No.

Japan International Cooperation Agency (JICA)

Final Report

for

The Technical Cooperation Project

for

Designing Prototype Seismic Resistant and Barrier-free BHUs

in

Azad Government of the State of Jammu and Kashmir (AJK)

and

North West Frontier Province(NWFP)

February 2007

BINKO International Ltd.

GE
JR
07-007

PREFACE

In response to a request made by the Government of Pakistan, the Government of Japan decided to conduct the Project on Designing Prototype Seismic Resistant and Barrier-free Basic Health Units (BHUs) in NWFP and AJK and entrusted the project to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan an expert teams headed by Mr. Nobuyoshi FURUICHI of BINKO International Ltd. between March 2006 and February 2007.

The team held discussions with the officials concerned of the Government of Pakistan and conducted field activities in the project area. The team prepared present report upon the final modification.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Pakistan, Government of NWFP and the Government of AJK for their close cooperation extended to the team.

February, 2007

Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

Final Report

Contents

<Annexure>

Chapter 1

Chapter 1 Summary of the Project

1.1 Background of the Project

An earthquake measuring 7.6 on the Richter scale struck the northern areas of Pakistan and India on October 8, 2005. Its epicenter was 19km northeast of Muzaffarabad. (measured by United States Geological Survey, USGS).As a result of that Azad Jammu Kashimir (hereinafter referred to as “AJK”) and North West Frontier Province (hereinafter referred to as “NWFP”) were severely affected. The estimated overall death toll is 73,000, whereas housing infrastructure also received heavy damages, i.e.,84% of houses in AJK and 36% in NWFP were also reported to have collapsed primarily due to the poor earthquake resilience. Similarly the infrastructure of primary health care facilities including Basic Health Unit(hereinafter referred to as “BHU”) and Rural Health Center (hereinafter referred to as “RHC”) were also affected adversely as the facilities were constructed according to the standards and designs that were developed by respective governments as early as 20 years ago, and the infrastructure design and standards were not prepared keeping in view the impact of high intensity seismic motion on the facilities.

The need for safeguarding primary health care facilities, from earthquake devastation and ensuring that they remain safe and functioning should there be another earthquake of the similar and/or higher intensity, becomes more evident and pertinent after the October 2005 earthquake. Apart from damage to infrastructure the unprecedented October earthquake also left a large number of people with physical disabilities, therefore, it is equally important to ensure that the new health facility designs are not only earthquake resistant but are also barrier-free so that the people with disabilities could easily access the health facilities. In order to make a prototype BHU design with seismic resistant and barrier-free idea, Government of Islamic republic of Pakistan requested to Government of Japan to conduct the technical cooperation project “Designing Prototype Seismic Resistant and Barrier-free Basic Health Units and Rural Health Centers in North West Frontier Province and Azad Jammu Kashimir”(hereinafter referred to as “the Project”). Government of Japan decided to conduct the project and Japan International Cooperation Agency (hereinafter referred to as “JICA”) dispatched the project team (hereinafter referred to as “the Team”) for both standard design and construction management of the barrier-free and seismic resistant building.

1.2 Objective and Output of the Project

<Overall Goal >

The design created in the project will be endorsed by Pakistani Authorities as a standard in AJK and NWFP, and when BHUs are reconstructed or newly constructed, the concept of seismic resistance and barrier-free would be secured.

<Project Purpose >

The technical capabilities of the Governments of AJK and NWFP, needed for the designing of prototype seismic resistant and barrier-free design and construction of primary health care facilities would be enhanced.

<Output>

(1) Prototype of standard design of BHU

(2) Technical Transfer of techniques on how to build seismic resistant and barrier-free BHUs through construction of Prototype BHU

(3) Surveillance Manual on construction and maintenance of BHU

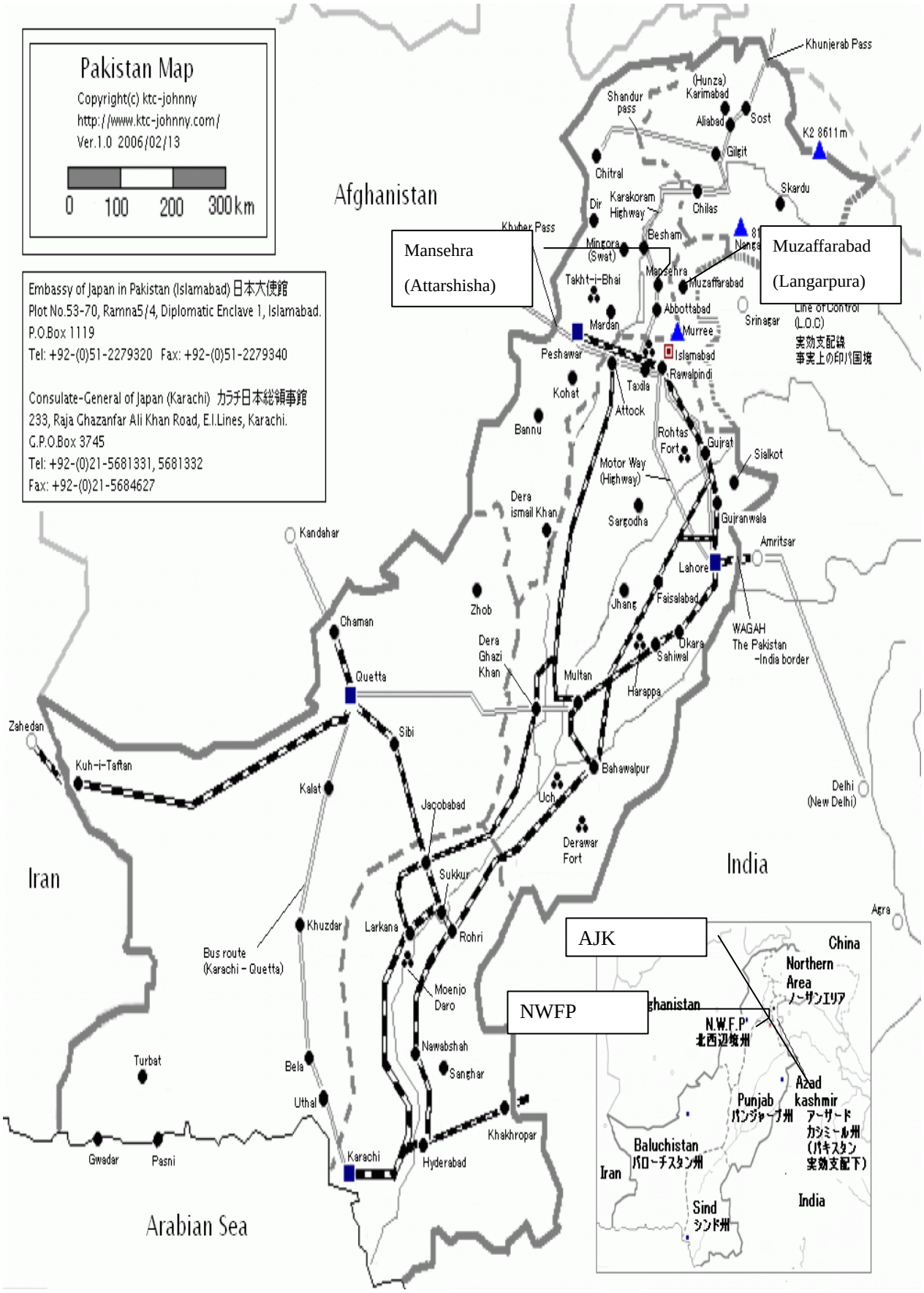
(4) Dissemination of information on earthquake resistant and barrier-free technology

1.3 Target Area and Location of Construction sites

(1) Attarshisha, District Mansehra,
North West Frontier Province（NWFP）

（2） Langarpura, Muzaffarabad
Azad Jammu Kashmir（AJK）

Following map shows the location of each province or state and location of Mansehra and Muzaffarabad.


Pakistan Map
Copyright(c) ktc-johnny
http://www.ktc-johnny.com/
Ver.1.0 2006/02/13
0 100 200 300km
Embassy of Japan in Pakistan (Islamabad) 日本大使館
Plot No.53-70, Ramna5/4, Diplomatic Enclave 1, Islamabad.
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Tel: +92-(0)51-2279320 Fax: +92-(0)51-2279340
Consulate-General of Japan (Karachi) カラチ日本総領事館
233, Raja Ghazanfar Ali Khan Road, E.I.Lines, Karachi.
G.P.O.Box 3745
Tel: +92-(0)21-5681331, 5681332
Fax: +92-(0)21-5684627
Mansehra (Attarshisha)
Muzaffarabad (Langarpura)
Afghanistan
Iran
India
Arabian Sea
Khunjerab Pass
(Hunza) Karimabad
Shandur pass
Aliabad
Sost
K2 8611m
Gilgit
Chitral
Skardu
Dir
Karakoram Highway
Chilas
Khyber Pass
Besham
Mingora (Swat)
Takht-i-Bhai
Mansehra
Muzaffarabad
Abbottabad
Srinagar
Line of Control (L.O.C) 実効支配線 事実上の印パ国境
Mardan
Murree
Peshawar
Islamabad
Rawalpindi
Taxila
Kohat
Attock
Bannu
Rohtas Fort
Gujrat
Sialkot
Motor Way (Highway)
Dera ismail Khan
Sargodha
Gujranwala
Kandahar
Amritsar
Lahore
Zhob
Jhang
Faisalabad
Chaman
Dera Ghazi Khan
Okara
Sahiwal
WAGAH The Pakistan -India border
Quetta
Multan
Harappa
Zahedan
Sibi
Kuh-i-Taftan
Bahawalpur
Kalat
Uch
Jacobabad
Delhi (New Delhi)
Derawar Fort
Sukkur
Agra
Khuzdar
Larkana
Rohri
Bus route (Karachi - Quetta)
Moenjo Daro
Nawabshah
Sanghar
Turbat
Bela
Uthal
Khakhropar
Gwadar
Pasni
Karachi
Hyderabad
AJK
NWFP
China
Northern Area ノーザンエリア
N.W.F.P 北西辺境州
Azad kashmir アーザード カシミール州 (パキスタン実効支配下)
Punjab パンジャーブ州
Baluchistan バローチスタン州
Iran
India
Sind シンド州

1.4 Members of the Team

Name affiliation and subject in charge	Duration of Dispatch	Work contents
Hiroshi IMAI Japan International Cooperation Agency (JICA) Seismic Resistance Design	First: March 8th to April 4th, 2006 Second: April 8th to May 9th, 2006 Third: August 9th to August 20th, 2006 Fourth:October25th to November 5th, 2006 Fifth: January 27th,to February 4th,2007	・ Investigation of BHUs where located in earthquake affected area ・ Explanation of Scope and Aim of the Project to Counterpart Organization and conclude Mutual Understanding on Work Plan from AJK and NWFP Governments ・ Obtaining Approval of Seismic Resistance Design from ERRA
Dr. Toshikazu HANAZATO Japan International Cooperation Agency (JICA) Structural Design	First: March 8th to April 4th, 2006 Second: April 8th to May 9th, 2006 Third: August 9th to August 20th, 2006 Fourth:October25th to November 5th, 2006	・ Investigation of BHUs where located in earthquake affected area ・ Obtaining Approval of Structural Design from AJK and NWFP Governments and ERRA
Nobuyoshi FURUICHI Binko Internatinal Ltd. Manager, Construction plan And Maintenance	First : June 2nd to June 21st ,2006 Second：July 4th to August 3rd,2006 Third：September 16th to November 15th	・ Explain & Discuss about Inception Report ・ Confirmation of the project background,contents,objective and seek clarification on the position of the Project with Pakistan's post earthquake development plan ・ Survey regarding Pakistan government's obligation ・ Discuss & Consider with C/P on "how to keep financial & technical sustainability and its problem & conditions etc." ・ Survey of Current situation and analysis of damaged facilities ・ Assist C/P to summarize damaged facilities by earthquake ・ Discuss standard BHU design ・ Settlement of detailed design documents ・ Selection and survey of construction sites ・ Place order to local consultant

		・ Inspection of procured medical equipment ・ Technical transfer through construction of BHU ・ Make correction of standard design documents ・ Technical transfer about seismic resistance and barrier-free technology ・ Preparation and distribution of the construction management & maintenance manual ・ Suggestion on adoptability to other public facilities such as schools etc. ・ Training of persons in charge Dept. of Health and Public Works Department
Takashi OGAWA Binko Internatinal Ltd. Procurement and Cost Estimation	First : June 2nd to June 11th ,2006 Second: June 20th to June 29th ,2006 Third: Oct. 5th to Oct.16th ,2006	・ Evaluate construction companies by financial and technical aspects and finalize the short list of construction companies ・ Correction of related documents about architectural & construction plan ・ Settle the plan of procurement for construction companies ・ Project Cost Estimation ・ Survey about distributors of medical equipment ・ Selection of local consultant
Nobuyasu KOIZUMI Binko Internatinal Ltd. Construction Plan and management 1	First : July 4th to July20th,2006 Second : August 1st to Sept. 23rd,2006 Third: October 19th to November 15th,2006.	・Survey of construction management work of local contractors ・Settle the draft of construction management plan ・Settle detailed design documents ・Train the local consultant on how to make design drawings ・ Inspection of procured medical equipment ・ Technical transfer of Seismic resistance and barrier-free technology ・Correction of Construction management manual during process of construction ・Discuss and prepare construction management manual ・Technical transfer of construction management through model BHU

Naohito MORIMOTO Binko Internatinal Ltd. Architect, Construction Plan and Management 2	First : Oct. 5th 2006 to Feb. 1st ,2007	・Survey of construction management work of local contractors ・Settle the draft of construction management plan ・Settle detailed design documents ・Train the local consultant on how to make design drawings ・Inspection of procured medical equipment ・Technical transfer of Seismic resistance and barrier-free technology ・Correction of Construction management manual during process of construction ・Discuss and prepare construction management manual ・Technical transfer of construction management through staff residence

1-5 Counterpart Organizations

(1) Earthquake Rehabilitation and Reconstruction Agency, Government of Pakistan

(2) Provincial Earthquake Rehabilitation and Reconstruction Agency, NWFP

(3) Works &Service Department, Government of NWFP

(4) Health Department, Government of NWFP

(5) Works & Service Department , District Mansehra

(6) Health Department, District Mansehra

(7)State Earthquake Rehabilitation and Reconstruction Agency, AJK

(8) Public Works Department, State Government of AJK

(9) Health Department, State Government of AJK

1-6 Implementation Schedule

Duration of the Project : From 25th March 2006 to 15th February 2007

Project scope: Construction of BHU and Staff Residence with technical transfer for management of the construction.

＜BHU Building＞

	2006								
Activity	May	Jun.	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Preparationof the Project in Japan									
Field survey in Paksitan									
Construction of model BHU									
Technical Transfer									
Technical Transfer Seminar									
Explanation of draft final report									

Work in Japan

Work in abroad

＜Staff Residences>

Activity	2006 Sep	Oct	Nov	Dec	2007 Jan	Feb
Preparationof the Project in Japan	□					
Conclusion of the Contract	■					
Construction of Staff Residences		■	■	■	■	
Technical Transfer		■	■	■	■	
Submission of Final Report					■	
Handing-over					▼	

□ Work in Japan
■ Work in abroad

1-7 Output of the Project

(1) Technical transfer items

1) Seismic resistant technique

a) Concept of structural design, reinforced concrete (rigid) frame system, grid system

b) Concept of structural calculation, dual mode calculation

c) Strengthening of brick wall and block wall by steel bar or wire mesh

d) Use of plinth bands and lintel bands

e) Preparing drawings and technical specifications

f) Understanding architectural and structural drawings

g) Need to make shop drawings or detail drawings

h) Reinforcement, fabrication of reinforcing bars.

i) Anchorage, splice length, 135 degree hook of stirrup, bending of reinforcing bar

j) Concrete clear cover

k) Site selection, land slide, soil test retaining wall

l) Site engineer’s job, quality control and management system

m) Computer aided design

2) Barrier-free design

a) Design of ramps

b) Design of handrail

c) Design of steps

d) Design of doors

(2) Number of targeted person in the technical transfer

1) Attendants of Seminars

a) Seminar at Muzaffarabad 22 persons

b) Seminar at Mansehra 30 persons

c) Seminar at Islamabad	70 persons
Sub total	122 person

2) Attendants of Workshops

a) July 18, 2006, Muzaffarabad	6 persons
b) July 25, 2006, Attarshisha	5 persons
c) July 31, 2006, Attarshisha	6 persons
d) July 29, 2006, Muzaffarabad	4 persons
e) July 29, 2006, Attarshisha	6 persons
f) August 12, 2006, Attarshisha	4 persons
g) August 31, 2006, Muzaffarabad	5 persons
h) September 16, 2006, Attarshisha	4 persons
i) October 16, 2006, Muzaffarabad	5 persons
j) October 16, 2006, Attarshisha	4 persons
k) October 20,2006,Islamabad	2 persons
l) October 22, 2006,Muzaffarabad	6 persons
m) October 22, 2006, Attarshisha	5 persons
n) October 25 &26,2006 Muzaffarabad	6 persons
o) October 27,2006,Attarshisha	5 persons
p) October 28,2006,Islamabad	2 persons
q) October 30,2006,Muzaffarabad	6 persons
r) October 30,2006, Attarshisha	4 persons
s) November 1,2006, Muzaffarabad	6 persons
t) November 1,2006,Attarshisha	4 persons
u) November 4,2006, Muzaffarabad	6 persons
v) November 4,2006,Attarshisha	5 persons
w) November 5,2006 Muzaffarabad	6 persons
x) November 5,2006,Attrarshisha	5 persons
y) November 6,2006 Muzaffarabad	6 persons
z) November 6,2006,Attrarshisha	4 persons
a') November 7,2006,Islamabad	2 persons
b')November 11,2006,Muzaffarabad	6 persons
c') November 11,2006,Muzaffarabad	6 persons
d') December 17,2006,Muzaffarabad	6 persons
e') December 17,2006,Attarshisha	4 persons
Sub total (accumulative total)	148 person

3) Local consultant	5 persons
4) Local contractor	
a)AJK	2 persons
b)NWFP	3 persons
Total	122 persons

**Attendants for Seminars and attendants for 2),3) & 4) are same persons, therefore total numbers shall be 122 persons which is equal to 1).*

(3) Output of the project (Details are shown on 4.4 Output)

a) Standard design drawings

b) Working drawings

c) Surveillance manual

d) Text book

(4) Collected information and materials

a) Standard design of Basic Health Unit of NWFP and AJK

b) Typical design of health and education facilities prepared by NESPAK

c) Typical design of schools and BOQ prepared by Works and Services Department, Mansehra

d) Sample of contract documents prepared by Public Works Department, Muzaffarabad

Chapter 2

Chapter 2 Surrounding situation of construction sites and its problems

2.1 Damage to public buildings

(1) Stone masonry, brick mansonry and concrete block mensonry buildings.

Stone masonry, brick masonry and concrete block masonry buildings are basically one story buildings. These buildings are seriously damaged by the earthquake.

Even if they have plinth beam and lintel, some of these buildings are damaged seriously. The beam and lintel were not strong enough for seismic force.

	
Damaged stone masonry building District Headquarter Hospital, Battagram	Damaged stone masonry school KuzBazargai, Battagram

(2)Reiforced concrete frame buildings

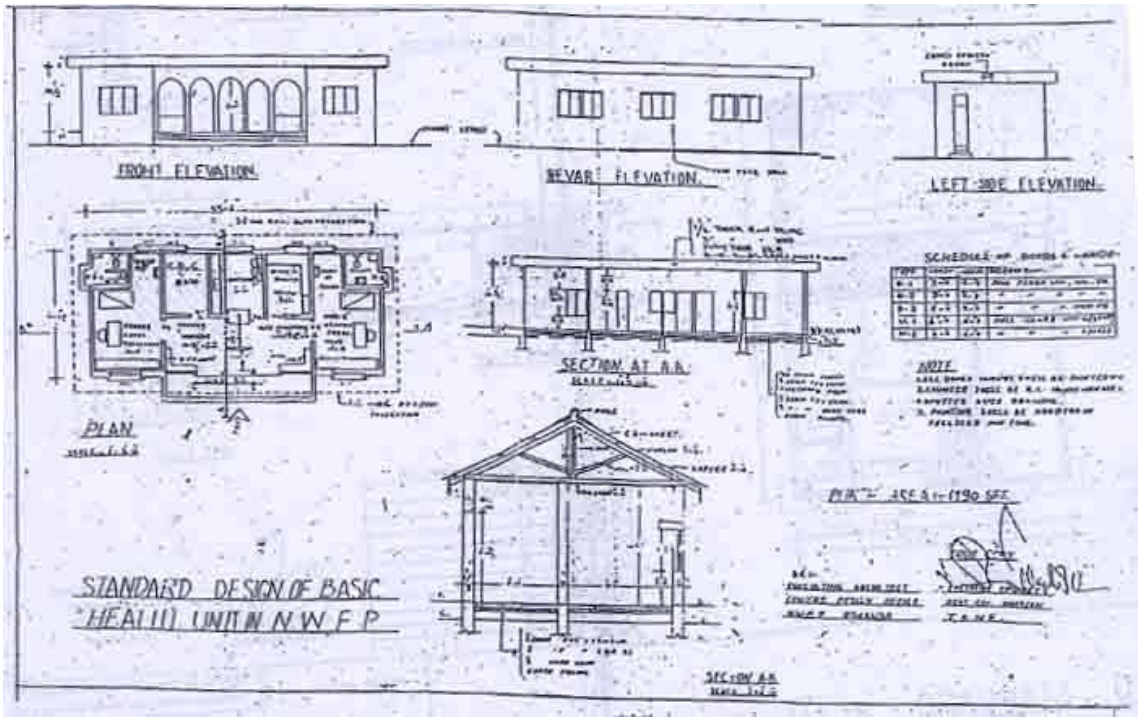
Some of the reinforced concrete frame structure buildings are seriously damaged and the others are not damaged. It is conceivable that the difference derived from the variation of site specific ground motion, ground (soil) condition, structural design or construction skill.

	
Collapsed school building. Langarpura, near Muzaffarabad.	Reinforcement is not sufficient. Langarpura, near Muzaffarabad.

	
Damage of reinforced concrete framing building. District Headquarter Hospital Mansehra	Reinforced concrete framing building with no or a little damage. Government office building, Muzaffarabad.

2.2 Existing BHU standard design

The standard design of BHU of NWFP was drawn up in 1986. While the total area of the OPD is 1,190 square feet, the proposed OPD plan for NWFP in the Project is 3,024 square feet.



source: Ministry of Planning & Development

Specifications for the foundation, column and lintel are unclear and no barrier free design, like a slope, is provided for in the standard design.

2.3 Current construction circumstances

The construction skill or workmanship of the construction work varies from the top level of a big project to a small housing construction. A certain luxury hotel extension project in Islamabad or a new construction project of a famous hotel chain at Muzaffarabad are well supervised. Many detailed drawings for reinforcing works are prepared by engineering consultants, and the sites are well organized and clean. The construction of the new hotel at Muzaffalabad started before the earthquake of October 2005 and is now underway with only minor change. The method of construction or technical level of these projects are almost equivalent to those of developed countries and they are also supported by many engineers with working or overseas academic experience.

	
Well supervised construction site. Islamabad	Low level of construction technique. Girls college Battagram

On the other hand construction skills in rural area remain at a low level.

It is because there are the following incompleteness of the construction technology;

a) There is no structural designer in rural area who can do structural calculation of reinforced concrete building or structural steel building. So knowledge about design concept can not spread among site engineer or construction manager.

b) Most of the engineers who are working in rural area do not have proper understanding of structure.

c) Most of the site engineers (engineers of Contractor) can not read the structural drawings, so they can not follow the important description of drawings and technical specifications. So result is improper implementation of given design on site.

2.4 Building code of Pakistan

The building code of Pakistan, compiled by the Environment & Urban Affairs Division of

the Ministry of Hosing & Works, was published in 1986. It is difficult for the public to obtain, however, because it is unavailable in bookstores in towns or related offices such as the Pakistan Engineering Council.

On chapter 1.5 of the building code seismic load is stipulated as follows;

V=ZIKCSW

V: Shear at the base

W: Sum of dead load and live load

Z: Coefficient dependent upon the zone

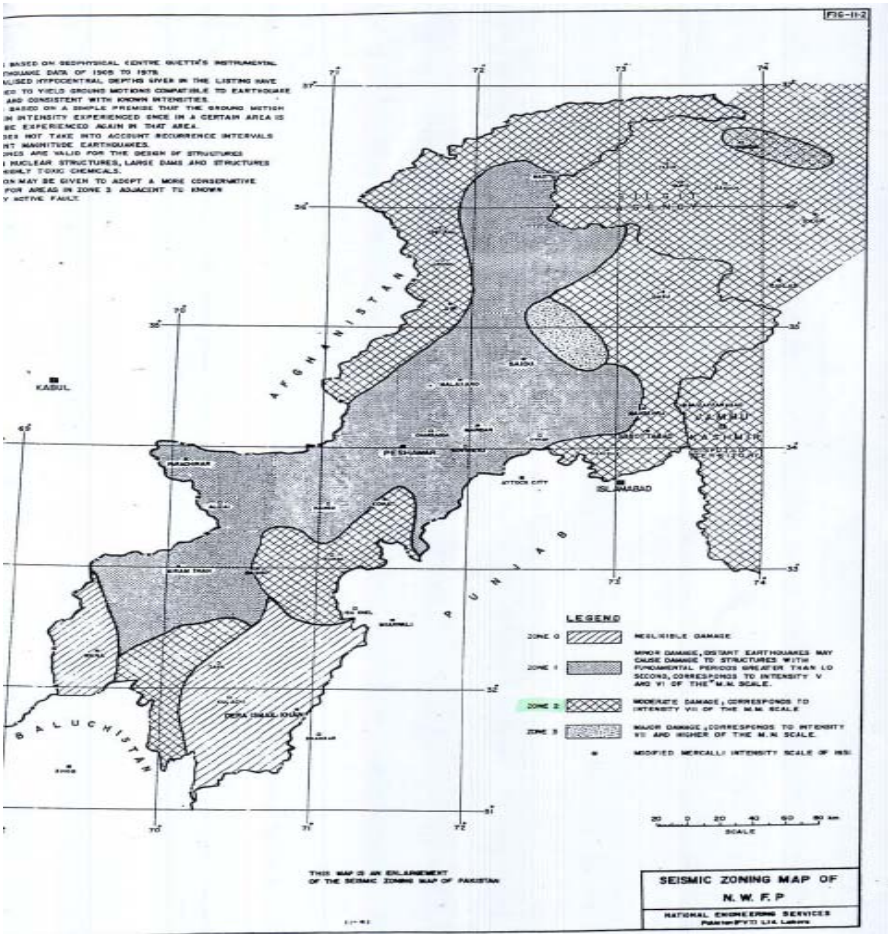
Zone 0: Z=3/32

Zone 1: Z=3/16

Zone 2: Z=3/8

Zone 3: Z=3/4

Following Zoaning Map shows from Zone 0 up to Zone 3 in NEFP.



Seismic zoning map of NWFP
Source: Building code of Pakistan, Ministry of Housing and Works.

I:: Values for occupancy importance factor

Essential facilities: 1.5

Any building where the primary occupancy is for assembly use for more than 300 persons: 1.25

All others: 1.0

K: Coefficient depend on the type of structure

Framing system: 1.0

Box system: 1.33

Dual bracing system: 0.8

etc

C: Coefficient determined by

$C=1/15\sqrt{T}$ (not more than 0.12)

T: Period of the structure

S: Coefficient for site-structure resonance

Moreover, the building code of Pakistan is not mandatory and is currently subject to ongoing revision. Structural engineers use foreign codes like UBC, IBC (USA) or Euro code (EU).

2.5 Organization

After the earthquake of October 2005, Earthquake Reconstruction & Rehabilitation Authority (hereinafter ERRA) was established. Reconstruction projects in the earthquake affected area must obtain planning permission from ERRA. National Engineering Services Pakistan (Pvt.) Limited (hereinafter NESPAK) provides a technical consultancy service to ERRA and University of Engineering & Technology Peshawar(hereinafter UET, Peshawar) provides technical consultancy services to the Government of NWFP. Under ERRA , PERRA or SERRA (Provincial or State Earthquake Reconstruction & Rehabilitation Authority) was organized. On a district level, District Construction Units (DRU) are organized to coordinate many reconstruction projects.

The following is an organizational chart showing the inter-relationship regarding operation of BHUs.

<Operational Organization Chart of BHU>

NWFP	AJK
Department of Health, Ministry of Health	
EDO(Executive District Officer), Mansehra	DHO(District Health Officer), Muzafarrabad
BHU Attarshisha	BHU Langarpura
Medical Officer Other Medical Personnel	Medical Officer Other Medical Personnel

2.6 Lessons learned from the earthquake for the reconstruction of BHU

(1) Selection of the site

1) Wrong selection of the site

Based on the result of survey, it was found that many small buildings collapsed or were partially damaged due to inappropriate selection of the land. This phenomenon is applicable not only to public buildings but also to ordinary residences.

Above left photograph shows dangerous situation of the building. Above right photograph shows the destroyed building by stone.

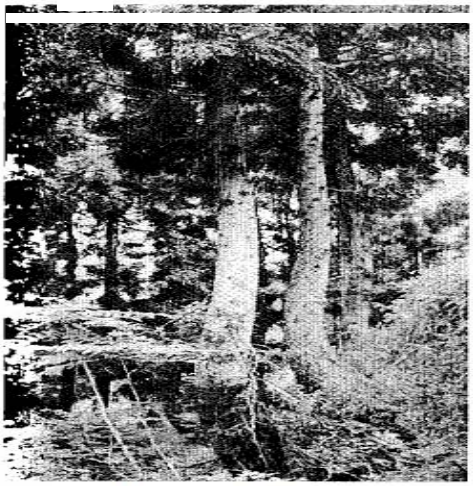
Taking into consideration water flows during the downpour, it is necessary to investigate whether there is any loose rock or not.

1. Collapse of Retaining Wall

Many buildings were destroyed because of collapse of the retaining wall, when earthquake struck.

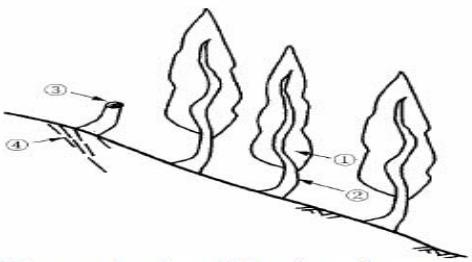
2. Landslide

At the time of the Earthquake many buildings were destroyed by landslides. Landslide can be foreseen beforehand from "Signs of the landslide which occurred before", "Cracks in the ground surface and movement of the rolling stone", "Bending of the tree", and "Discontinuity of weathering of the surface of the rock", etc.



Root bending of tree

Judgment example of ground movement



①Abnormal twist and bending of tree
②Bump caused in curved part of tree
③The annual ring in the part of this bump does not become a concentric circle.
④Abnormal putting condition of root of tree and crack of surface of the ground

(2) Problem of construction method

The following problems were identified through a site survey and on-site construction management .

1) Construction Management (Inspection) Style

Engineers from the Public Works Department or Works and Services Department, who are responsible for the supervisory work on behalf of government organizations such as the Health Department, for health care facilities, execute Total Inspection. The Total Inspection means they can not control many sites at the same time. This is due to the lack of control mechanism and the engineers remain unaware of a checkpoint at each stage of construction.

According to the opinion obtained from the Public Works Department or Works and Services Department engineers, the following facts came out such as “It is necessary to manage a lot of sites at the same time and appropriate supervision for many individual sites was not possible to manage”. Similarly a lot of problems became apparent from the investigation of tender documents prepared by the engineers belonging to public organization such as old or incomplete technical specifications, and lack of structural, architectural, electrical, plumbing drawings.

Judging from this current state of affaires, the situation that many buildings won’t reach the demand quality of the design could not be avoided.

The engineers should keep intact their performance as a quality controller on the site in the above mentioned circumstances. For maintaining his job level, the engineers should change from the previous management method such as All-time-Observation & Supervision Style and Total Inspection Style to Sampling Inspection Style which consists of sampling some inspection items by the engineers and autonomous management by the contractor. The contractor carries out Total Inspection according to the Check-list and the engineers inspect only sampling items based on the Check-list. From the above Style a quality guarantee method for many sites at the same time will be established.

1. Lack of Consideration for the Structure

There were several types of cases investigated at small construction sites.

Connection between Beam and Column

There was no strong connection between Beam and Column in building structures constructed before the Earthquake.

2. The incompleteness of the construction technology

-There was no structural designer in rural areas able to perform structural calculations for reinforced concrete or structural steel buildings.

-Most of the engineers working in rural areas lack a proper understanding of structure.

-Most of the site engineers (contractor engineers) are unable to read structural drawings, so they can not follow important descriptions of drawings and technical specifications, leading to an improper implementation of the given design on site.

2.7 Recommendations

a) Only three strong motion records of the earthquake were reported, namely those of Abbotabad, Murree and Nilore respectively .To estimate the actual seismic load, a numerous strong motion seismographs must be provide in earthquake affected areas.

b) It is important to analyze the cause of collapse of certain featured buildings. Simulations must be based on structural calculations using existing structural design (structural calculation and drawings), actual seismic load, ground (soil) condition, the concrete strength of the core taken out of existing structures, and reinforcing bar strength. Retaining the design document for many years is useful for these analyses, which must also be published for the public.

c) It is recommended that a Pakistan standard for structural calculation and relevant standard specifications be compiled. These two standards should also be closely related to the building code of Pakistan. This means if engineers in Pakistan wich to design according to building code of Pakistan, which is unique for the country, a standard for structural calculation and specifications, which complements to this code, must be drawn up.

d) It is recommended that professional organizations of engineers, architects, geologists,

university researchers, and government engineers etc be established to lead the above b), c) tasks like Architectural Institute of Japan or Japanese Society of Civil Engineers.

e) It is recommended that a registration or license system of architects, structural engineers and construction supervisors be established to secure proper design and practices for construction works.

Chapter 3

Chapter 3 Major Activities in the Project

3.1 Preparation stage for Construction Work

(1) Pakistani Standard Design & its Modification (9Grid and 12Grid)

1) BHU Outpatient Building (OPD)

NESPAK, as a technical consultant for ERRA, prepared drawings (most of which were plans) for public buildings such as schools and health facilities and including plans for BHUs as well. ERRA clarified that these were standard plans and could be accommodated in consideration of land availability, end user needs and other reasonable factors.

Through discussion with ERRA, it was mutually agreed that certain new features for buildings could be added for the BHUs, since a variety of land was available. On the other hand, large BHUs with additional features could not be constructed due to the limited land available in some cases. With this reality in mind, the Team decided to make propose several types of plan which could be easily accommodated in the limited space available. At an early stage of the project, the Team decided to make plans for BHU only, excluding RHC, and ERRA approved this decision. The Team prepared 3 types of 9feet Grid and 3 types of 12feet Grid respectively , a total of six types of plans. Structural analyses were then calculated for 12 feet Grid three span type and 12feet Grid two span types.

ERRA approved the design of a 12 feet Grid for model construction under JICA's technical cooperation project in AJK and NWFP on an experimental basis. The Team has received a No Objection Certificate for the reconstruction of BHU at Attarshisha from EDO (Executive District Officer)Health Mansehra. The Team has also received a No Objection Certificate for reconstruction of BHU at Langarpura from DHO (District Health Officer) Muzaffarabad.

2) BHU Staff Residences

Taking into consideration the fact that health care facilities should be provided for those in remote rural areas, it was considered essential to reconstruct the staff residences. The Team obtained standard design documents for staff residences in the earthquake affected area prepared by NESPAK. The Team modified the drawings of NESPAK with the latter's consent and then discussed these with the related organization. The necessary No Objection Certificates were obtained from PERRA and SERRA once the designs had been approved by the Health Departments of NWFP and AJK. ERRA was informed accordingly by PERRA and SERRA.

(2) Concept of BHU in NWFP and AJK

i) Standard Design Plan

There are so many variety of construction lands so that design should have flexibility. Due to that reason, adopted Grid system (12ft x 12ft) and three types from 5 to 7 spans in total 6 plans are available.

ii) Construction

Construction should be simple and easy, taking into consideration the local contractor's technical level. Standardization for RCC column & beam by Grid System. Simplify the foundation.

iii) Wall

For strengthening the wall, it is required to insert reinforcement or wire mesh for prevention from collapsing.

ⅳ） Roof Structure

Adopt steel truss. The use of wooden truss for large public building is prohibited by ERRA.

ⅴ） Structural Design

・Dual Mode Design

Moderate earthquake ground motions will not cause structural damage to the building and extremely strong ground motions will not cause damage to human lives .

Prevent collapse of not only framed structure but also masonry walls

・Structural Design

Reinforced Concrete Frame + Masonry Wall

Seismic resistant design of framed structure of reinforced concrete and of masonry walls

Wind and snow resistant design of roof trusses

・Regulations for Design

Based on concepts of Japanese Building Code.

To strengthen masonry walls, the guidelines published by Architectural Institute of Japan and proposal by Dr. Qaisar Ali, Associate Professor, UET Peshawar are adopted, referring to Uniform Building Code, as well as, to the original structural design by UET,Peshawar.

Comparison of Seismic Design Loads Base shear coefficient

	Pakistan Standard	Present design	Japanese Code
Allowable unit stress	0.07 for Zone 2(before EQ)	0.15	0.20
Ultimate lateral strength	0.223 UET, Peshawar (UBC-97) (0.223 is introduced after the earthquake of Octover 2005)	0.225(Ds=0.30)	0.30(Ds=0.30)

Ds: Reduction factor due to damping and ductility

・Ultimate Lateral Strength

For protecting human lives during extremely large earthquakes ;

1)Framed structure will not collapse

Deformation and failure mechanism are confirmed by Limit state of structure analysis

2)Masonry walls will not collapse

Deformation of structure < Safety limit of masonry walls

・Barrier-free design

Adopt the Japanese or USA standard as in case of entrance slope and toilet specification for the hospital because there is no barrier-free standard in Pakistan. .

(3) Site Selection of Model Construction

Japanese side and Pakistani side , both agreed to construct one Model BHU for each province and state to check the appropriateness and suitability of design for providing better health care services.

The Pakistani side agreed to take all the necessary measures required for construction, such as land availability and leveling etc. Based on the criteria such as the population of the catchment’s area , fully collapsed buildings, easy accessibility by road , flat land and a reasonable number of medical personnel, the Team finally agreed to construct on the following sites.

AJK

Name	: **BHU LANGARPURA**
District	: Muzaffarabad
Tehsil	: Muzaffarabad
Union Council	: Langarpura
Place	: 20 minutes drive from Muzaffarabad in the direction for Hatian,on Jehlum Valley Road
Construction Situation	: Fully Damaged
Catchment's Population	: 25,000
Numbers of staff	: FMO(female medical officer) (1) HT(health technician) (1) LHV(lady health visitor):(1) EPI Technician (3) Dispenser:(1) TBA(traditional birth attendant) （2） WB(ward boy)(1) Sweeper(2)

NWFP

Name of BHU:	**: BHU Attarshisha**
District	: Mansehra
Tehsil	: Mansehra
Union Council	: Attarshisha
Catchment Population	: 11,000
Place	: 30 Minutes drive from Mansehra
Construction Situation	: Fully Collapsed except Medical Officer's Residence
Numbers of staff	: MO:(medical officer)(1) MT: (medical technician)(1) FMT: (female medical technician)(1) LHV(lady health visitor)(1) EPI technician(1) TBA: (traditional birth attendant)(1) Supervisor Malaria(1) WB(ward boy)(1) Sweeper(1)

(4) Land Survey and Soil Testing

The Team had conducted a topographical survey and a penetration test .Attarshisha had no problems in terms of site conditions since it was flat land. The site plan of Langarpura was modified slightly according to the topographical data.

(5) Preparation of Tender Documents

Tender Documents were prepared based on the Standard Design and the conditions defined by the Pakistan Engineering Council were also taken into consideration. The contents of these documents are as follows;

<Volume I>

- Instruction to Tenderers
- General Conditions of Contract
- Specification

<Volume II>

- BOQ
-Drawings

3.2 Nomination for prospective tenderers

According to the financial(Net Profit and Assets) and technical （Project experience , Number of Engineer , Property of Construction Machinery） aspects, the Team nominated 8 contractors , 2 in Muzaffarabad, 2 in Mansehra, 1 in Peshawar, 2 in Islamabad and 1 in Rawalpindi.

The Team announced the distribution date of the tender documents and all listed companies received these in due time.

3.3 Tendering and Award

On July 1st, the Team held a tender meeting and nominated CEMCON(Pvt) Ltd. and Parthenon General Contractors as initial negotiators having submitted the lowest bids. Finally, the Team awarded their offer and entered into a construction contract on July 10th with both CEMCON(Pvt) Ltd., for the BHU Attarshisha and with Parthenon General Contractors, for the BHU Langarpura.

On July 1st 2006, quotation for medical equipment was received from three participants, namely RIF International, Grand Agencies and Matoradigionics. The lowest bid was submitted by RIF International and the products they offered products conformed to the required technical specification. Therefore, the Team concluded a contract with RIF International.

3.4 Model Construction

<BHU Attarshisha, NWFP>

The commencement order was delivered to CEMCON(Pvt) Ltd. on 15th of July 2006 for the construction at Attarshisha and the work started the same day. The progress of construction work can be shown in a weekly report as per Annex 3.

The completion of the work was delayed due to on-site water resource problems at site and the work had to be stopped during the initial days of construction.

<BHU Langarpura, AJK>

In the case of the Langarpura Site, the commencement order was delivered to Parthenon General Contractors on 17th July 2006 and the work started on the same day. The Progress of the Construction work can be shown on weekly report as per Annex 3.

Due to the heavy rains in July, the bridge for transporting construction materials to Langarpura site ultimately collapsed. This collapse caused a considerable delay in delivering the materials to the site on time. In addition, the removal of a Telephone Exchange that had been temporally occupying part of the construction site, took considerable time, following the intervention of Health Department.

For the above two reasons , completion was delayed.

<Staff Residences, NWFP>

Construction Agreement was signed with CEMCON (Pvt) Ltd. on 12th of October 2006 for the following scope of works and actual construction work was started on 1st of November.

Contents	Scope	Number(s)
Doctor's quarter (Type 1)	Renovation	1
Medical Staff's quarter (Type 2)	New Construction	1
Guard's quarter (Type 3)	New Construction	1
Bath for Guard	New Construction	1

<Staff Residences, AJK>

Construction Agreement was signed with Parthenon General Contractors on 12th of October 2006 for following scope of works and actual construction work was started on 1st of November.

Contents	Scope	Number(s)
Doctor ‘s quarter (Type 1)	New Construction	1
Medical Staff’s quarter (Type 2)	New Construction	2
Guard’s quarter (Type 3)	New Construction	1
Bath for Guard	New Construction	1

Chapter 4

Chapter 4 Contents of Technical Transfer & Outcome

4.1 Workshops

During the technical transfer period, the Team gave lectures on following topics. Details of workshops are attached as per Annex 4.

No.	Description& form of Lecture	Date and Place of Lecture	Lecturer	No. of Attendants
1 -01	Incident or Accident? Brainstorming	July 18th, 2006 (Muzaffarabad)	N.FURUICHI	6
1 -02	Incident or Accident? Brainstorming	July 25th, 2006 (Attarashisha)	N. FURUICHI	5
1 -03	Incident or Accident? Brainstorming	July 31st, 2006 (Attarashisha)	N. FURUICHI	6
2-01	Engineer's role in Stability of Land Lecture	July 29th, 2006 (Muzaffarabad)	N.FURUICHI	4
2-02	Engineer's role in Stability of Land Lecture	July 29th, 2006 (Attarashisha)	N.FURUICHI	6
2-03	BHU concept, Seismic Design Lecture	August 12,2006 (Attarashisha)	H.IMAI and T.HNAZATO	4
07-1	Make a drawing of reinforcing bar assembling Lecture	August 31,2006 (Muzaffarabad)	N.KOIZUMI	5
07-2	Make a drawing of reinforcing bar assembling Lecture	September 16th, 2006 (Attarashisha)	N.KOIZUMI	4
3-01	Engineer’s role and New material Lecture	October 16th, 2006 (Muzaffarabad)	N.FURUICHI	5
3-02	Engineer’s role and New material Lecture	October 16th, 2006 (Attarashisha)	N.FURUICHI	4

No.	Description& form of Lecture	Date and Place of Lecture	Lecturer	No. of Attendants
4	Introduction of how to make Japanese design drawing (center line)	October 20th , 2006 (Islamabad) For Private consultants	N.MORIMOTO	2
5-01	How to prepare Construction Schedule (Overall schedule & Process schedule)	October 22nd, 2006 (Muzaffarabad)	N.MORIMOTO	6
5-02	How to prepare Construction Schedule (Overall schedule & Process schedule)	October 22nd, 2006 (Attarashisha)	N.MORIMOTO	5
6-01	Data collection for site management	October 25th& 26th,2006 (Muzaffarabad)	N.MORIMOTO	6
6-02	Data collection for site management	October 27th, 2006 (Attarashisha)	N.MORIMOTO	5
8	Difference between design drawing and construction drawing	October 28th, 2006 (Islamabad) For Private consultants	N.MORIMOTO	2
9-01	Reinforcement concrete structure	October 30th, 2006 (Muzaffarabad)	N.MORIMOTO	6
9-02	Reinforcement concrete structure	October 30th, 2006 (Attarashisha)	N.MORIMOTO	4
10-01	The role of site engineers (how to penetrate instructions to the organization)	November 1st, 2006 (Muzaffarabad)	N.MORIMOTO	6
10-02	The role of site engineers (how to penetrate instructions to the organization)	November 1st, 2006 (Attarshisha)	N.MORIMOTO	4

No.	Description& form of Lecture	Date and Place of Lecture	Lecturer	No. of Attendants
11-01	Making by Japanese way	November 4th , 2006 (Muzaffarabad)	N.MORIMOTO	6
11-02	Making by Japanese way	November 4th , 2006 (Attarashisha)	N.MORIMOTO	5
12-01	Purpose of Progress Surveillance within the process	November 5th , 2006 (Muzaffarabad)	N.MORIMOTO	6
12-02	Purpose of Progress Surveillance within the process	November 5th , 2006 (Attarashisha)	N.MORIMOTO	4
13-01	Construction Plan and Management (Construction Flow)	November 6th , 2006 (Muzaffarabad)	N.MORIMOTO	6
13-02	Construction Plan and Management (Construction Flow)	November 6th , 2006 (Attarashisha)	N.MORIMOTO	4
14	Surveillance check sheet	November 7th , 2006 (Islamabad) For Private consultants	N.MORIMOTO	2
15-01	Introduction of Japanese working drawings and its explanation	November 11th , 2006 (Muzaffarabad)	N.MORIMOTO	6
15-02	Introduction of Japanese working drawings and its explanation	November 11th , 2006 (Attarshisha)	N.MORIMOTO	4
16-01	Suggestion of concrete block and brick forms	December 17th ,2006 (Muzaffarabad)	N.MORIMOTO	6
16-02	Suggestion of concrete block and brick forms	December 17th ,2006 (Attarashisha)	N.MORIMOTO	4

4.2 OJT at sites

Technical transfer of seismic resistant technique and Barrier-free technique executed on the items mentioned on the 1-7 (1) Technical transfer items in Chapter 1, using design documents on the both Langarpura site (AJK) and attarshisha site(NWFP).

At the beginning of this project, Pakistan and Japan came to a mutual understanding concerning the Work Plan and Minutes of Discussions dated June 5, 2006, whereby the supervision of on-site work would be managed by the Public Works Department(AJK) or the Works and Services Department(NWFP). Following the preparatory stage, the counterpart engineers of the Public Works Department or Works and Services Department were nominated by each district or by the state government of AJK. The experts dispatched from Japan expected that the site supervision would be done by the government engineers, so that they themselves could concentrate on the technical transfer through OJT or Work Shop. As it happened , however, the counterpart engineers were unable to concentrate fully on the Project due to construction rush at recovery stage in Pakistani society. The Japanese experts, therefore performed the supervisory work, mainly in collaboration with the contractor’s engineers.

At the site, Japanese experts have explained following topics by following way.

<Example of OJT A: Making a module for a Reinforced Concrete Block Structure>

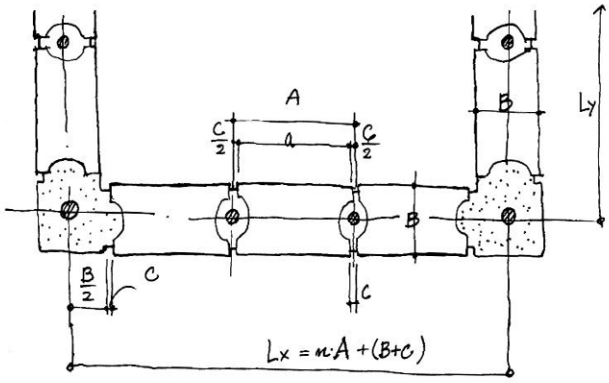
To realize a seismic resistant building, it is preferable to design a flat plan at the time of the basic design for making the module. The main objective is to construct symmetrical walls by placing the rebars and bearing walls as equally as possible.

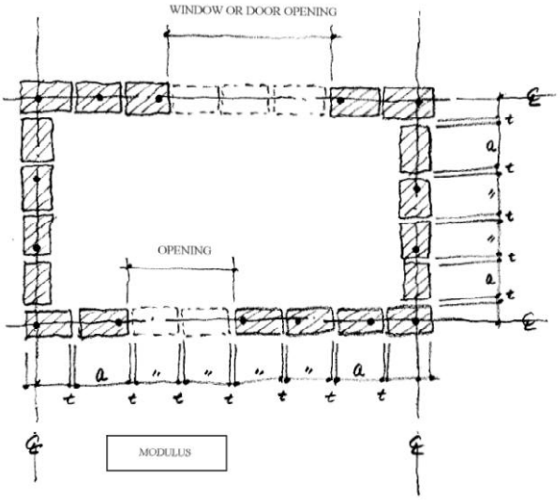
The following photograph shows the standard specifications for concrete block structures such as ordinary houses. This manufacturing process is common all over the world. As with the manufacture of sun-dried bricks, the concrete blocks are manufactured in wooden molds. The manufacturing specifications, strength and standardization of the size of concrete blocks for making modules need to be widely understood.

Based on hearing about making modules and reinforced concrete block structures from the design side and construction side, there appears to be no concept of block layout in either the design stage or the construction stage.

For this reason, training has been conducted regarding the equal placement of blocks and the adjustment of overall building size, width of the opening spot, explanation regarding Japanese working drawings on how to adjust the place and decide the insertion place of the rebars and making the body plan, along with simultaneously explaining the module.

As for the outcome of the training, staff residences and guard houses have been successfully constructed using such modules. In addition to building these basic modules, the engineers who attended the training program came to understand that by obtaining the proper sizes, they could purchase construction materials in advance such as doors, windows, floor materials and ceiling materials, which they normally purchased only after completion of the structural walls. Following pictures show example of modules.





<Example of OJT B: Suggestion for concrete block and brick forms>

Maintaining a precise cross section and the quality control of the concrete itself are necessary for constructing reinforced concrete structures with seismic resistant design at the implementation stage.

In Pakistan, there are two main obstacles to the construction of concrete structures: The rebars are very expensive and the wood required for making the molds is expensive due to its scarcity.

Regarding the second point, it even affects contractors preparing temporary scaffolding and simple ladders in the process of construction, which seems easier in other countries. This causes many inconveniences onsite.

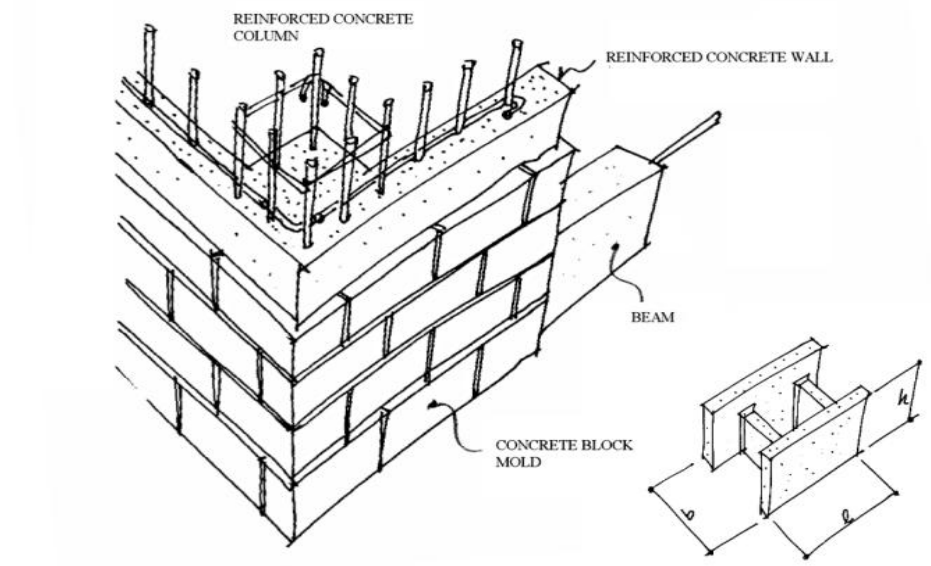
In major projects it may be supposed that contractors would put financial resources into preparing steel forms or wooden molds, but the following photograph shows the actual situation at an ordinary construction site.

The stone masonry structures in Pakistani are one of the features of the beautiful landscape.

Through discussion with Pakistani engineers, Japanese experts have suggested adopting the Japanese concrete and block form, using local available materials at low cost, to provide seismic resistant buildings. Using concrete blocks or pulling out of bricks can combine the required architecture and structure whilst maintaining the scenery of Pakistani cities.

There are many merits to this type of construction: The structural form directly becomes the exterior design, there is no need for plastering, no need to pull bricks out of molds, the total cost is lower and the construction schedule is shorter. Regarding pulling brick out of molds, further improvements are required, and there are other considerations such as salt corrosion on concrete due to the unglazed brick commonly used in Pakistan. Japanese experts consider that Pakistani can construct its own architectural and structurally combined buildings using concrete without wasting resources.

Following pictures show construction example of Japanese concrete block forms.

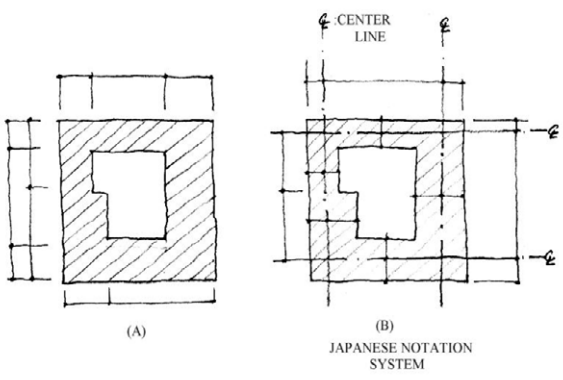


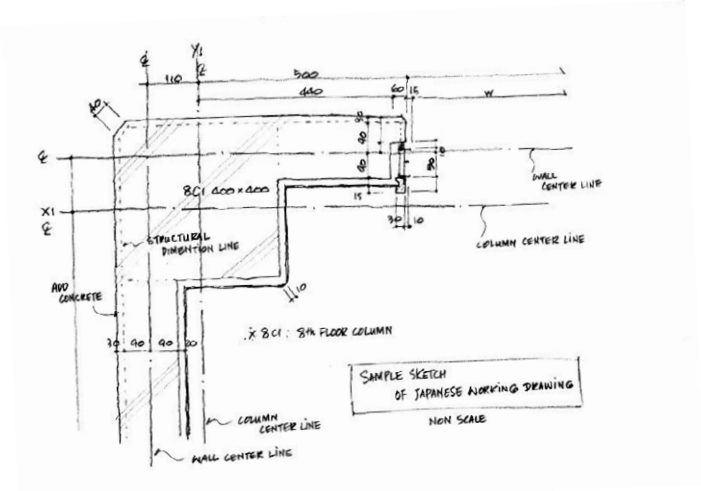
<Example of OJT C: Japanese working drawing >

In English, a construction drawing is called a “working drawing” or a “shop drawing” even though the method and contents may differ compared with those of foreign countries.

At this opportunity, a Japanese working drawing was explained to the design consultant and contractor’s engineers.

Each shop drawing is made at the manufacturing process for several items so that the details of the manufactured items are combined with the construction design drawing. Left pictures show the comparison example for how to write standard lines and right picture shows the example of Japanese construction working drawings.





In Japan, once a contract or commencement order has been finalized, the contractor immediately begins preparation. The drawings should be ready from 1 to 6 months before depending on the number of items that need to be manufactured at a factory. This preparation work is performed by the group specified in the working drawing. Its scale should be at least 1/50 or full scale drawing in some cases. The method of working drawings in Japan has been developed and improved along with the development of reinforced concrete structures.

Taking the example of reinforcement processing, factory processing is mainstream in Japan. Therefore, in addition to proper construction drawings, working drawing are important materials for internal technical meetings among engineers, detailed meetings with processing and manufacturing factories and also for schedule control by obtaining the precise working volume.

After completion of the working drawing, it is possible to place an order not only for doors and windows but also for all the necessary construction items even at the beginning of construction. As accurate working drawings reduce the number of mistakes at the construction stage, working drawings are very important for the overall construction.

It will take time to adopt the Japanese working drawing method in Pakistan, but providing a brief explanation to the construction related people at this special occasion will make a contribution to the spread of this method.

4.3 Technical Transfer Seminar

The Team held seminars in Muzafarrabad on 31st of October , in Mansehra on 2nd of November, and in Islamabad on 4th of November. The following presentations were made to the Pakistani Engineers and details of Seminars and Attendant List are shown as per Annex 2.

Technical Transfer Seminar Program

Speaker & his title	Contents
Mr. Hiroshi IMAI Architect, Earthquake resistant design	Concept of BHU prototype design
Dr. Toshikazu HANAZATO Structural design	Structural seismic design
Dr. Qaisar ALI, Structural design	Innovation in Earthquake Resistant Design of Reinforced Concrete Structure
Mr. Nobuyoshi FURUICHI Engineer, Project Manager	Site Management
Mr. Nobuyasu KOIZUMI, Architect	Preparing sufficient document and drawings

Lecture by Mr. H.IMAI, Muzaffarabad

Lecture by Mr. N.FURUICHI,Muzaffarabad

Participants at Mansehra

Lecture by Prof. HANAZATO,Mansehra

Opening speech, Islamabad

Lecture by Dr Q. ALI, Islamabad

4.4 Output

(1) Surveillance Manual

This manual provides essential items for both surveillance engineer (government engineers) and contractor's engineers regarding the proper site management method in both Urdu & English and focuses on "how to make seismic resistant buildings using a specific method described in the specifications and working drawings". 500 copies of this manual will be distributed to AJK and a further 500 to NWFP departments and the officials concerned.

The contents of the manual are mentioned hereunder.

Surveillance Manual
Preface
Part I. Management Procedure
1. Definition of Words
2. Flow of Construction Work and Management Organization Chart
3. Role of related parties
4. Problem of Construction Management
5. Predation of Construction Work
6. Commencement of the Work
7. Reinforcement Work
8. Concrete Work
9. Conclusion of Part I

Part II. Maintenance of damaged building
1. Evaluation of Damage of the building
2. Steps of Making repair plan
3. Method of repair

Part III. Prototype BHU and its Barrier-free concept
1. Prototype BHU
2. Barrier-free concepts

(2) Standard Design Drawings

These documents consist of Architectural Drawings and Structural Drawings including structural analysis. These documents would be available at JICA Pakistan Office.

(3) Working Drawings

Working Drawings would be available at JICA Pakistan Office.

(4) Text Book

The text book "Can you defend yourself and your family from the disaster?" has been written for local residents, explaining the safety of the surrounding residential area and how

to secure their families at the time of disaster. It also explains the concept of seismic resistant building. 250 copies each will be distributed to departments and officials concerned in AJK and NWFP, while a further 100 copies will be distributed to departments concerned in Islamabad.

The contents of the text book are mentioned hereunder.

"Can you defend yourself & your family from the disaster?"
1. Is surrounding of your house safe?
2. Is your house safe?
3. Barrier-free method at your home

4.5 Lessons leaned trough this project

(1) Time management of Construction Project in Pakistan

It is rather difficult to keep construction time which defined in the construction contract. So many construction works are delayed and sometimes delay period would be 1 year from the original date. This delay closely related with the proper planning, its control and shortage of management items. While construction term of BHU, Japanese experts could not keep records on manpower working shift such as how many workers involves at site in that week and also do not keep records about weather. Considering construction overall schedule, manpower mobilization and consumption time for that specific work can guess depending on previous weather records and manpower working records.

While construction work for staff residences, Japanese experts held meeting one time in a week referring to the above records and consider with contractor's engineer about the volume of manpower for coming week.

It is strongly recommended in Pakistan to keep these records for time management and hold a internal meeting at least one time in a week for effective resource mobilization of resources for keeping the overall construction schedule. Time is one of the quality of the work.

(2) Frequency of C/P engineer's Site Attendance

In this project, owner was Binko International ltd. and contractor was private construction company. (Normally, owner is public works department of district government and contractor is the same). Due to the construction rush in this project period from May 2006 up to January 2007 which occurred after the recovery organization was officially formed on April 2006, C/P engineers were too busy to attend the site for OJT from Japanese experts. This facts lead not to have deep understanding for seismic resistant and barrier free concepts

adapted design documents. In case there is another opportunity to receive this kinds of assistance by ODA, scheme should have flexibility to send the money to recipient country first such as Non-project grant aid project , therefore recipient country can give order directly to the public works department as usual and this can make construction surveillance work independently by governmental engineers.

(3) Working drawings & appropriate reference of the standard

Working drawings prepared by the public works department in charge for supervision of the public buildings in Pakistan refer the BS (British standard) or ASTM(American standard) but there is no original standard available at office of public works department at district level and construction works are going on without any confirmation of the request of each standard. To break trough this situation, Japanese experts prepared and attached these standard as part of the surveillance manual by CD-R. When surveillance work is done by working drawings, it is necessary to confirm that appropriate construction materials are using confirmed by original standards.

(4) Penetration of construction management technique using by surveillance manual

It is important to establish the surveillance system between the governmental engineers and private engineers (contractor’s engineers) at the time of commencement which is the essence of surveillance manual for quality assurance and time management. To construct the seismic resistant building which is attainability of this project, it is required to manage the works process by process such as engagement of contract, commencement , each construction work. Therefore, it is recommendable to bring the surveillance manual and refer at the site.

(5) Penetration of the concept of seismic resistant and barrier-free at community level

Text book is written for the ordinary Pakistani people how to select the safety construction site , how to secure the surrounding safety, how to improve comfortableness for handicapped persons damaged by the earthquake. It is important for each community to adopt the seismic resistant design as well as barrier-free design for minimization of the damage from the next disaster.