JICA Hyogo	Making action plan 2	JICA Tokyo Mr. Tatsuaki INOUE Penta-Ocean Construction Co., LTD., Operating Officer Mr. Toyokazu SHIMIZU
		PM	13:30～16:00	2.5		Presentation of the action plan and its compilation	
			16:15～17:30	1.3		Evaluation, Award of certificate	JICA Tokyo Mr. Tatsuaki INOUE
16-Feb-2012	Thu	AM	7:00～9:00	2.0	JICA Hyogo > Kansai airport	Check-out and Move	
		PM	11:00～15:45	6.5	Kansai airport > Bangkok	Move	
17-Feb-2012	Fri	AM	10:55～12:30	2.5	Bangkok > Dhaka	Move	

(b) List of Trainee

	Name	Position / Occupation	Working Team
1.	Md.Abdul Malek Sikder	Superintending Engineer PWD Design Circle-1 Dhaka	PMT Project Manager
2.	Mohammad Ziaul Hafiz	Superintending Engineer PWD Circle-IV Dhaka	WT 4 Team Leader
3.	Ali Newaz Ahmed	Executive Engineer PWD Survey Division Dhaka	WT 1 Team Leader
4.	Sardar Mainul Islam	Executive Engineer PWD Resource Division Dhaka	WT 5 Team Leader
5.	K.M.Mostafa Hasan	Executive Engineer (Audit) PWD Audit and Monitoring Circle Dhaka	WT 4 Deputy Team Leader
6.	Muhammad Mostafijur Rahman	Subdivisional Engineer PWD Survey Subdivision-I Dhaka	WT 1 Team Member
7.	Mohammad Abul Kalam Azad	Subdivisional Engineer PWD Design Division-VI Dhaka	WT 5 Team Member
8.	Md.Akhsanul Islam	Assistant Engineer PWD Design Division-II Dhaka	WT 1 Team Member

2nd year Training in Japan

Senior Officers Training

Duration: Jul 7, 2012 to Jul 15, 2012

Training in Japan (2nd year) Senior Officers Training

(a) Schedule and Syllabus

Date	Week	AM/PM	Place	Stay	Theme
2012/07/07	Sat	PM	Dhaka ⇒ Bangkok	flight	Transfer
2012/07/08	Sun	AM	Bangkok ⇒ Narita Airport		Transfer
			Narita Airport ⇒ Tokyo	Tokyo	Transfer
2012/07/09	Mon	AM	JICA Tokyo International Center (TIC)	Tokyo	Briefing Session & Program Orientation
					Lectuer 1: 1-1 Building regulation in Japan (Regulation system and Building code) 1-2 Promotion system of retrofitting in Japan
2012/07/10	Tue	AM	JICA Headquarters		Lecture 2: Vulnerabilities of Building in Developing Countries and How to Conquer it
			Central Govemment Building No.2, Government Buildings Department		Courtesy visit 1: Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Minister's Government Buildings Management Department - Exchange of opinions on Policy for Retrofitting of Government Buildings
			Central Govemment Building No.3 (Seismic isolation)	Tokyo	Site Visit 1: Retrofitting design and construction management - Existing seismic isolation
2012/07/11	Wed	AM	The Japan Building Disaster Prevention Association		Courtesy Visit 2: Japan Building Disaster Prevention Association - Necessity and Difficulty of Seismic Retrofitting
					Lectur 3: Necessity of Seismic Resistance Technology
			Technical Research Institute, Shimizu Corporation	Tokyo	Site visit 2: Cutting-edge of Seismic isolation and seismic response active control structure (presentation of
2012/07/12	Thu	AM	Tokyo ⇒ Sendai		Transfer
		PM	Touhoku University, Disaster Control Research Center		Courtesy Visit 3: Tohoku University - Actual state and issues of Retrofitting
			Sendai ⇒ Ishinomaki	Ishinomaki	transfer
2012/07/13	Fri	AM	Ishinomaki and Onagawa		Site Visit 3: Observation of damage condition
		PM	Onagawa ⇒ Sendai ⇒ Tokyo ⇒ JICA HQ		Transfer
			JICA Headquarters		Courtesy Visit 4: JICA Headquarters - Evaluation Meeting, Closing Ceremony
			JICA HQ ⇒ Tokyo	Tokyo	
2012/07/14	Sat	AM			
		PM	Tokyo ⇒ Haneda Airport		Transfer
2012/07/15	Sun	AM	Haneda Airport ⇒Bangkok	flight	Transfer
		PM	Bangkok⇒Dhaka		Transfer

(b) List of Trainee

No.	Name	Position	Organization (Ministry)
1	Mr. Shayam Shundar SIKDER	Additional Secretary (Administration)	Ministry of Housing and Public Works
2	Mr. Mohammad Abdul WAZED	Additional Secretary (Disaster Management)	Ministry of Food and Disaster Management
3	Mr. Kamal Uddin TALUKDER	Joint Secretary	Ministry of Housing and Public Works
4	Mr. Md. Kabir Ahmed BHUIYAN	Chief Engineer	Public Works Department , MoHPW
5	Mr. Md. Ahsanul Haque KHAN	Chief Architect	Department of Architecture, MoHPW
6	Mr. Md. Abul QUASEM	Additional Chief Engineer (P & SP & Project Director of CNCRP)	Public Works Department, MoHPW
7	Mr. Md. Abul BASHER	Additional Chief Engineer, (Rajshahi Zone)	Public Works Department, MoHPW

2nd year Training in Japan

General Training

Duration: Jul 21, 2012 to Aug 9, 2012

Training in Japan (2nd year) General Training

(a) Schedule and Syllabus

CNCRP Shedule of Trainning and Dialogue in Japan for PWD Team for the project, "Project for Capacity Development on Natural Disaster-Resistant Techniques of Construc

Date	Week	AM/PM	Time	Term	Movement / Place of training	Purpose(Detail)	Lecturer
2012/07/21	Sat	PM	13:40~ 17:10	3.5	Dhaka →Bangkok	Move	
2012/07/22	Sun	AM	23:00(1)~ 7:30	3.5	Bangkok → Narita Airport	Move	
			9:00~ 12:00	3.0	Narita Airport →JICA Tokyo	Move and Check in	
		PM	Day off				
2012/07/23	Mon	AM	9:30~ 12:00	2.5	JICA Tokyo (Hatagaya)	Briefing	JICA Tokyo
			12:30~ 14:00	0.5	JICA Tokyo (Hatagaya)	Orientation	OYO International Corporation Mr. Akira INOUE
		PM	14:00~17:00	3.0	JICA Tokyo (Hatagaya)	Making Action plan 1	Penta-Ocean Construction Co., LTD. Operating Officer Mr. Toyokazu SHIMIZU JICA Tokyo Dr. Tatsuo NARAFU
2012/07/24	Tue	AM	9:00~12:00	3.0	JICA Tokyo (Hatagaya)	Lecture 1 1-1 Building regulation and code in Japan (Regulation system and Building code) 1-2 Promotion measures for retrofitting in Japan 1-3 Building damages by Higashi-Nihon Earthquake Disaster and measures since then	Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Director for International Building Analysis Housing Bureau Mr. Tomohiro HASEGAWA
		PM	14:00~15:30	1.5	Central Gov't Bldg No.3 (Seismic isolation)	Site Visit 1 : Retrofitting design and construction supervision (1) Existing seismic isolation (2) Seismic retrofitting construction site	MLIT, Architecture and Building Engineering Division, Government Buildings Department Minister's Secretariat Government Building Disaster Prevention Officer Mr. YAMADA
			16:00~17:00	1.0	National Diet Library Tokyo Main Building (Earthquake resistant)		
2012/07/25	Wed	AM	9:00~12:00	3.0	JICA Tokyo (Hatagaya)	Lecture 2: Seismic evaluation and Retrofitting design of existing RC buildings	Earthquake Research Institute,The University of Tokyo Prof. Toshimi KABEYASAWA
		PM	14:00~17:00	3.0	New building site (under construction)	Site Visit 2: Observation of new RC building construction	Project Manager Mr. Takafumi Yamaguchi (General Manager Mr.Mitsuo TAKAHASHI)
2012/07/26	Thu	AM	9:00~12:00	3.0	JICA Tokyo (Hatagaya)	Lecture 3 Earthquake resistant structure and design of RC buildings	The University of Tokyo Prof. Emeritus Syunsuke OTANI
		PM	14:00~17:00	3.0	JICA Tokyo (Hatagaya)	**Lecture 4: Building vibration and analysis (Practice 1)**	**Building Research Institute Dr. Taiki SAITO**
2012/07/27	Fri	AM	8:30~11:30	3.0	JICA Kyoto → Sendai	Move	
		PM	13:30~16:00	2.5	Tohoku University, Comprehensive Research Building, 3rd floor	Lecture 5: Damages by Higashi-nihon Earthquake Disaster and effect of seismic retrofitting Site Visit 3: Damages of buildings at Tohoku University	Tohoku University Prof. Masato MOTOSAKA
			16:30~18:00	1.5	Tohoku University →Ishinomaki	Move	
2012/07/28	Sat	AM	9:00~11:00	2.0	Ishinomaki and Onagawa	Site Visit 4: Observation of shaken areas	Yamagata University Associate Prof. Kazuya MIDO
		PM	11:00~17:30	6.0	Onagawa →Ishinomaki Station → Sendai Station →Tokyo Station → Hatagaya	Move	
2012/07/29	Sun	All	Holiday				
2012/07/30	Sat	AM	10:00~12:00	2.0	Architecture Hall 5th floor, Chiba city	Lecture 6: Examples of Seismic evaluation and Retrofitting design	Japan Structural Consultants Association in Chiba Deputy Representative Teruhiko ICHIHARA
		PM	13:00~16:00	1.5	Public school in Chiba Prefecture (Site visit, Retrofitting construction sites)	Site Visit 5: Observation of construction (reinforce retrofitting)	Kamagata Corporation Mr. Hideyuki KAMIKAKI Japan Structural Consultants Association in Chiba Deputy Representative Teruhiko ICHIHARA
			16:00~17:00	1.0			
2012/07/31	Tue	AM	11:00~13:00	2.0	LIFE SAFETY LEARNING CENTER	Visit 1 : Experience of Disaster	
		PM	14:30~17:00	2.5	Technical Research Institute of Shimizu Corporation	Site Visit 6: The most advanced engineering of seismic isolation and seismic response control structure (introduction of technology)	SHIMIZU Corporation Technical Research Institute Mr. Shoji HAYASHI
Date	Week	AM/PM	Time	Term	Movement / Place of training	Purpose(Detail)	Lecturer
2012/08/01	Wed	AM	10:00~13:00	3.0	JICA Tokyo (Hatagaya)	**Lecture 7: Architectural Vibration and analysis (practice 2)**	**Building Research Institute Dr. Taiki Saito**
		PM	15:00~17:00	2.0	**Hachioji Takiyama Housing estate**	**Lecture 8: Quality Control of RC Structure Retrofitting**	**Urban Renaissance Agency Headquarters of East Japan Rental Housing Design Division Structure Team Mr. Shoji IDEBA E-mail : s-ideba@ur-net.go.jp**
2012/08/02	Thu	AM	8:50~12:30	3.6	**JICA Tokyo (Hatagaya) →Tokyo →Shin Osaka → Site in Osaka city**	**Check out, Move → Site**	
		PM	14:00~16:30	2.5	**Building construction site in Osaka city**	**Site visit 6: Observation of Steel Structure Construction site**	**Eajima Corporation Kansai Branch IDEC Corporation new headquarters Research building new construction project Project Manager Mr Hiroki ECHI TEL. 06-6396-2440**
2012/08/03	Fri	AM	8:30~10:00	1.5	Hotel → E-Defense	Move	
			10:00~12:00	2.0	E-Defense	Visit 2: Observation of experimental facility	
		PM	13:00~17:00	2.0	Disaster Reduction and Human Renovation Institution	Visit 3: Lesson learned from the Great Hanshin-Awaji Earthquake on Disaster prevention awareness	Disaster Reduction and Human Renovation Institute
2012/08/04	Sat	Whole day	Holiday				
2012/08/05	Sun	Whole day	9:00~17:00	8.0	Traditional buildings in Kyoto	Site Visit 7: Seismic resistance technique of the traditional buildings (1)	**Managing director Mr Yoshiaki KOMMAGA**
2012/08/06	Mon	AM	10:00~12:00	2.0	Hyogo Prefecture, Center for Disaster Management	Lecture 9: Damages by Hanshin-Awaji Earthquake Disasters in 1995 and its recovery / reconstruction	Hyogo Prefectural Government, Disaster Management Division, Disaster Management Bureau, Citizens Planning Department Mr Natsuhisa AZUMA
		PM	14:30~16:30	2.0	Site visit Himeji Castle	Site Visit 8: Seismic resistance technique of the traditional building (2)	**Manager Mr. Masakazu EGAWA**
2012/08/07	Tue	AM	9:30~12:00	2.5	JICA Kansai	Making action plan 2	JICA Tokyo Mr Tatsuki INOUE Penta-Ocean Construction Co., LTD., Operating Officer Mr Toyokazu SHIMIZU
		PM	13:30~16:00	2.5		Presentation of the action plan and its compilation	
			16:30~17:30	1.0		Evaluation, Award of Certificate	JICA Tokyo Ms. Yuki TAKAKI
2012/08/08	Wed	AM	7:00~ 9:00	2.0	JICA Kansai → Kansai Airport	Check-out and Move	
		PM	11:00~ 15:45	6.3	Kansai Airport → Bangkok	Move	
2012/08/09	Thu	AM	10:55~ 12:30	2.5	Bangkok → Dhaka	Move	

(b) List of Trainee

No.	Name	Designation	Working Group
1	MD. MAFIZUR RAHMAN	Executive Engineer PWD Design Division-V	DEPUTY PROJECT MANAGER
2	MD. SOHEL RAHMAN	Executive Engineer, PWD Design Division-IV	TEAM LEADER, WT-3
3	MD. RAFIQUL ISLAM	Executive Engineer, PWD Design Division-III	TEAM LEADER, WT-2
4	KAZI MD. FIROZE HASSAN	Executive Engineer, PWD PECU Division	MEMBER, WT-4
5	MD. MOMINUR RAHMAN	Sub Divisional Engineer, PWD Design Division-III	MEMBER, WT-2
6	MD. MORSHED HOSSAIN	Sub Divisional Engineer, PWD Resource Sub Division.	MEMBER, WT-5
7	ABDULLAH MOHAMMOD ZUBAIR	Sub Divisional Engineer, PWD Design Division-V	MEMBER, WT-4
8	ANUP KUMAR HALDER	Sub Divisional Engineer, PWD Design Division-V	MEMBER, WT-2
9	Ms. RAFIA BEGUM	Sub-Divisional, Engineer PWD E/M P&D Circle,	MEMBER, WT-1
10	MD. JAHIDUL ISLAM KHAN	Assistant Engineer, PWD Design Division -II	MEMBER, WT-2
11	MD. SHAFIUL ISLAM	Assistant Engineer, PWD Design Circle-1	MEMBER, WT-3
12	NUR-E-KAWONINE	Assistant Engineer, PWD Design Division -I	MEMBER, WT-3
13	A.S.M. SHAHRIAR JAHAN	Assistant Engineer, PWD Design Division-I	MEMBER, WT-3
14	MONIRUZZAMAN MONI	Assistant Engineer, PWD Design Division -III	MEMBER, WT-2
15	ZAHID HASAN KHAN	Assistant Engineer, PWD Design Division –V	MEMBER, WT-3

6. Procurement of Equipment

Procurement of Equipment

Table 1 shows equipment list to be procured in each Year managed by JET. JICA Bangladesh Office grants a vehicle to PWD directly.

Table 1 Procured Equipment List

[Procurement in Japan]

Item		Unit	1st Year	2nd Year	3rd Year	4th Year
Software						
1	Microsoft Access	license	-	-	2	-
Site survey in related with building structure						
2	Rebar detector	nos.	2	1	-	-
3	Antenna of rebar detector for deep	nos.			3	
4	High spec rebar detector	nos.			1	
5	Concrete core sampling machine	nos.	3	-	-	-
6	Optional parts of the above	set	3	-	-	-
7	Schmidt hammer	nos.	3	-	-	-
8	Dial gauge 100mm strokes	piece	-	4	-	-
9	Displacement Transducer	piece	-	4	-	-
10	Guide Roller (Wear Plate)	set	-	4	-	-
11	Rebound Test Hammer for Soft Rock	nos.	-	1	2	
12	Calibration Anvil for Rebound Test Hammers (For Soft Rock Rebound Test Hummer)	nos.	-	1	-	-
13	Calibration Anvil for Rebound Test Hammers (For Concrete Rebound Test Hummer)	piece	-	1	-	-
14	Portable cone penetration testing machine	nos.			1	
Activity record						
15	Digital camera with GPS	nos.	9	-	-	-
16	Video camera	nos.	1	-	-	-
Awareness materials						
17	My home Bururu	nos.	3	-	-	-

[Procurement in Bangladesh]

Item		Unit	1st Year	2nd Year	3rd Year	4th Year
Software						
18	GIS software (ArcView)	license	2	-	-	-
19	OS (Microsoft Office)	license	3	-	-	-
20	Antivirus software (for Desktop PC)	license	3	-	-	-
21	Renewal of above soft	license	-	3	3	3
22	Antivirus software (for Laptop PC)	license	-	9	-	-
23	Renewal of above soft	license	-	-	9	9
Site survey in related with building structure						
24	Laser distance meter	nos.	3	-	-	-
25	Phenolphthalein	bottle	12	6	2	-
Structural calculation software						
26	Perform 3D	license	2	-	-	-
27	Annual license fee of the above	L/S	-	-	2	-
28	SeismoStruct & SeismoSignal	license	2	-	-	-
Office automation equipment						
29	Desktop computer for GIS	nos.	1	-	-	-
30	Desktop computer for calculation	nos.	1	-	-	-
31	Desktop computer for common	nos.	1	-	-	-
32	Inkjet all in one printer (color)	nos.	1	-	-	-
33	UPS	nos.	3	-	-	-
34	Multifunctional laser printer	nos.	1	-	-	-
35	Projector	nos.	1	-	-	-
36	Plotter	nos.	3	-	-	-
37	Sound system	nos.	1	-	-	-
38	Laptop computer	nos.	6	-	-	-

7. Joint Coordination Committee(JCC)

1st JCC

Date: June 15, 2011

The project for Capacity Development on Natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings
[A JICA Technical Cooperation Project in association with PWD]

First meeting of the Joint Coordination Committee (JCC)

Date: 15-06-2011
Time: 11.00am
Venue: Office of the Chief Engineer, PWD

Programme:

1. **Address of welcome by the Chief Engineer, PWD**
2. **Address by Hiroyuki Tomita, Senior Representative, JICA Bangladesh Office.**
3. **Presentation on the background of the Project by Mr. Fumio Kaneko, Team Leader, Japanese Expert Team**
4. **Presentation on the Work Plan of the Project by Md. Abdul Malek Sikder, Superintending Engineer, PWD Design Circle-I and Project Manager.**
5. **Comments on the Project by the JCC members**
6. **Closing Speech by the Chief Engineer, PWD**

15/06/2011 **1st JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Md. Ahsanul Haque Khan	Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Md. Golam Mosaddeque	Senior Assistant Chief, Ministry of Housing and Public Works	JCC
4	Md. Abul Quasem	Additional Chief Engineer (P & SP), PWD / Project Director of CNCRP	JCC
5	Dr. Mehedi Ahmed Ansary	Representative of Vice Chancellor of Bangladesh University of Engineering and Technology (BUET)	JCC
6	Mr. Khadiza Begum	Deputy Secretary, ERD	JCC
7	Mr. Maimdahin Ahmed	Director, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
8	Md. Abdul Malek Sikder	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
9	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
10	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
11	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
12	Md. Sohel Rahman	Team Leader of WT-3	JCC
13	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
14	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
15	Md. Anisuzzaman Choudhury	Senior Program Officer, JICA Bangladesh Office	JCC
16	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
17	Mr. Akira Inoue	Seismic Design/ Retrofitting of Existing Buildings (1)	JET
18	Mr. Hiroshi Ohira	Construction Management	JET
19	Mr. Takeshi Takeshita	Construction Management	JET
20	Mr. Osamu Miyoshi	Retrofitting of Existing Buildings (2)	JET
21	Mr. Yosuke Nakajima	Seismic Evaluation	JET
22	Mr. Masayuki Takazawa	Building Administration	JET
23	Mr. Ryo Miyazaki	Operational Coordination	JET
24	Md. Shafiul Islam	Assistant Engineer, PWD	PWD

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JET: JICA Expert Team Member, Obs.: Observer

2nd JCC

Date: March 01, 2012

Minutes of the Second Joint Coordination Committee (JCC) Meeting

Project: **Capacity Development on Natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings (CNCRP)**

Date : 1st March, 2012.
Time : 10 : 30 am
Venue : Office of the Chief Engineer, Public Works Department, Segunbagicha, Dhaka.

The Second JCC meeting under the chairmanship of Engr. Md. Kabir Ahmed Bhuiyan,, Cheif Engineer, Public Works Department was held on date and time mentioned above.

The chairman warmly welcomed all members present at the 2nd JCC meeting. At the onset, the minutes of the 1st JCC Meeting was approved by all the members present. The chairman briefly narrated the urgency of his department's need for capacity development on seismic assessment, retrofitting design and retrofitting works for public buildings against earthquake and other natural forces. He also thanked profusely the Japan Government for helping Bangladesh Government in this timely and very important project.

Advisor (Disaster Management & Climate Change), JICA Bangladesh Office, Mr. Hideki Katayama in his welcome speech wished every success for the project and also expressed his satisfaction for his government's association with such a project. He also noted that this project is the only hardcore project in the sector of capacity development on earthquake retrofitting of buildings.

The chairman then gave the floor to five team leaders of Bangladesh counterpart to narrate the progress of their respective teams during last one year.

The team leaders briefly presented their progress report where team leaders of working team 1, 4 and 5 highlighted their experience of recent Japan trip.
Then Engr. Md. Abdul Malek Sikder, Project Manager of CNCRP narrated overall progress and performance of CNCRP in last one year. He also highlighted his recent Japan experience on different retrofitting projects.

All the members of JCC expressed their satisfaction over the progress during last one year.
Dr. Mehedi Ahmed Ansary, Professor, BUET, in his discussion thanked PWD and JICA for undertaking this timely project and mentioned his satisfaction on the progress attained so far. He suggested the following issues to be incorporated in the project-

a) Retrofitting of Foundation
b) Liquifaction potential and site amplification analysis and counter measures.
c) Determination of building period using micro tremor.
d) Establishment of a permanent GIS unit in PWD.
e) Institutionalization of the project to ensure sustainability.

Md. Ahsanul Haque Khan, Chief Architect, Department of Architecture, thanked PWD and JICA for undertaking this project which is very important for construction of disaster resilient buildings. He suggested for inclusion of the architects of Department of Architecture in this project.

Chairperson in his concluding remark thanked all the members and hoped their support and effort will continue in the same manner. He requested JICA to consider the participation of Department of Architecture in a suitable way. As there was no further points to discuss the meeting was concluded.

Attachment:

- Attendance List

(Md.Kabir Ahmed Bhuiyan)
Chief Engineer, PWD
&
Chairman
Joint coordination Committee, CNCRP

No: DS-1/ 1423 Date: 13/3/12

C.C for kind information and necessary action:
(not in order of seniority)

1. Chief Architect, Department of Architecture, Dhaka.
2. Additional Chief Engineer (P&SP), Public Works Department (PWD) and Project Director
3. Dr. Mehedi Ahmed Ansary, Professor, Department of Civil Engineering, BUET.
4. Director, Housing and Building Research Institute, Darus Salam, Mirpur, Dhaka-1216.
5. Director (Planning), Disaster Management Bureau, 92-93, Mohakhali C/A, Dhaka.
6. Deputy Secretary, Japan Branch, Economic Relations Division, Ministry of Finance, Sher-e-Bangla Nagar, Dhaka.
7. Deputy Chief, Planning Cell, Ministry of Housing and Public works, Bangladesh Secretariat, Dhaka.
8. Md. Mafizur Rahman, Executive Engineer, PWD Design Division-V and Deputy Project Manager.
9. Team leaders of 5-components of the Project (not in order of seniority).
   i) Ali Newaz Ahmed, Executive Engineer, PWD Survey Division and Team Leader, Component-I.
   ii) Md. Rafiqul Islam, Executive Engineer, PWD Design Division- III and Team Leader, Component- II.
   iii) Md. Sohel Rahaman, Executive Engineer, PWD Design Division- IV and Team Leader, Component-III.
   iv) Md. Ziaul Hafiz, Superintending Engineer, PWD Monitoring and Audit Circle and Team leader, Component-IV.
   v) Sardar Mainul Islam, Executive Engineer, PWD Resource Division and Team Leader, Component-V.
10. Senior representative of JICA Bangladesh Office.
11. JICA experts of the Project.

(Md. Abdul Malek Sikder)
Superintending Engineer
PWD Design Circle-I & Project Manager.

01/03/2012 **2nd JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Md. Ahsanul Haque Khan	Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Md. Abul Quasem	Additional Chief Engineer (P & SP), PWD / Project Director of CMCRP	JCC
4	Dr. Mehedi Ahmed Ansary	Representative of Vice Chancellor of Bangladesh University of Engineering and Technology (BUET)	JCC
5	Mr. A.K.M. Hafizur Rahman	Deputy Secretary (DD), Representative of Director (Planning) of Disaster Management Bureau (DMB)	JCC
6	Engr. Syed Isar Hossain	PRE, Housing and Building Research Institute (HBRI), Dhaka	JCC
7	Md. Abdul Malek Sikder	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
8	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
9	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
10	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
11	Md. Sohel Rahman	Team Leader of WT-3	JCC
12	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
13	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
14	Mr. Hideki Katayama	Advisor, JICA Bangladesh Office	JCC
15	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
16	Mr. Akira Inoue	Seismic Design/ Retrofitting of Existing Buildings (1)	JET
17	Mr. Osamu Miyoshi	Retrofitting of Existing Buildings (2)	JET
18	Mr. Yosuke Nakajima	Seismic Evaluation	JET
19	Md. Akhsanul Islam	Engineer, PWD	PWD
20	Md. Ali Akbar Mollick	Technical Advisor	JET
21	Md. Mostafizur Rahman	SDE, PWD	PWD

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JET: JICA Expert Team Member, Obs.: Observer

3rd JCC

Date: August 12, 2012

添付資料- 1　第 3 回 JCC 議事録（案）

Minutes of the Third Joint Coordination Committee (JCC) Meeting

Project: **Capacity Development on Natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings (CNCRP)**

Date: 12th August 2012

Time: 11.00 am

Venue: Mini Conference Room of the Office of the Chief Engineer, Public Works Department, Segunbagicha, Dhaka

The Third JCC meeting under the chairmanship of Engr. Md. Kabir Ahmed Bhuiyan, Chief Engineer, Public Works Department was held on date and time mentioned above.

First all the members present in the 3rd JCC meeting got introduced. Then the chairman warmly welcomed all the members present in the meeting. He highlighted on the recently concluded Japan tour by all the working teams and also expressed his impression about his visit to Japan in the tour of the High Officials. He also thanked JICA for extending their helping hand and expected their support through the progress of the project.

Chief Architect, Department of Architecture, Mr. Ahsanul Haque Khan in his welcome speech briefly narrated his experience in the Japan tour of the High Officials and thanked JICA team for their support and help. He expressed his desire to include the architects of his Department of architecture in the project and thus disseminate the knowledge achieved.

Then, the minutes of the second JCC meeting was confirmed without any correction and approved by all the members present. The chairman then gave floor to Mr. Fumio Kaneko, Team Leader, JICA Expert Team to give a presentation on the progress of CNCRP in the first year. Mr. Kaneko gave a brief presentation on the first year's work progress of the project.

Engr. Md. Abdul Malek Sikder, Project Manager of CNCRP narrated the work plan for the second year of the project. In his presentation, he highlighted the following work plans-

a) Preparation of Road map for building inventory
b) Building inventory for Sylhet and Chittagong
c) Categorization of Buildings
d) Preparation of design manual for new construction
e) Compilation of design document for retrofitting
f) Development of more appropriate methods for retrofitting work
g) Preparation of manual
h) Review of contents of the manual
i) Counterpart training and dignitary training in Japan (already completed)
j) Preparation of checklist
k) Monitoring of quality assurance

l) Training in Bangladesh
m) Seminar/workshop
n) Structural experiments

Then, Advisor, JICA Bangladesh Office, Mr. Naoki Matsumura in his address congratulated all the members for a successful completion of first year. He narrated about receiving positive feedback about the project from the concerned ministries and departments of Bangladesh Government and stated that JICA will continue to provide all the supports to this project.

Then Engr. Md. Mofizur Rahman, Deputy Project Manager of CNCRP narrated his recent tour experience in Japan through a brief presentation. Following this, two of the five team leaders of Bangladesh counterpart narrated their experience of the recent Japan tour. Team Leaders of working teams 2 and 3 highlighted on the scenario of construction sites in Japan as well as learning from Japan tour of their respective teams in their presentations.

In a brief concluding address, Mr. Md. Abul Quashem, Additional Chief Enginner (P&SP), PWD and Project Director, CNCRP, thanked everyone for attending the meeting.

Chairperson in his concluding remark briefly narrated the importance of this project and the learning from the tours for PWD and other Government organizations and ensured about the dissemination of the knowledge to others. He thanked all the members and JICA as well and hoped that their support and effort will continue in the same manner. As there was no further points to discuss the meeting was concluded.

(Md. Abdul Malek Sikder)
Superintending Engineer
PWD Design Circle-1
&
Project Manager, CNCRP

12/08/2012 **3rd JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Md. Ahsanul Haque Khan	Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Md. Abul Quasem	Additional Chief Engineer (P & SP), PWD / Project Director of CMCRP	JCC
7	Md. Abdul Malek Sikder	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
5	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
6	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
7	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
8	Md. Sohel Rahman	Team Leader of WT-3	JCC
9	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
10	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
11	Mr. Naoki Matsumura	Advisor, JICA Bangladesh Office	JCC
12	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
13	Md. Akhsanul Islam	Engineer, PWD	PWD
14	Nur-E-Kawonine	Assistant Engineer, PWD	PWD
15	Mr. Masaaki Aizawa	Operational Coordination	JET
16	Md. Jahidul Islam Khan	Assistant Engineer. PWD	PWD
17	Md. Shafiul Islam	Assistant Engineer, PWD	PWD
18	A.S.M. Shahriar Jahan	Assistant Engineer, PWD	PWD
19	Abdullah Md. Zubair	SDE, PWD	

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JET: JICA Expert Team Member, Obs.: Observer

4th JCC

Date: February 20, 2013

MINUTES OF MEETING
OF
THE FOURTH JOINT COORDINATION COMMITTEE (JCC)
ON
PROJECT
FOR
CAPACITY DEVELOPMENT
ON
NATURAL DISASTER-RESISTANT TECHNIQUES
OF
CONSTRUCTION AND RETROFITTING
FOR
PUBLIC BUILDINGS
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

Dhaka, 20 February 2013

27/02/2013

Md. Abdul Malek Sikder

Project Manager of "Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh"

松尾 淳

Mr. Jun MATSUO

for Mr. Fumio KANEKO
Team Leader of JICA Expert Team

Date	:	1st December 2012
No. reference	:	CNCRP 15
Attention	:	To Whom It May Concerned
Subject	:	POWER OF ATTORNEY

Dear Ladies and Gentlemen,

POWER OF ATTORNEY

BY THIS POWER OF ATTORNEY, written on 1st December 2012, Mr. Fumio KANEKO, who is the Team Leader of JET (JICA Expert Team) of the project for, Project for Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the Peoples Republic of Bangladesh hereby appoints Dr. Jun MATSUO, who is an Deputy Team Leader of JET.

I will give him the permission to sign the contract and Minutes of Meeting under my confirmation, with regard to the subcontract of consulting service on the concrete for the structural test, CNCRP in this project.

Name	Position	Signature
Jun Matsuo	Deputy Team Leader of JET	松尾 淳

THIS POWER OF ATTORNEY goes into force on and after the day and year above written and shall remain in force until the completion of the Agreement or the Contract referred to the above.

IN WITNESS WHEREOF, the undersigned as the Team Leader of JET has signed and sealed as the dated above.

金子文彦

OYO INTERNATIONAL CORPORATION

Mr. Fumio KANEKO
The Team Leader of the JICA Expert Team

The JICA Team for the Project for "Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh" (the Project) and Public Works Department (PWD) organized the fourth Joint Coordination Committee meeting on 20th February 2013 at the conference room of the Public works department, Ministry of Housing and Public Works. The program and participants are shown in Annexes 1 and 2.

The main points of the discussion were progress of the project, plans for 3rd year activities and revised PDM.

This project was initiated in 2011. The experience gained from the various project activities suggest that the PDM set at the beginning of the project needs some modifications. This will help the technology transfer activities more effectively. The proposed modifications were placed in front of the JCC meeting and agreed by the members of committee. The modifications made are as follows.

1) The term "Quality Assurance" used in 2011, is modified as "Quality Control" in 2013

The term "Quality Assurance" in general, means that assurance has to be given a third party which is not practiced in Bangladesh now. Therefore, considering the works and responsibilities of PWD, it is appropriate to use the term "Quality Control" instead of "Quality Assurance". There JET and PWD proposed to establish the guidelines for keeping the necessary quality for public buildings.

2) The term "Vulnerability Assessment Manual" used in 2011, is modified as "Vulnerability Assessment (Seismic evaluation) Manual"

Generally, Vulnerability Assessment means the assessment of buildings against all natural hazards, which is not the case for this project. This project focuses mainly on earthquakes. Therefore, for avoiding confusions "seismic evaluation" has been incorporated in the title of the Manual.

3) Inclusion of a term "Design Manual for New buildings"

To establish a strong city against natural disasters, JET and PWD agreed to consider the preparation of a manual for design of new buildings and is now underway. However, it was not incorporated in the PDM of 2011.

4) The term "Manual for Retrofitting Works" as in 2011 and is modified as "Construction Manual for Seismic Retrofitting Works"

Considering the role of PWD it is believed that the term "Construction Manual for Seismic Retrofitting Works" is more suitable than "Manual for Retrofitting Works".

5) Other changes

There are other small changes (all together 42) mainly wordings have been made in the PDM of 2011 and agreed in the meeting.

Annex 1

The project for Capacity Development on Natural Disaster Resistant Techniques of Construction and Retrofitting for Public Buildings

[A JICA Technical Cooperation Project in association with PWD]

Forth Joint Coordination Committee (JCC) Meeting

Date: 20-02-2011

Time: 11:00am - 13:00pm

Venue: Office of the Chief Engineer, PWD HQ

Program:

Welcome speech by Mr. Kabir Ahmed Bhuiyan, Chief Engineer, PWD

Address by Mr. Naoki Matsumura, Project Formulation Adviser, JICA Bangladesh Office.

Confirmation of Meeting Minutes of 3rd JCC meeting

Presentation of progress of the Project	Mr. Abdul Malek Sikder Project Manager, CNCRP	10 min
Presentation of Building Inventory Survey results and plan for 3rd year	WT-1	5 min
Work progress of WT-2	WT-2	10 min
Presentation of 2nd year test works and construction manual of retrofitting works	WT-3	5 min
Presentation of check list of 2nd year and the plan for application for new building construction	WT-4	5 min
Speech by deputy Team Leader.	Dr. Jun Matsuo	5 min
Discussion / Comments on the Project by the JCC members		20 min
Approval of the revised PDM		5 min
Closing speech by Mr. Kabir Ahmed Bhuiyan, Chief Engineer, PWD		5min

	Name	Affiliation, Position	
1	Mr. Kabir Ahmed Bhuiyan	Chief Engineer, Public Works Department	JCC
2	Md.. Ahsanul Haque Khan	Chief Architect Department of Architecture (DOA), Dhaka	JCC
3	Md. Abul Quasem	Additional Chief Engineer (P & SP) PWD / Project Director of CNCRP	JCC
4	Dr. Mehedi Ahmed Ansary	Representative of the Vice Chancellor of Bangladesh University of Engineering and Technology (BUET)	JCC
5	Md.Abdus Salam	SRE, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
6	Dr.SK.Md.Rezaul Islam	Deputy Drector,DDM,Representative of Director (Planning) of Disaster management Bureau (DMB)	JCC
7	Md. Adbul Malek Sikader	Superintending Engineer (Design Circle 1) of PWD / Project Manager of CNCRP	JCC
8	Md. Mafizur Rahman	Deputy Project Manager of CNCRP	JCC
9	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
10	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
11	Md. Sohel Rahman	Team Leader of WT-3	JCC
12	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
13	Sardar Mainul Islam	Team Leader of WT-5	JCC
14	Dr. Jun Matsuo	Deputy Team Leader of JET	JET
15	Mr. Akira Inoue	Seismic Design/ Retrofitting of Existing Buildings (1)	JET
16	Mr. Osamu Miyoshi	Retrofitting of Existing Buildings (2)	JET
17	Mr. Seiichi Horikoshi	Construction Management	JET
18	Mr. Yukio Katagayagi	Building Administration	JET
29	Dr. Koichi Hasegawa	Management of GIS Database	JET
21	Dr. Mahbub Reza	Operational coordination	JET
22	Mr. Masaaki Aizawa	Operational coordination	JET
23	Mr. Tetsuo Suzuki	Japan Overseas Cooperation Volunteers,	Obs
24	Zahid Hasan Khan	Assistant Engineer,DD-2,PWD	PWD
25	K.M Mostofa Hasan	Executive Engineer. PWD	PWD
26	Md.Mostafizur Rahman	SDE,PWD	PWD
27	Khairul Islam	Executive Engineer, PWD	PWD
30	Md.Matiur Rahman	Technical Advisor	JET
33	Md.Ali Akbar Mollick	Technical Advisor	JET
34	Ali Newas Ahmed	Executive Engineer	PWD
35	Sardar Mainul Islam	Executive Engineer	PWD
36	Md .Ziaul Hafiz	Superitending Engineer, PWD & Team Leader WT-1	PWD

JCC:Joint Coordination Committee Member, PWD: Public Works Department Member

JET:JICA Expert Team Member, Obs; Observer

Comments by the JCC Members

Prof. Ansary

i) Format of M/M

After reviewing the M/M of 3rd JCC which was presented for confirmation in 4th JCC meeting, he suggested that important paragraphs of M/M should be presented as "Bullet Form" so that importance is understood. He also mentioned about the follow up of the comments made in the last meeting.

Adding to the comments of Prof. Ansary, Chair of the meeting also suggested that the M/M should be in the forms of "Discussion----Follow up form".

Decision/Ans.: It was decided that from next M/M suggested form will be followed

ii) Structural Tests

The structure tests done under CNCRP did not reflect the actual conditions of construction methodologies of Bangladesh (also raised in the last technical discussion meeting). He suggested to under-take more tests using old buildings to be demolished (as suggested by JRC).

Decision/Ans.: Further study is required in order to implement this suggestion

iii) Use of CNCRP Manuals

Since the government has decided to introduce two courses on retrofitting, one for under graduate and another for graduate course within a year, he suggested to allow the use of manuals produced under CNCRP even if they are in their draft forms.

Decision/Ans.: No decision has been taken yet.

iv) GIS database updating

Proposed that in updating GIS database of CNCRP, BUET students can be used. It will be a free involvement. Only a MOU would be necessary.

Decision/Ans.: Taken as a good suggestion. Further study is required

v) Domestic Training

Suggested that in domestic training course more HBRI engineers should be invited or motivated for taking part.

Decision/Ans.: Necessary action to involve more HBRI engineers will be taken

vi) FEMA ranking

Wanted to know about what FEMA ranking was used in using screening the buildings

Decision/Ans.: Moderate ranking has been used

vii) Editorial board

Inquired about the editorial board for the Manual

Decision/Ans.: A positive answer has been given.

A.H.Md.Rahman

i) Word used in the Inventory
Suggested to change the word "Concerned" and use the word "Client" instead

Decision/Ans: A positive answer was given

ii) Coverage of Database
Wanted to know whether floor area of buildings are collected but not shown in the case in the presentation , due to time constraint.

Decision/Ans: Whole area was covered

iii) Unit used
Mix up of SI unit and fps init was observed in the Quality control Check List as suggested to stick to any one unit system.

Decision/Ans.: A positive answer was given

Capacity Development on Natural Disaster-Resistant Techniques of Construction and Retrofitting for Public Buildings in the People's Republic of Bangladesh

Area: Dhaka, Sylhet, Chittagong　Period: March 2011- February 2015　Counterparts: PWD Engineers

Version 0 Version 1 Draft

Date: December 2010 Rev. February 2013

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Goal Safety of the buildings is enhanced, and the response activities after disaster events shall be conducted smoothly.	Cases where the natural disasters have not caused buildings to collapse and the buildings users as well as residents near buildings have escaped from their collapse.	MoFDM or other relevant organizations' reports or newspaper articles on these cases	
Overall Goal 1 Retrofitting of public buildings including government buildings, hospital, fire station, school, shelter, etc. is implemented. 2 Ministry of Housing and Public Works issues official license to the engineers upon completion of the training program introduced by the Project 3 Manuals and the concepts prepared through the Project are incorporated in future edition of Bangladesh National Building Code.	1 Number of the retrofitting works 2 Number of the licensed engineers 3 The manuals are incorporated in BNBC	1 Interview with PWD and relevant organizations 2 MoHPW 3 BNBC	The trained engineers appropriately apply what they learned at the Project
Project Purpose The capacity of PWD for the construction and retrofitting works of the public buildings against natural disasters, such as earthquake, cyclone, flood and high tide is developed.	Status of PWD: 1 Number of the trained personnel as well as C/Ps who can conducted the training on the techniques developed by the Project. 2 Quality assurance system of PWD 2 Quality control system of PWD 3 PWD's future activity plan on retrofitting	Project report	1. Other relevant organizations owing the public buildings finance retrofitting works. 2. Relevant organizations adopt a serious stance on building disaster.
Outputs			1. Trained C/P remain active for the Project. 2. Fund for the pilot projects is produced as scheduled.
1 The capacity to do vulnerability assessment of the existing public buildings is developed. 1 The capacity to do inventory, vulnerability assessment (seimsic evaluation) of the existing public buildings is developed.	1-1 Volume of building inventory data 1-2 Vulnerability assessment manual is prepared 1-2 Vulnerability assessment (Seismic evaluation) manual is prepared 1-3 Roadmap for retrofitting public buildings is prepared.	1-1 Building inventory data 1-2 Vulnerability assessment manual 1-2 Vulnerability assessment (Seismic evaluation) manual 1-3 Roadmap for retrofitting public buildings	
2 The design methods for designing as well as retrofitting the public buildings against natural disasters are established. 2 The design methods for new building designing as well as retrofitting the public buildings against natural disasters are established.	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters is prepared. 2-1 Design manual for new building designing as well as evaluating and retrofitting the public buildings against natural disasters is prepared. 2-2 Design documents for retrofitting the selected buildings are prepared.	2-1 Design manual for designing as well as retrofitting the public buildings against natural disasters 2-1 Design manual for new building designing as well as evaluating and retrofitting the public buildings against natural disasters 2-2 Design documents for retrofitting the selected buildings	
3 The capacity to implement retrofitting of the public buildings is developed.	3-1 Manual for retrofitting works is prepared. 3-1 Construction manual for seismic retrofitting works is prepared.	3-1 Manual for retrofitting works 3-1 Construction manual for seismic retrofitting works	
4 Quality assurance system is established. 4 Quality control process is developed.	4-1 Checklist and judgment guidelines for quality assurance are prepared. 4-1 Checklist and judgment guidelines for quality control are prepared. 4-2 Training materials on quality assurance are prepared. 4-2 Training materials on quality control are prepared. 4-3 Monitoring database is prepared.	4-1 Checklist and judgment guidelines for quality assurance 4-1 Checklist and judgment guidelines for quality control 4-2 Training materials on quality assurance 4-2 Training materials on quality control 4-3 Monitoring database	
5 The methods such as designing and retrofitting the public buildings which have been developed by the Project are widely acknowledged by other relevant engineers. 5 The methods such as new building designing and retrofitting the public buildings which have been developed by the Project are widely acknowledged by other relevant engineers.	5-1 Training curriculum, materials, plan(budget) and schedule are prepared. 5-2 Number of seminars on the training 5-3 Number of certificates given to the trainees who completed the vulnerability assessment course 5-3 Number of certificates given to the trainees who completed the seismic evaluation course 5-4 Number of certificates given to the trainees who completed training for designing as well as retrofitting of the public buildings 5-4 Number of certificates given to the trainees who completed training for new building designing as well as retrofitting of the public buildings	5-1 Training curriculum, materials, plan(budget) and schedule 5-2 Project report 5-3 Project report 5-4 Project report	

Activities

1-1 To produce building inventory with GIS

1-2 To categorize (rank up) existing public buildings

1-3 To select buildings and to collect/ prepare documents such as design drawings

1-3 To select buildings for vulnerability assessment (seismic evaluation) and to collect/ prepare documents such as design drawings

1-4 To study BNBC, foreign codes, and to develop criteria and index for vulnerability assessment

1-4 To study BNBC, foreign codes, and to develop criteria and index for seismic evaluation

1-5 To establish the method for assessing vulnerability

1-5 To establish the method for seismic evaluation

1-6 To prepare the manual for doing vulnerability assessment of the existing public buildings

1-6 To prepare the manual for seismic evaluation of the existing public buildings

1-7 To do vulnerability assessment of the existing public buildings

1-7 To conduct seismic evaluation of the existing public buildings

1-8 To prioritize the existing public buildings and prepare roadmap for retrofitting public buildings

2-1 To review BNBC, foreign codes, manuals and other existing literatures related to construction and retrofitting design.

2-2 To study the current methods for designing as well as retrofitting the public buildings against natural disasters and develop more appropriate methods.

2-3 To prepare the design manual for designing as well as retrofitting the public buildings against natural disasters

2-3 To prepare the design manuals new building designing as well as retrofitting the public buildings against natural disasters

2-4 To select the buildings to be retrofitted

2-4 To select the buildings for seismic retrofitting design

2-5 To prepare the retrofitting plan for the selected buildings and prepare their design documents.

3-1 To conduct theoretical training on retrofitting works to C/P.

3-2 To study current experience on retrofitting works.

3-3 To develop more appropriate method for retrofitting work.

3-4 To do test work and to test material.

3-4 To manage test work and to test materials.

3-5 To prepare manual for retrofitting works.

3-5 To prepare construction manual for seismic retrofitting works.

4-1 To prepare check list and judgment guidelines for quality assurance.

4-1 To prepare check list and judgment guidelines for quality control.

4-2 To prepare training materials on quality assurance.

4-2 To prepare training materials on quality control.

4-3 To prepare monitoring database.

4-4 To do monitoring of the retrofitting works.

4-4 To do monitoring of pilot project for Retrofitting.

4-5 To review and feedback the monitoring results.

5-1 To prepare curriculum, materials, plan (budget) and schedule for the training courses on vulnerability assessment and designing as well as retrofitting of the public buildings against disasters.

5-1 To prepare curriculum, materials, plan (budget) and schedule for the training courses on seismic evaluation and designing as well as retrofitting of the public buildings against disasters.

5-2 To have coordination with relevant organizations including having periodic seminars for the engineers in PWD as well as relevant organizations in order to promote their participation in the training.

5-3 To conduct the training.

5-3 To coordinate and arrange the training.

5-4 To review the training through course evaluation by the trainees.

5-5 To issue certificate to the trainees who completed training.

5-6 To produce and disseminate the materials of the project and traning

Inputs

Japanese Side

1 Japanese Experts Dispatch

1-1 GIS Database Management

1-2 Seismic Resistant Design

1-3 Construction Plan, Management

1-4 Existing Building Evaluation (Seismic Resistant Inspection)

1-5 Existing Building Retrofit (Seismic Retrofit)

1-6 Public Building Management

1-7 Training Planning

2 Training in Japan

2-1 Genral Training Course; Field (Seismic Resistant Design, Existing Building Inspection (Seismic Evaluation) Existing building retrofitting (Seismic Retrofitting))
Duration: aroudn 2 to 4 weeks

2-2 Senior Offoicers Course; Field (Building Adnilmnistration)
Duration: around 1 to 3 weeks

3 Donating equipment

3-1 Equipment required to operate GIS

3-2 Required equipments for structural investigation

3-3 Required equipments to operate structural calculation software

3-4 PC operation

4 Test construction cost

5 Structural test cost

6 Cost for Dissemination materials of manuals, training handouts, pamphlets etc.

7 Cost for Editorial Board of Manuals

Bangladesh Side

1 Placement of Counterparts (C/P)
Project director
Project manager
PC1 : GIS Building inventory database
PC2 : Vulnerability assessment and retrofitting design
PC3 : Retrofitting construction
PC3 : Retrofitting construction control
PC4 : Quality Assurance
PC4 : Quality control
PC5 : Training
PC: Project Components Note
Clerk

2 Provide office space
Project office space (furnished)
Maintenance costs of the equipment provided

3 Pilot project budget

4 Other Expenses

4-1 Training facilities, lecturer, materials for Domestic training

4-2 Dissemination materials like Web Page

4-3 Other Domestic Expenses

Pre-conditions

Great earthquake, cyclone, flood or high tide does not occur before the Project is completed.

20/02/2013 **4th JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Md. Ahsanul Haque Khan	Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Md. Abul Quasem	Additional Chief Engineer (P & SP), PWD / Project Director of CMCRP	JCC
4	Dr. Mehedi Ahmed Ansary	Representative of Vice Chancellor of Bangladesh University of Engineering and Technology (BUET)	JCC
5	Md. Abdus Salam	SRE, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
6	Dr. SK Md. Rezaul Islam	Deputy Director, DDM, Representative of Director (Planning) of Disaster Management Bureau (DMB)	JCC
7	Md. Abdul Malek Sikder	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
8	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
9	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
10	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
11	Md. Sohel Rahman	Team Leader of WT-3	JCC
12	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
13	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
14	Mr. Naoki Matsumura	Advisor, JICA Bangladesh Office	JCC
15	Dr. Jun Matsuo	Deputy Team Leader of JET for CNCRP	JET
16	Mr. Akira Inoue	Seismic Design/ Retrofitting of Existing Buildings (1)	JET
17	Mr. Osamu Miyoshi	Retrofitting of Existing Buildings (2)	JET
18	Mr. Seiichi Horikoshi	Construction Management	JET
19	Mr. Yukio Katayanagi	Building Administration	JET
20	Dr. Koichi Hasegawa	Management of GIS Database	JET
21	Dr. Mahbub Reza	Operational Coordination	JET
22	Mr. Masaaki Aizawa	Operational Coordination	JET
23	Mr. Tetsuya Suzuki	Japan Overseas Cooperation Volunteers	Obs.
24	Mr. Zahid Hasan Khan	Assistant Engineer. DD-2, PWD	PWD
25	Mr. K.M. Mostafa Hasan	Executive Engineer, PWD	PWD
26	Md. Mostafizur Rahman	SDE, PWD	PWD
27	Md. Khairul Isram	Executive Engineer, PWD	PWD
28	Md. Matiur Rahman	Technical Advisor	JET
29	Md. Ali Akbar Mollick	Technical Advisor	JET
30	Mr. Mahmudul Hasan	Assistant Engineer, DD-2, PWD	PWD

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JET: JICA Expert Team Member, Obs.: Observer

5th JCC

Date: August 05, 2013

Fifth JCC Meeting of CNCRP

Date & Time: August 5, 2013 14:00-15:30

Venue: CE Conference Room at PWD Building, Purta Bhaban, Segunbagicha

Chair: Chief Engineer of PWD, MoHPW

Agenda:

1. Welcome Speech:
   by Engr. Md. Kabir Ahmed Bhuiyan, Chief Engineer, PWD, MoHPW
2. Outline of the Mid-term Review by JICA:
   by Mr. Naoki Matsumura, Japanese Mid-term Review Team, JICA Bangladesh
3. Result Summary of the Mid-term Review:
   by Mr. Harumi Iida, Japanese Mid-term Review Team, Consultant for JICA
4. Regarding to BGMEA project:
   by Md. Abdul Malek Sikder, Project Manager of CNCRP
5. Discussion:
6. Meeting Summary
   by Mr. Hiroyuki Tomita, Leader of Japanese Mid-term Review Team, JICA Bangladesh
7. Thanks Giving:
   by M. Abul Quasem, Project Director of CNCRP
8. Closing Speech:
   by Chair person

   adjourn

05/08/2013 **5th JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Md. Ahsanul Haque Khan	Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Md. Abul Quasem	Additional Chief Engineer (P & SP), PWD / Project Director of CMCRP	JCC
4	Mr. Mahbubur Rahman	Deputy Secretary, Ministry of Housing and Public Works	JCC
5	Md. Abu Sadeque, PEng.	Director, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
6	Md. Abdul Malek Sikder	Assistant Chief Engineer, PWD / Project Manager of CNCRP	JCC
7	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
8	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
9	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
10	Md. Sohel Rahman	Team Leader of WT-3	JCC
11	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
12	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
13	Mr. Hiroyuki Tomita	Deputy resident Representative, JICA Bangladesh Office	JCC
14	Mr. Naoki Matsumura	Advisor, JICA Bangladesh Office	JCC
15	Md. Anisuzzaman Choudhury	Senior Program Officer, JICA Bangladesh Office	JCC
16	Mr. Hiromi Iida	Mid-Term Review Team, JICA	JICA
17	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
18	Dr. Jun Matsuo	Deputy Team Leader of JET for CNCRP	JET
19	Mr. Masaaki Aizawa	Operational Coordination	JET
20	Mr. Tetsuya Suzuki	Japan Overseas Cooperation Volunteers	Obs.

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JICA: Japan International Cooperation Agency, JET: JICA Expert Team Member, Obs.: Observer

6th JCC

Date: February 23, 2014

The project for Capacity Development on Natural Disaster Resistant Techniques of Construction and Retrofitting for Public

[A JICA Technical Cooperation Project in association with PWD]

Sixth meeting of the Joint Coordination Committee (JCC)

Date: 23-02-2014

Time: 9:30am- 16:00pm

Venue: Lakeshore Hotel, Gulshan 2, Dhaka

Program:

Welcome speech by Mr. Chitta Ranjan Das, Additional Chief Engineer, PWD

Address by Mr. Naoki Matsumura, Project Formulation Adviser, JlCA Bangladesh Office.

Presentations were made in the Fourth Workshop

Inaugural Session:9:3o am- 10:45 am

Chairperson: Secretary, MoHPW, Mr. Md. Golam Rabbani

1. Welcome address:

   Additional Chief Engineer, PWD, Mr. Chitta Ranjan Das

2. Briefing on the project:

   a) Project Background and Experience Gained

   Mr. Fumio Kaneko, Team Leader, JET (Japanese Expert Team)

   b) Project Progress and Direction

   Engr. Md. Abdul Malek Sikder, Project Director, CNCRP

3. Address by the Guests ofHonor:

   a) JICA Chief; Mr. Mikio Hataeda, Chief Representative, JICA Bangladesh Office.

   b) His Excellency the Ambassador of Japan, Mr. Shiro Sadoshima

Discussion / Comments on the Project by the JCC members

Closing speech by Mr. Chitta Ranjan Das, Additional Chief Engineer, PWD

23/02/2014 **6th JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
2	Fahmida Luitana	Assistant Chief Architect, Department of Architecture (DOA), Dhaka	JCC
3	Mr. Ainul Farhad	Additional Chief Engineer (P & SP), PWD / Project Manager of CNCRP	JCC
4	Mr. Mahbubur Rahman	Deputy Secretary, Ministry of Housing and Public Works	JCC
5	Md. Abu Sadeque, PEng.	Director, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
6	Engr. Md. Ahsan Habib	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
7	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
8	Md. Ali Newaz Ahmed	Team Leader of WT-1	JCC
9	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
10	Md. Sohel Rahman	Team Leader of WT-3	JCC
11	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
12	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
13	Mr. Naoki Matsumura	Advisor, JICA Bangladesh Office	JCC
14	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
15	Dr. Jun Matsuo	Deputy Team Leader of JET for CNCRP	JET
16	Mr. Akira Inoue	Seismic Design/ Retrofitting of Existing Buildings (1)	JET
17	Dr. Mahbub Reza	Operational Coordination	JET
18	Mr. Masaaki Aizawa	Operational Coordination	JET

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JICA: Japan International Cooperation Agency, JET: JICA Expert Team Member, Obs.: Observer

7th JCC

Date: December 11, 2014

Agenda of Seventh JCC Meeting of CNCRP

Date & Time: 10th December, 2014 3:00-4:30 pm

Venue: CE's Meeting Room at PWD Building, Purta Bhaban, Segunbagicha

Chair: Chief Engineer of PWD, MoHPW

Agenda:

1. Welcome Speech:
   by Engr. Md. Kabir Ahmed Bhuiyan, Chief Engineer, PWD, MoHPW
2. Result Summary of the Terminal Evaluation Review:
   by Mr. Harumi Iida, Member the Terminal Evaluation Review Team, Consultant for JICA
3. Discussion:

4. Comment on Presentation and Discussion
   By Mr. Naoki Matsumura, member the Terminal Evaluation Review Team and Adviser JICA Bangladesh
5. Thanks Giving:
   by Mr. Ainul Farhad, Project Director of CNCRP
8. Closing Speech:
   by Engr. Md. Kabir Ahmed Bhuiyan, Chief Engineer, PWD, MoHPW Chair person

10/12/2014 **7th JCC Meeting**

	Name	Affiliation, Position	Type
1	Mr. Kabir Ahmed Bhuyan	Chief Engineer, Public Works Department	JCC
3	Mr. Ainul Farhad	Additional Chief Engineer (P & SP), PWD / Project Manager of CNCRP	JCC
5	Md. Abu Sadeque, PEng.	Director, Representative of Director of Housing and Building Research Institute (HBRI), Dhaka	JCC
6	Engr. Md. Ahsan Habib	Superintending Engineer (Design Circle 1), PWD / Project Manager of CNCRP	JCC
7	Md. Mafizur Rahman	Executive Engineer, PWD/ Deputy Project Manager of CNCRP	JCC
9	Mr. Rafiqul Islam	Team Leader of WT-2	JCC
10	Md. Sohel Rahman	Team Leader of WT-3	JCC
11	Md. Ziaul Hafiz	Team Leader of WT-4	JCC
12	Mr. Sardar Mainul Islam	Team Leader of WT-5	JCC
13	Mr. Naoki Matsumura	Advisor, JICA Bangladesh Office	JCC
	Mr. Hiromi Iida	Terminal-Evelauation Team, JICA	JICA
14	Mr. Fumio Kaneko	Team Leader of JET for CNCRP	JET
15	Dr. Jun Matsuo	Deputy Team Leader of JET for CNCRP	JET
	Ishtiaque Ahmed	Executive Engineer, Survey Division, PWD	PWD

JCC: Joint Coordinating Committee Member, PWD: Public Works Department Member

JICA: Japan International Cooperation Agency, JET: JICA Expert Team Member, Obs.: Observer