Annex 4　Workshop documents

Technical Transfer Program Curriculum Sheet				Curriculum No. 1 -01
Lecture name	Incident or Accident?			
Target of course	※ To survey deference of mind of engineer before & after of earthquake for seismic resistant building. ※ Level investigation of engineer's quakeproof engineering.			
Form of Lecture	☑Brainstorming	☐ Lecture	☐ Seminar	☑

Content :

1. Showing many photograph of destroyed Building element by the Earthquake.
2. Ask to the participant as follows:
   - What's happen?
   - Is this an incident or accident?
   - Could you prevent this mutter?
   - How do you prevent this muter?
3. From the answer, engineer's technical level and deference of mind of engineer before & after of earthquake for seismic resistant building can be judged.
4. Above information will be reflected to the following curriculums.
5. While discussion assistant shall make a record.

Teaching material:	Equipment:
1. Power Point "Curriculum 1" 2.	1. Computer 2. Projector 3. Pointer 4. Screen(wall)

Results	Date : 2006/07/18	Number of Attendance	Lecturer:
	Time: 11:00-12:30		Made by: Fuluichi
Place	Muzaffarabad office		

Person for attending a lecture: 6

Evaluation for Lecturer:	Skill:	Knowledge:	Concern:
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments;

Evaluation ⇒ Fill in the mean value.

Technical Transfer Program Curriculum Sheet				Curriculum No. 1 -02
Lecture name	Incident or Accident?			
Target of course	※ To survey deference of mind of engineer before & after of earthquake for seismic resistant building. ※ Level investigation of engineer's quakeproof engineering.			
Form of Lecture	☑Brainstorming	☐ Lecture	☐ Seminar	☑

Content :

1. Showing many photograph of destroyed Building element by the Earthquake.
2. Ask to the participant as follows:
   - What's happen?
   - Is this an incident or accident?
   - Could you prevent this mutter?
   - How do you prevent this muter?
3. From the answer, engineer's technical level and deference of mind of engineer before & after of earthquake for seismic resistant building can be judged.
4. Above information will be reflected to the following curriculums.
5. While discussion assistant shall make a record.

Teaching material:	**Equipment:**
1. Power Point "Curriculum 1" 2.	1. Computer 2. Projector 3. Pointer 4. Screen(wall)

Results	Date : 2006/07/25	Number of Attendance 5	Lecturer: Fuluichi
	Time: 11:00-12:00		Made by: Fuluichi
Place	Mansehra office		

Evaluation for Lecturer:	Skill: 4.75	Knowledge: 5	Concern: 4.75
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments;

Evaluation ⇒ Fill in the mean value.

Technical Transfer Program Curriculum Sheet				Curriculum No. 1 -03
Lecture name	Incident or Accident?			
Target of course	※ To survey deference of mind of engineer before & after of earthquake for seismic resistant building. ※ Level investigation of engineer's quakeproof engineering.			
Form of Lecture	☑Brainstorming	☐ Lecture	☐ Seminar	☑

Content :

1. Showing many photograph of destroyed Building element by the Earthquake.
2. Ask to the participant as follows:
   - What's happen?
   - Is this an incident or accident?
   - Could you prevent this mutter?
   - How do you prevent this muter?
3. From the answer, engineer's technical level and deference of mind of engineer before & after of earthquake for seismic resistant building can be judged.
4. Above information will be reflected to the following curriculums.
5. While discussion assistant shall make a record.

Teaching material:	Equipment:
1. Power Point "Curriculum 1" 2.	1. Computer 2. Projector 3. Pointer 4. Screen(wall)

Results	Date : 2006/07/31	Number of Attendance 6	Lecturer: Fuluichi
	Time: 14:00-16:00		Made by: Fuluichi
Place	Mansehra office		

Evaluation for Lecturer:	Skill: 4	Knowledge: 4.5	Concern: 4.5
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments;
For other group of W&S

Evaluation ⇒ Fill in the mean value.

JICA

The Technical Cooperation Project
for
Designing Prototype Seismic
Resistant and Barrier-free BHUs
at Langarpur in AJK
and
at Attarshisha in NWFP

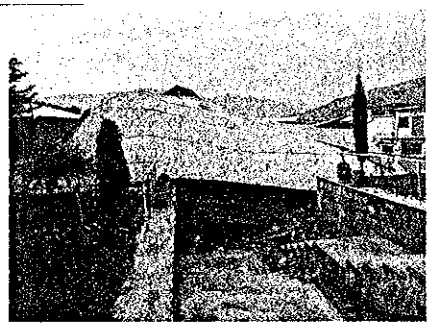
Curriculum 1

(Brainstorming)

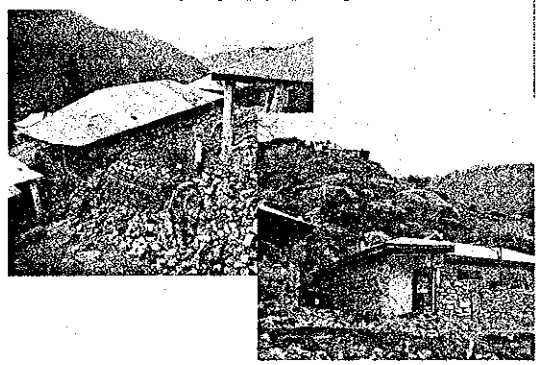
Incident or Accident?

Could you prevent this mutter?

Could you prevent this mutter?

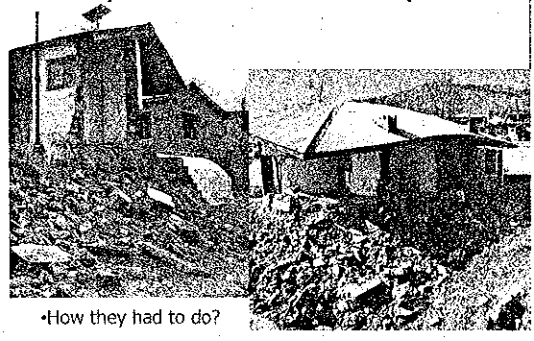


Land selection



Land selection 2

Why was this wall collapsed?



•How they had to do?

Veranda Collap

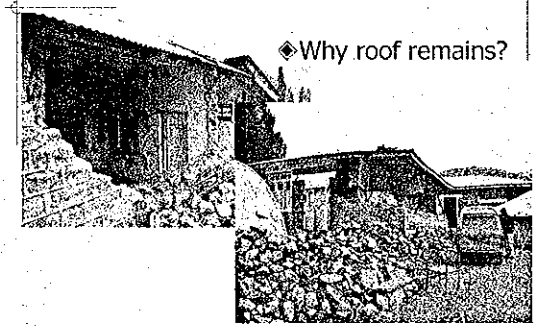
What kind
Structure

New Construction

◆New structure
Veranda

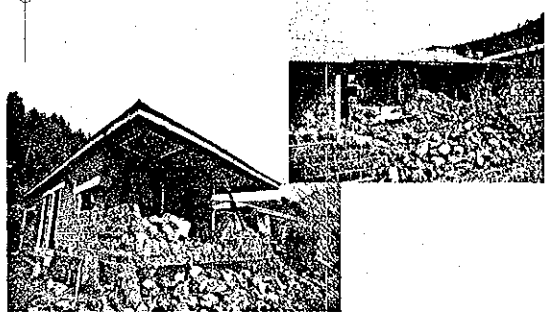
◆How do you think
this structure
◆Is it correct ?

Remaining Roof

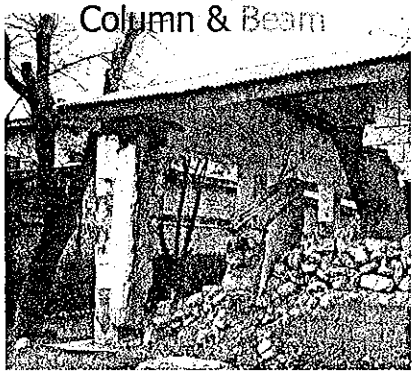


◆Why roof remains?

Remaining Roof 2

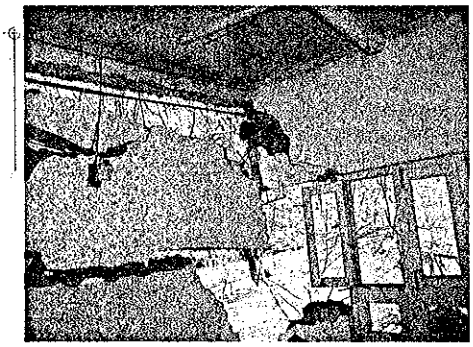


Column & Beam



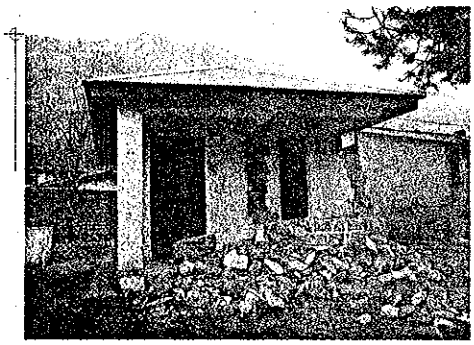
Column & Beam 2

Column & Beam 3

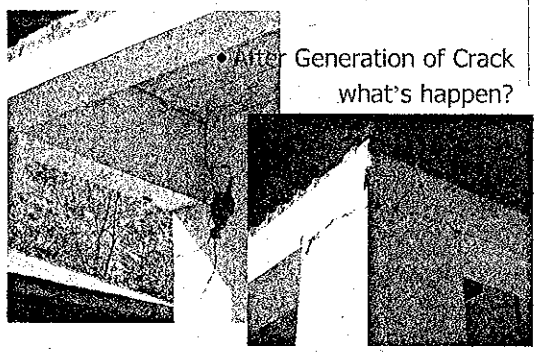


Rigidity / Stiffness

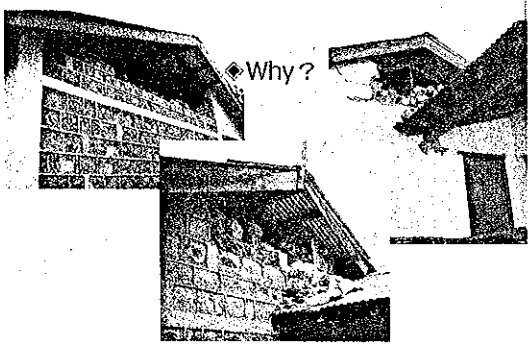
Rigid wall



Limitation of strength

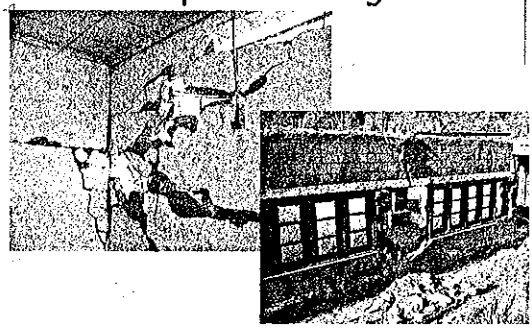


Is gable of saddle roof weak?



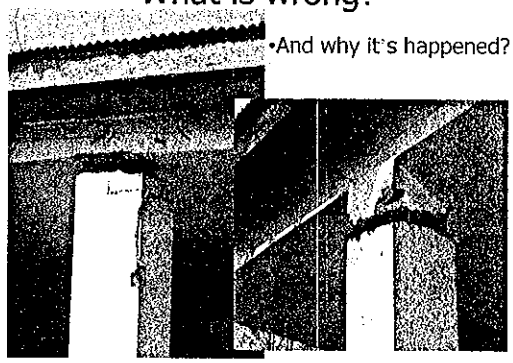
What is difference from other collapsed building?

What is difference from other collapsed building?

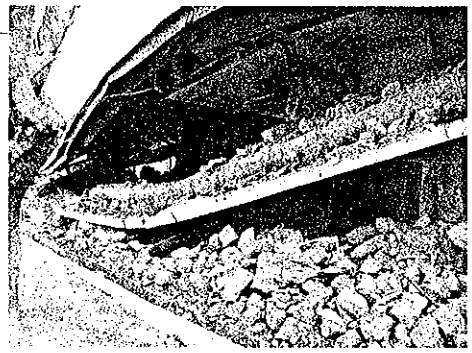


What is wrong?

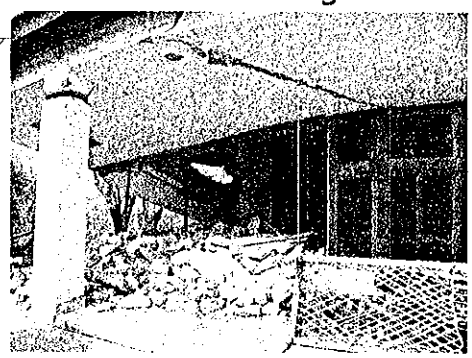
- And why it's happened?



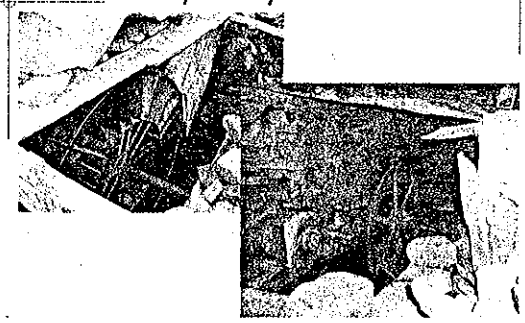
What is wrong?



What is wrong?



Pakistan nice technology Hydro-Dynamo



END

THANK YOU for your attention

Technical Transfer Program Curriculum Sheet				Curriculum No.02 - 1
Lecture name	Engineer's role in Stability of Land			
Target of course	1. Site engineer's job at the commencement of the site work 2. Many way of soil test			
Form of Lecture	☐ Brainstorming	☑ Lecture	☐ Seminar	

Content :
1. At the commencement of the site work what's kind of attention should be paid for the land?
2.How to check the land stability
3.Soil test
4.

Teaching material :	**Equipment :**
1. Power Point [Curriculum 2] 2. [Sheet 1] 3.	1. 1 Computer 2. Projector 3. Pointer 4. Screen(wall) 5.

Results	Date : 29 July 2006	Number of Attendance	Lecturer: Fuluichi
	Time: 14:00		Made by: Fuluichi
Place	Muzaffarabad		

Person for attending a lecture: 4

Evaluation for Curriculum:	Skill: 4	Knowledge: 4.25	Management: 3.75
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments:

Evaluation ⇒ Fill in the mean value.

Technical Transfer Program Curriculum Sheet				Curriculum No.02 -2
Lecture name	Engineer's role in Stability of Land			
Target of course	1. Site engineer's job at the commencement of the site work 2. Many way of soil test			
Form of Lecture	☐ Brainstorming	☑ Lecture	☐ Seminar	

Content :
1. At the commencement of the site work what's kind of attention should be paid for the land?
2.How to check the land stability
3.Soil test
4.

Teaching material :	**Equipment :**
1. Power Point [Curriculum 2] 2. [Sheet 1] 3.	1. 1 Computer 2. Projector 3. Pointer 4. Screen(wall) 5.

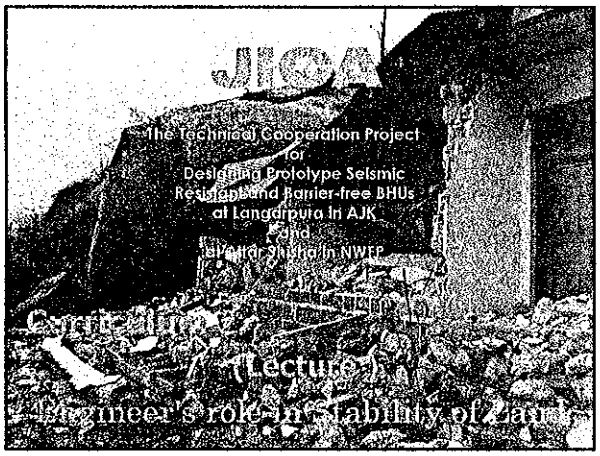
Results	Date : 29 July 2006	Number of Attendance	Lecturer: Fuluichi
	Time: 14:00-16:00		Made by: Fuluichi
Place	Mansehra office		

Person for attending a lecture: 6

Evaluation for Curriculum:	Skill: 4	Knowledge: 4.5	Management: 4.5
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments:

Evaluation ⇒ Fill in the mean value.



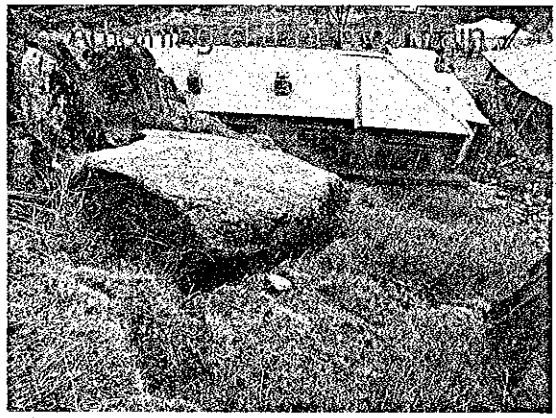
Engineer's work at the commencement

- Grasp of designer design intention
- Grasp of process
- Grasp of construction condition
  - Grasp of situation around the vicinity of site
  - Grasp situation of site
    - **Soil test, Topographic Survey**
- Establishment of system for Surveillance
  - Organization
  - Quality control
  - System of Meeting, Report, etc.
- Etc.

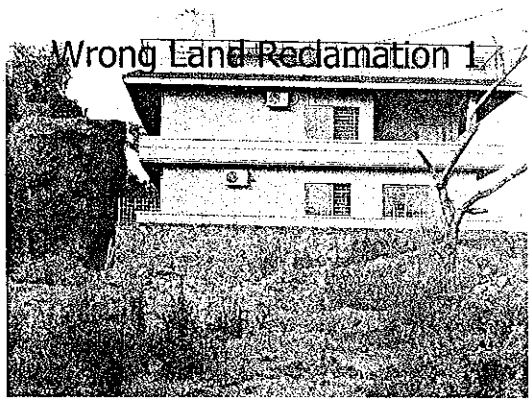
Grasp of situation around the vicinity of site

Observation Item

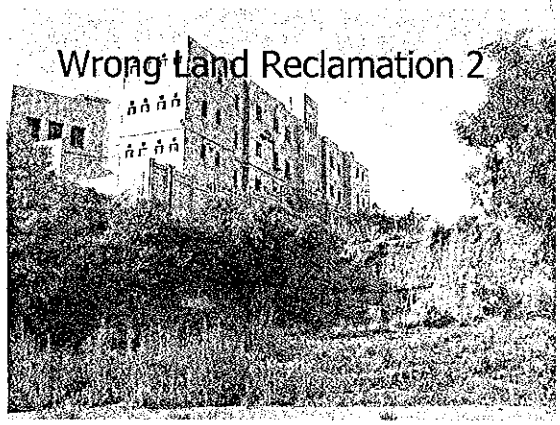
- **Adjoining cliff or mountain**
- **Peripheral nature of soil**
- **Retaining wall**
- **Water flow**
  - **River (Record of flood, The highest water level)**
  - **Flow of water at torrential rains**
  - **Amount of spring water**
- **Slope stability**
- **Trees**

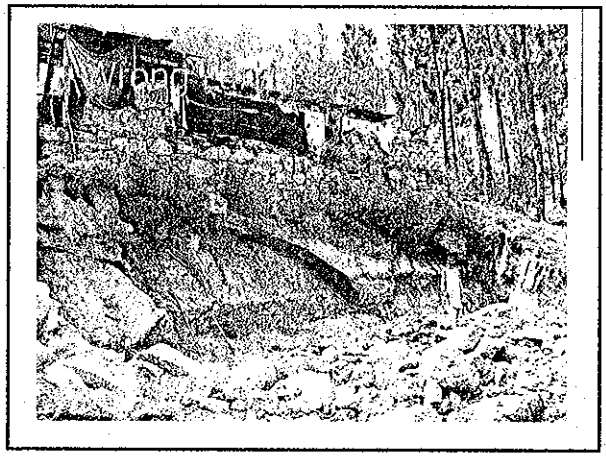


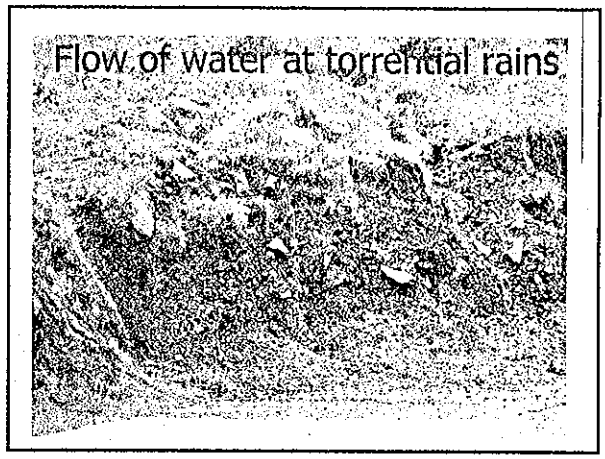
Wrong Land Reclamation 1

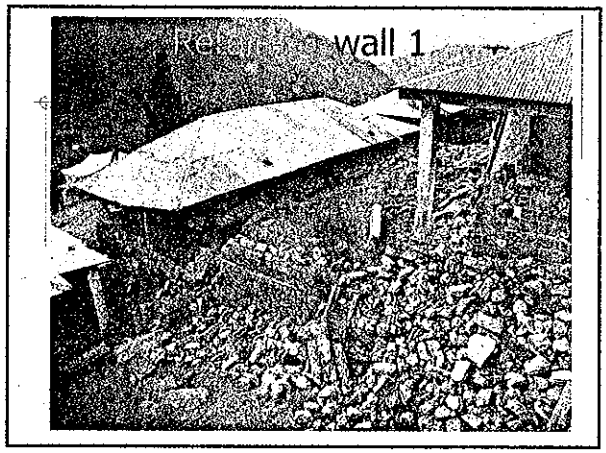


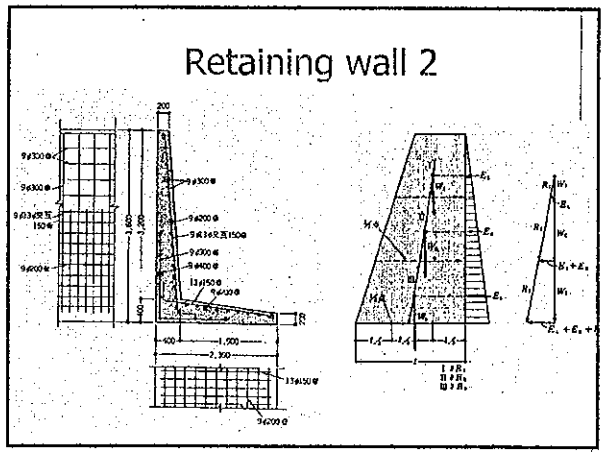
Wrong Land Reclamation 2

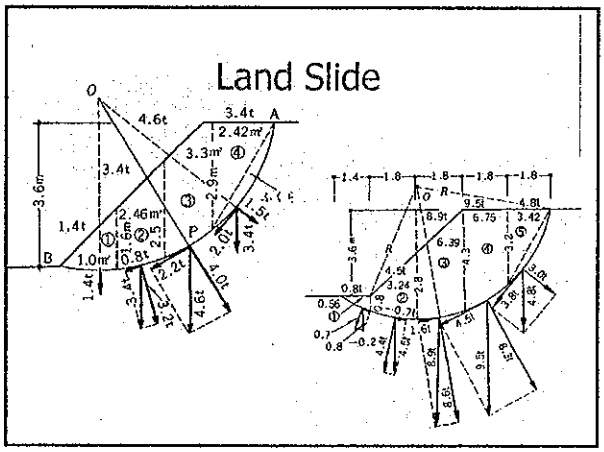


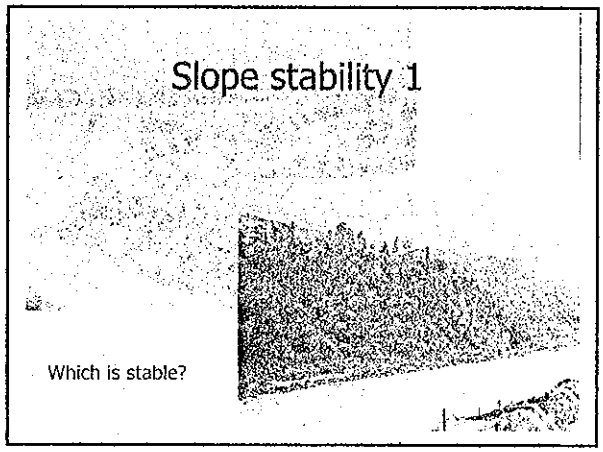



Flow of water at torrential rains


wall 1


Retaining wall 2


Land Slide


Slope stability 1
Which is stable?

Slope stability 2

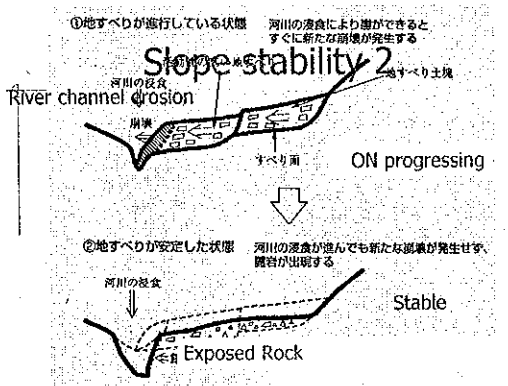
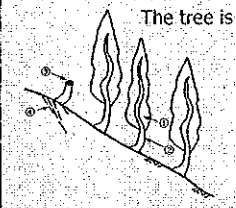


図3-3 崖からわかる地すべりの安定度

Trees

Signs of the landslide are shown.



The tree is curved.

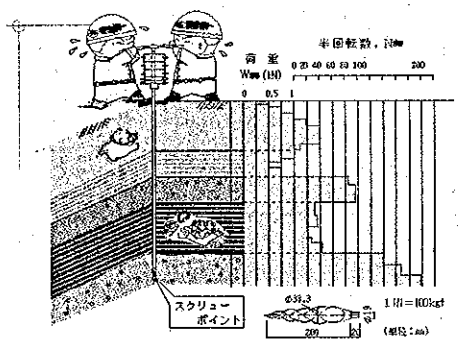
The annual ring of the tree does not become a concentric circle.

写真3-1 立木の根曲がり　　図3-2 地山挙動の判定例

Grasp situation of site

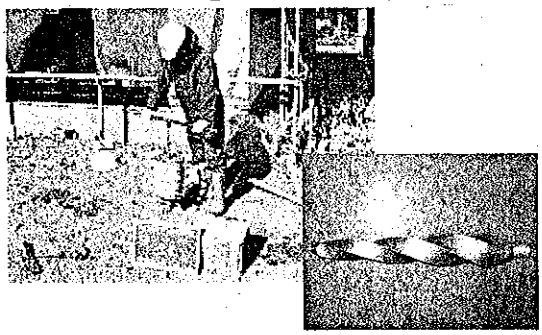
- **Soil test**
  - **Standard penetration test**
  - **Plate bearing test**
  - **Swedish weight sounding test**
  - **Etc.**
- **Topographic Survey**

Swedish weight sounding test 1



（全長で1回の右ねじれ最大径33）

Swedish weight sounding test 2



Correlation of Standard penetration test N value and Swedish weight sounding test

- Gravel, stone, and sandiness
  - N=0.002Wsw + 0.067Nsw
- Gravel clay, Clay
  - N=0.003Wsw + 0.050Nsw

Or

- Sand deposit
  - N=1/12・Nsw
- Tuff loam
  - N=1/9・Nsw

General method of surveying ground and satisfaction rating

requirement / test method	Standard Penetration test	Swedish weight Sounding test	Dutch Penetrometer Test	Plate bearing test	Hand Auger
Search cost cheap	X	◎	◎	X	◎
Investigation period short	X	◎	◎	X	◎
5m depth Possible	◎	◎	△	X	X
Soil nature can be judged	◎	△	X	X	◎
Light and small	X	◎	◎	X	◎
Handling easy	X	◎	◎	X	◎

END

THANK YOU
for your attention

Technical Transfer Program Curriculum Sheet				Curriculum No.03 -01
Lecture name	Engineer's role and New material			
Target of course	Engineer's role on Quality control and Management Item			
Form of Lecture	☐ Brainstorming	☑ Lecture	☐ Seminar	

Content :
1. Importance of preparing sufficient design document and drawings.
2. Structural Calculation.
3. Structural Drawings

Teaching material :	**Equipment :**
1. Building project of Works and Service 2. Documents and Drawings of this project. 3.	1. Computer 2. Projector 3. Pointer 4, Screen

Results	Date : 16 October 2006	Number of Attendance 5	Lecturer: Furuichi
	Time: 11:00		Made by: Furuichi
Place	Muzzafarabad		

Evaluation for Lecturer:	Skill: 3.4	Knowledge: 3.8	Management: 4.0
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments:

Evaluation ⇒ Fill in the mean value.

Technical Transfer Program Curriculum Sheet				Curriculum No.03 -02
Lecture name	Engineer's role and New material			
Target of course	Engineer's role on Quality control and Management Item			
Form of Lecture	☐ Brainstorming	☑ Lecture	☐ Seminar	

Content :
1. Importance of preparing sufficient design document and drawings.
2. Structural Calculation.
3. Structural Drawings

Teaching material :	**Equipment :**
1. Building project of Works and Service 2. Documents and Drawings of this project. 3.	1. Computer 2. Projector 3. Pointer 4, Screen

Results	Date : 16 October 2006	Number of Attendance 4	Lecturer: Furuichi
	Time: 15:00		Made by: Furuichi
Place	Mansehra		

Evaluation for Lecturer:	Skill: 4.75	Knowledge: 4.75	Management: 4.75
Evaluation for Attendance:	Volition:	Understanding:	Attitude:

Comments:

Evaluation ⇒ Fill in the mean value.

Management Control Item & New Material

For seismic resistant Building
Material of a less management control item

Role of Surveillance Engineer

- Elements of Site Management
  - Time and Quality
- Role of Site Surveillance Engineer
  - Control of Time and Quality
  - Final Responsible Person for Quality

Management control item

- Concrete Work
- Reinforcement
- Hollow Brick work
- Finishing work
- Steel Structure Work
- ETC.

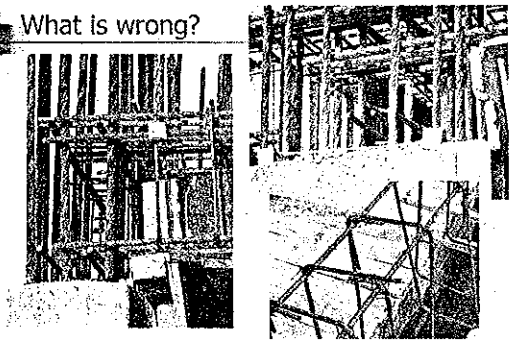
The management item decreases by going below

Management control items of Reinforcement

- Number, Size, Type, Strength (of each part)
- Splice (Position, Length, Hook of each part)
- Shape of Hook (180° , 135° , 90°)
- Compression Splice & Tension Splice
- Anchorage (Dowel)
- Thickness of Protection cover concrete
- Spacer, Bolster, Chair
- Etc.

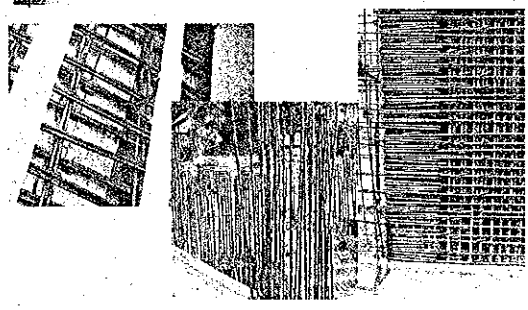
Many Mistake on Reinforcement

What is wrong?



Many Mistake on Reinforcement

- Why such mistakes were happened?



1

Can you control all Management Items?

- You can not control all Management Items.

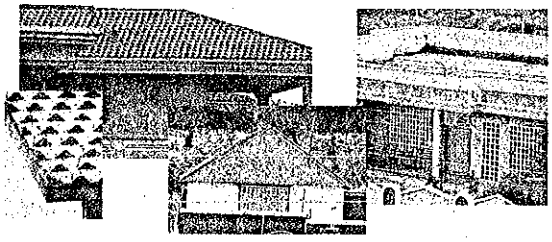
How to manage?

Two Solutions

- To find your colleague to support you
  - NO!
  - You have to make collaboration with Contractor's Engineer of Site
  - How to? ⇨ Next Lecture!
- To find Material of a Less Management Control Items

Material of a Less Management Control Items

- Which is a Less Management Control Item's Material

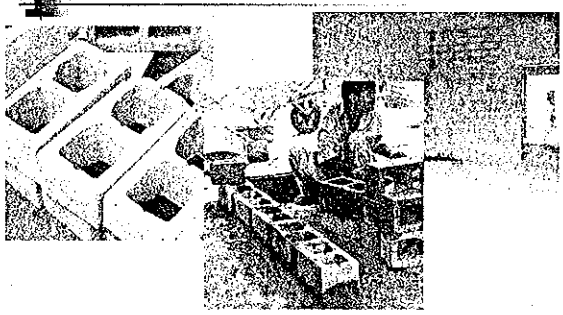


Material of a Less Management Control Items

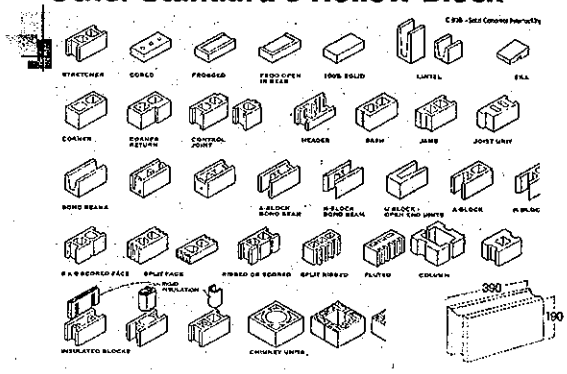
- Industrial Material

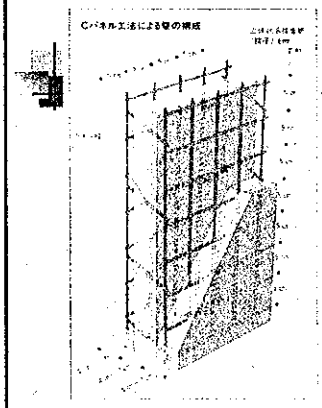
  half-finished goods, partially fabricated item
  semi manufactured goods
  - **Hollow Block**
  - Steel Structure
  - Prefabrication's building
  - Panel Wall
    - Pre-cast concrete Panel
    - **C-Panel Wall**

Hollow Block



Other Standard's Hollow Block

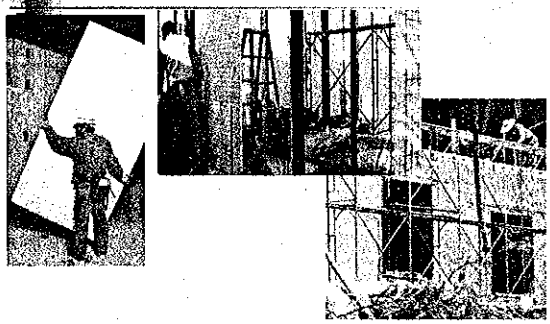




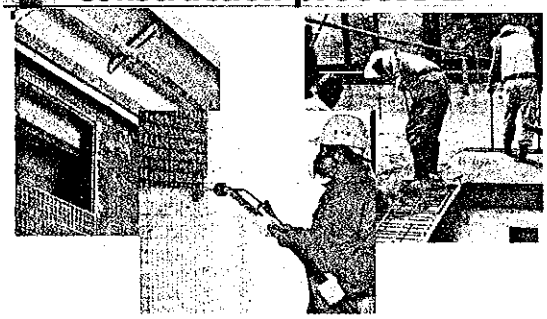
C-Panel Wall

4cm~7cm styrene board
+ cement mortar

C-Panel Wall construction process 1

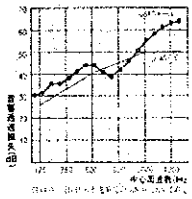


C-Panel Wall construction process 2



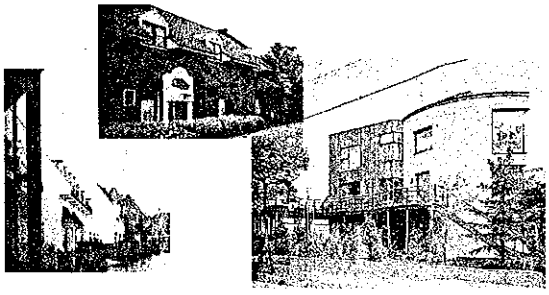
C-Panel Wall performance assessment

Weight of panel: 4.8kg/m2
Shear strength: 2.5t/m
Thermal insulation performance:
0.62kcal/m2・h・℃
Fire resistance class:
Mortar Th. 2 x 37.5 2 hour fireproof



Classification of sound insulation
More than D-40

C-Panel Wall Example of construction



END

THANK YOU for your attention

Technical Transfer Program Curriculum Sheet				Curriculum No.07
Lecture name	Make a drawing of reinforcing bar assembling			
Target of course	Upgrade of standard building technology			
Form of Lecture	☑ Work shop	Lecture	☐ Seminar	
Content : 1. Presentation of drawing of reinforcing bar assembling 2. 3.				
Teaching material : 1.drawings 2. 3.		Equipment : 1. Computer 2. Printer 3. 4,		
Results	Date : August 31,2006	Number of Attendance 5	Lecturer: Koizumi	
	Time: 11:30		Made by: Koizumi	
Place	PP band office, Muzaffarabad			
Person for attending a lecture:				
Evaluation for Lecturer:	Skill:	Knowledge:	Concern:	
Evaluation for Attendance:	Volition:	Understanding:	Attitude:	
Comments:				

Evaluation ⇒ Fill in the mean value.

Technical Transfer Program Curriculum Sheet				Curriculum No.07 -2
Lecture name	Make a drawing of reinforcing bar assembling			
Target of course	Upgrade of standard building technology			
Form of Lecture	☑ Work shop	Lecture	☐ Seminar	
Content : 1. Presentation of drawing of reinforcing bar assembling 2. 3.				
Teaching material : 1.drawings 2. 3.		**Equipment :** 1. Computer 2. Printer 3. 4,		
Results	Date : September 16,2006	Number of Attendance 4	Lecturer: Koizumi	
	Time: 15:00		Made by: Koizumi	
Place	PP band office, Muzaffarabad			
Person for attending a lecture:				
Evaluation for Lecturer:	Skill:	Knowledge:	Concern:	
Evaluation for Attendance:	Volition:	Understanding:	Attitude:	
Comments:				

Evaluation ⇒ Fill in the mean value.

Curriculum Result: Date 2006 31 August Curriculum No. _____ Lecturer: NOBUYASU KOIZUMI

Make a drawing of reinforcing bar assembling

No	Attendance		Culicuram Evaluation		
	Name	Title	Useful	Not useful	Other comment
1	Raja Saeed	SDO PWD	✓		
2	SOHAIL QURESHI	SDO PWD	✓		
3	MAJID IQBAL	SDO PWD.	✓		
4	ARSHAD AHMED Khan	SIE PWD			
5	ZAKA ULLAH	SITE ENGINEER (PARTHENON)	✓		
6					
7					
8					
9					

Opinion for today's Curriculum:

Clear Cover Size of Beam must increase the clear cover of the Col with same dimension.

I am agree at above noted. we Should charge the clear cover

Items you want to know to adjust the bind the bars (ZAKA ULLAH)

If you please let us know what ideas you have for future workshops.

The ACI specification of min & max clear cover of Col & Beam-

Curriculum Result: Date 2006 ~~31~~ 16 ~~August~~ September Curriculum No. _____ Lecturer: NOBUYASU KOIZUMI

Make a drawing of reinforcing bar assembling

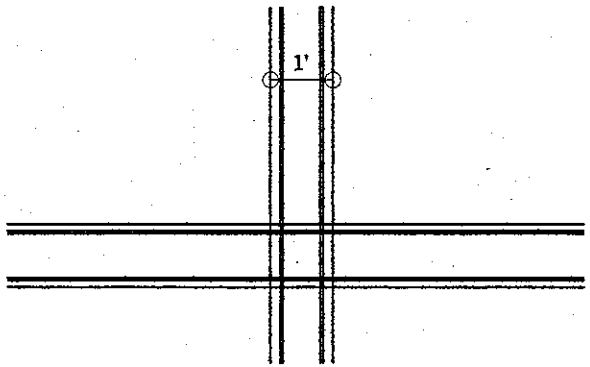
No	Attendance		Culicuram Evaluation		
	Name	Title	Useful	Not useful	Other comment
1	FIDA MUHAMMAD	SUB-ENGINEER W/s Manihan	✓		very very useful for us.
2	ISRAR AHMAD	— do —	do		do
3	TARIQ YOUSAF	— do —	do		do
4	Mohammad Sayyad	Contractor			
5					
6					
7					
8					
9					

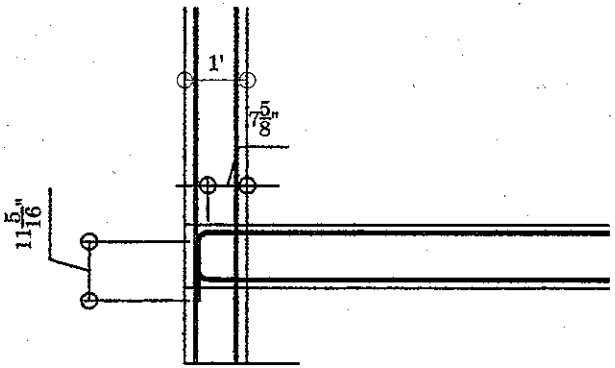
Opinion for today's Curriculum:

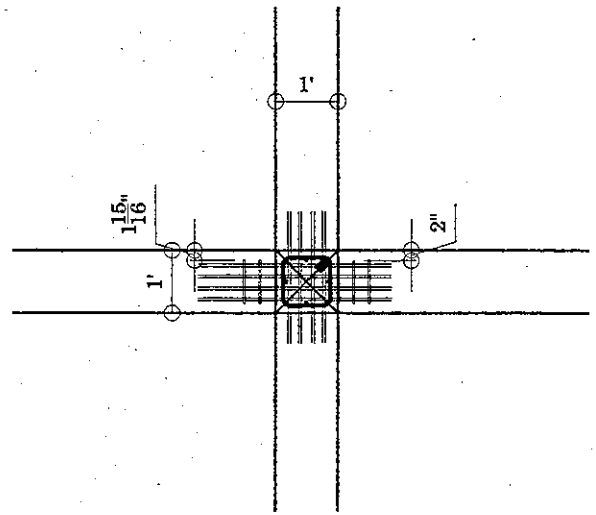
I received very good Informations about the steel/reinforcing design and apply in future Projects.

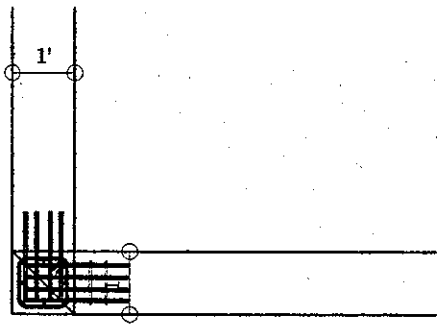
Items you want to know

About make a drawings of reinforcing bar assembling & design.





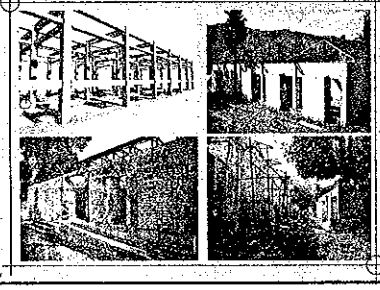




Public Works Department / Works and Services	PROJECT: Designing Prototype Basic Health Unit		DESIGNED BY:	DATE:	DRAWING No
	DRAWING TITLE: Make a drawing of reinforcing bar assenbling	SCALE:	DRAWN BY	SIGNATURE:	S01
			APPROVED BY		

Designing Prototype
Seismic Resistant and Barrier-free BHU
in AJK and NWFP

Islamabad
4th November, 2006



JICA Japan International Cooperation Agency

Designing Prototype Seismic Resistant and Barrier-free BHU in AJK and NWFP

Contents

- Perspective for the Standard Design of BHU
- Concept of Designing BHU
  - Seismic design
  - Barrier-free
  - Grid system
- Standard Plan
- Model Construction in AJK & NWFP

Background of the project

The primary health care facilities as BHU and RHC was damaged heavily by the earthquake on 8th October, 2005.

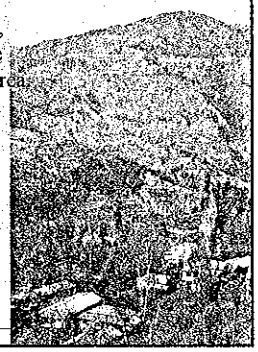
And the need for safeguarding primary health care facilities by earthquake, becomes **more evident and pertinent** after the last earthquake.

Designing Prototype
Seismic Resistant
And
Barrier-free BHU
in AJK and NWFP

Perspective for the Standard design of BHU

It is not only one building,
Standard design should be disseminated to the this Area.

We have to consider about
- **Local condition**
  - material availability
  - material accessibility
  - skill of workmanship
- **Local situation**
  - climate
  - land situation
  - (hilly area, soil condition)



Land situation

The standard design should be have a Adaptability for many kinds of lands.

It should be adapt to Hilly area for example Narrow and step site.

Cause of Damage in affected area

In many case, the buildings in the earthquake has been appeared to cause of damage

Vulnerability of buildings

Most damaged/destroyed houses were constructed Masonry method by stone, brick or C.B, and

No Earthquake Resistance Sources

Such buildings destroyed on account of,

Weakness of wall against horizontal force

-Weak connection on the corner

-Weak connection between roof to wall.

-Weak joint mortal

CONCEPT of Designing BHU

1, Seismic design

The health care facilities should be remain safe and functioning after earthquake.

2, Barrier-free as Universal design

All public facilities should be easy access and user friendly for the all people.

Standardization for the Public building

Seismic design

Structure method of BHU:

RC Frame + Masonry Wall

We consider about **design and detailing** for the quality of construction.

/ Dr. Hanazato

After the earthquake, Existing RC Frame structure also exposed

Improper construction,

Substandard material.

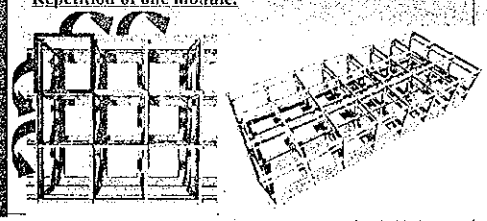
- *Quality control / Mr. Furuichi*
- *Knowledge of construction / Mr. Koizumi*

Ideal Earthquake Resistant building

*Small mass
*Low Height-to-base ratio
*Balanced Elevation
*Symmetrical Plan
*Short spans

Grid system

Repetition of one module.



Characteristic of Grids system

1. Flexibility:
Grids plan as module to provide flexibility for the needs.
We can choose the number of module Grid Box depend on necessary facility.

2. Adaptability:
Grids plan as module to provide adaptability. The standard design should be adapt to location.
The number of module Grid Box can adapt to the site situation.

3. Uniformity:
Grids plan as module to provide uniformity. The size of all coluron and beam should be standardized.

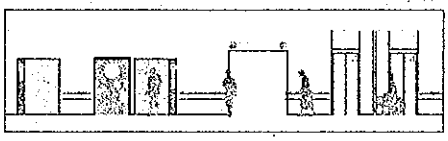
4. Simplify:
About human(workman) resource friendly, the construction should be about work simplification.

Barrier-free as Universal design

Apart from damage to infrastructure the last earthquake also left a large number of people with physical disabilities.

Therefore, it is equally important to ensure that the new health facility designing are not only earthquake seismic design but also barrier-free as universal design.

All public facilities should be easy access and user friendly for the all people.



Point of view of Universal design

It is not only disabled people, it is for the all people.

Design point of building

ts of view

- Simple for the all
- Comfortable for the all
- Safety for the all
- Flexible for the all

- Planning of Zoning
- People's circulation line
- Planning of level of elevation
- Planning of Signing

Perspective of the Universal design

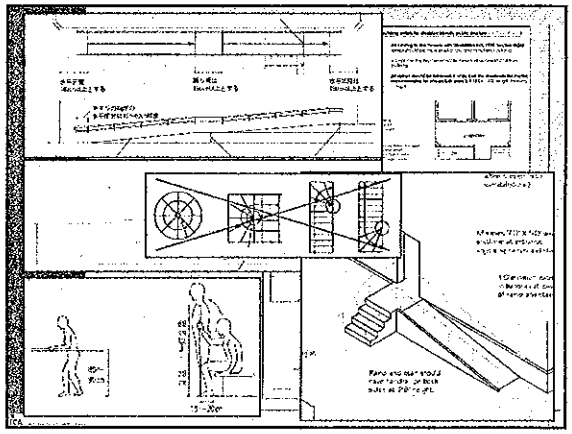
Step1 : Everybody can access to the building

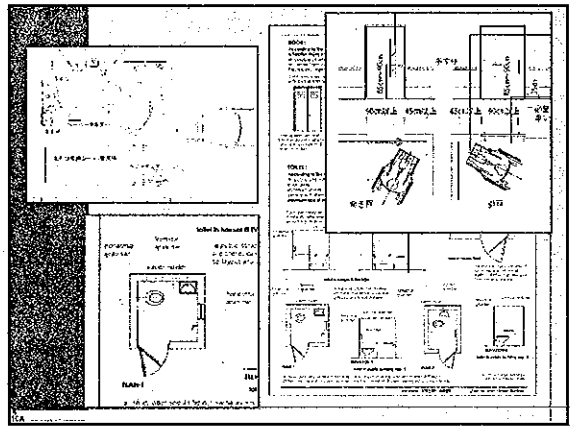
- ☐No difference in level → Provide slope
- ☐Easy access → Consider about entrance

Step2 : Everybody can use safety and comfortably

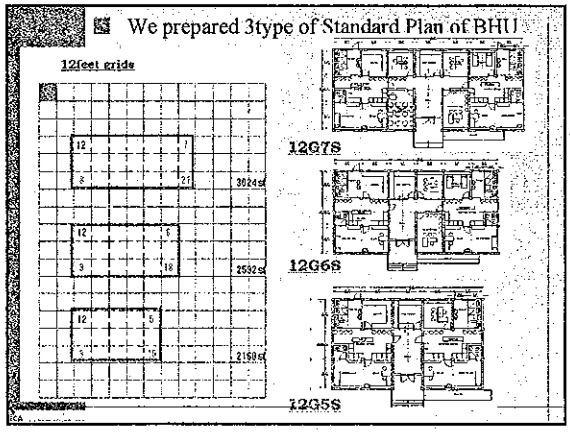
- ☐No difference in level → Flat slab (Between corridor to room)
- ☐Easy access → Consider about door size etc,
- ☐Waiting space → Enough space, People's Circulation line
- ☐Toilet → Clean, Enough number and size,

Step3 : Everybody will feel friendly to the building





We prepared 3type of Standard Plan of BHU



Why we choose 12feet Grids for the module,

1. Flexibility

12feet grids can be planed 2span or 3span depth based on site situation.

----------2span depth is 24ft, 3span depth is 36ft.

(Existing BHU was depth 27ft – 30ft)

2. Economical

According to structural analyses,

Columns is 1ft x 1ft

Plinth beam is 1ft x 1ft

Roof beam is 1ft x 9inch

---------These are standard size.

3. Earthquake Safer design structure

Short span, small mass.

Easy Quality control

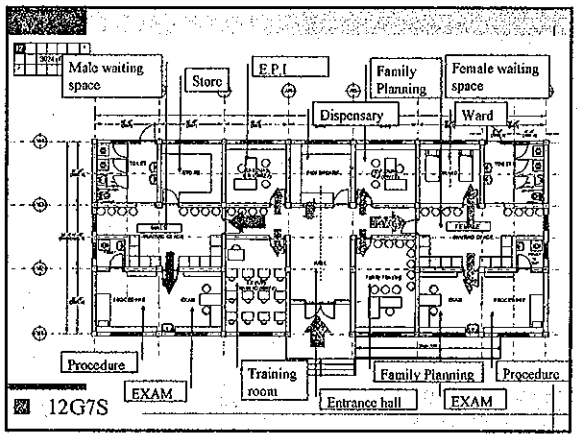
12ft Grids is the most suitable design in the present and future situation.

New BHU facilities

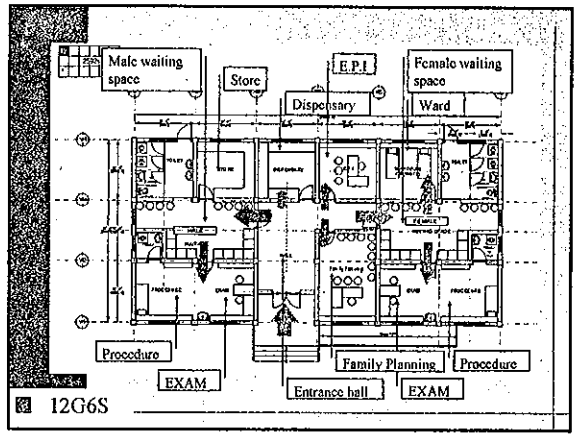
As request from health department, New BHU should be integrated facilities,

Necessary facilities,

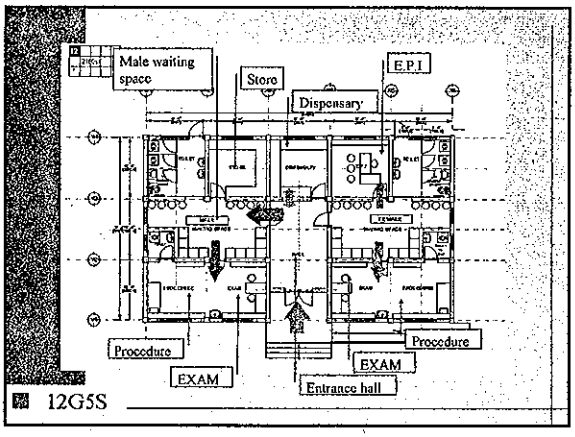
- **Procedure**
- **Exam**
- **Dispensary**
- **E.P.I**
- **Ward**
- **Family planning (NWFP)**
- **Training room (NWFP)**
- **T.B center (AJK)**
- **Laboratory (AJK)**



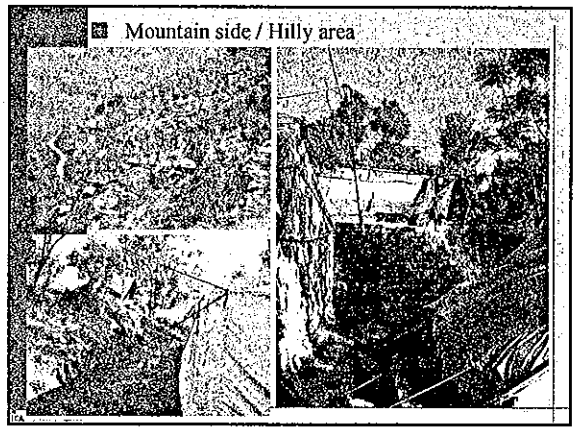
12G7S

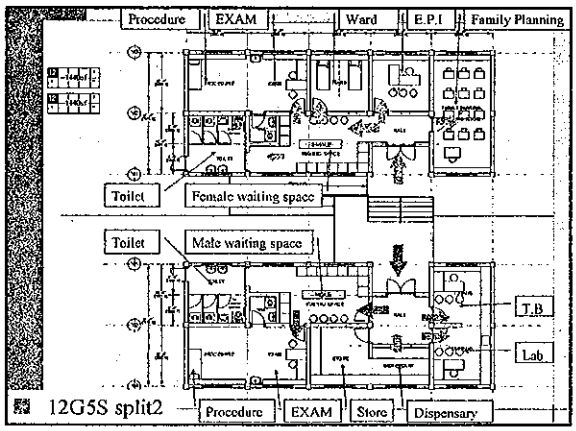


12G6S

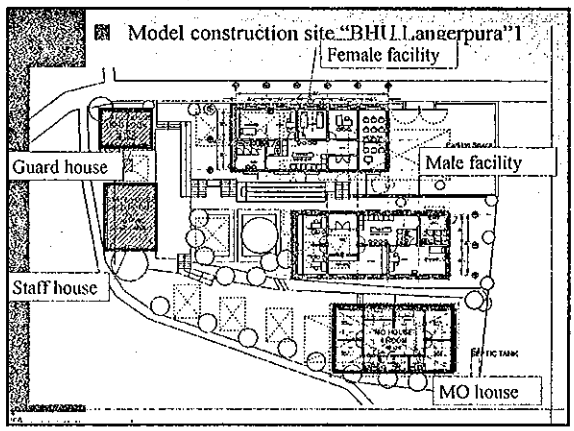


12G5S


Mountain side / Hilly area

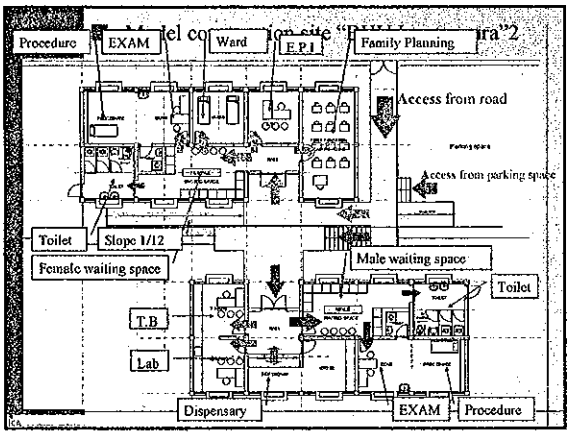


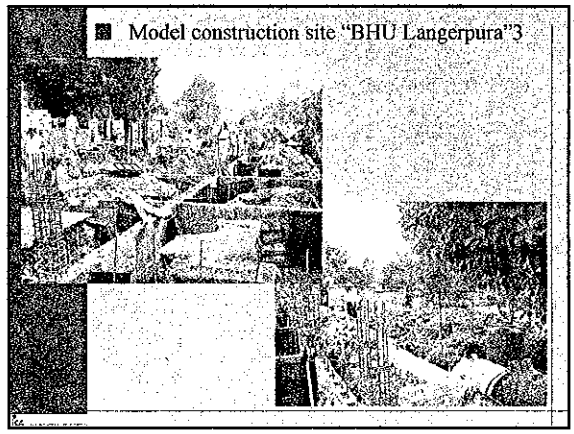
12G5S split2

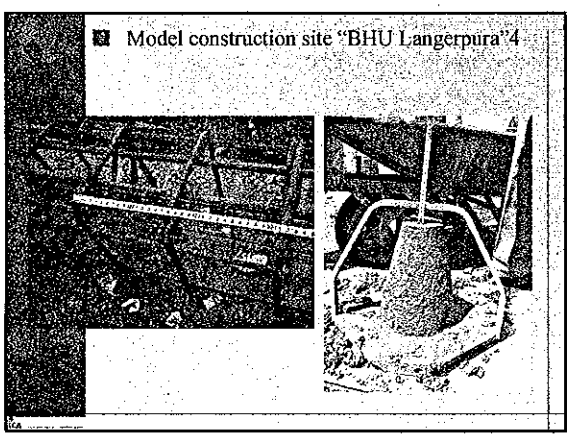


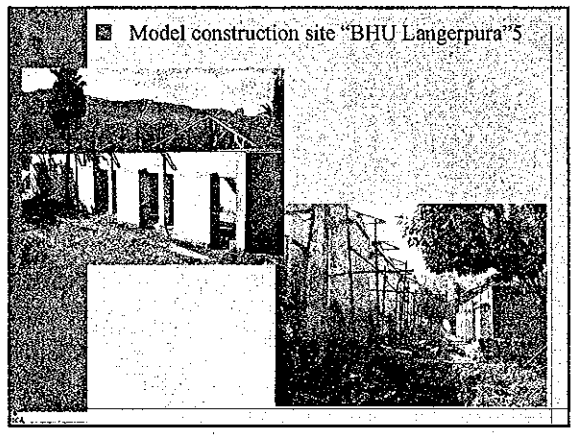
Model construction site "BHU Langerpura"1

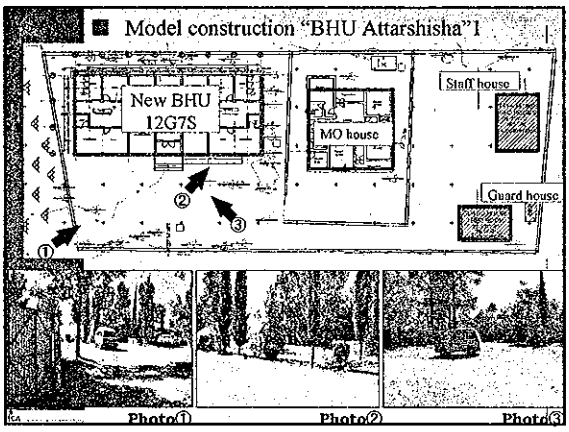
4

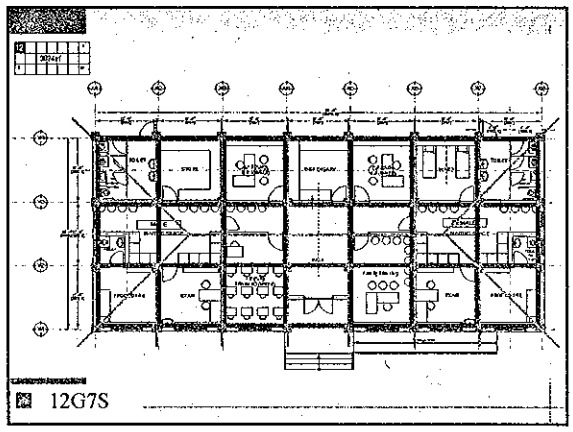

Procedure
EXAM
Ward
E.P.I
Family Planning
Access from road
Access from parking space
Toilet
Slope 1/12
Female waiting space
Male waiting space
Toilet
T.B
Lab
Dispensary
EXAM
Procedure


Model construction site "BHU Langerpura"3

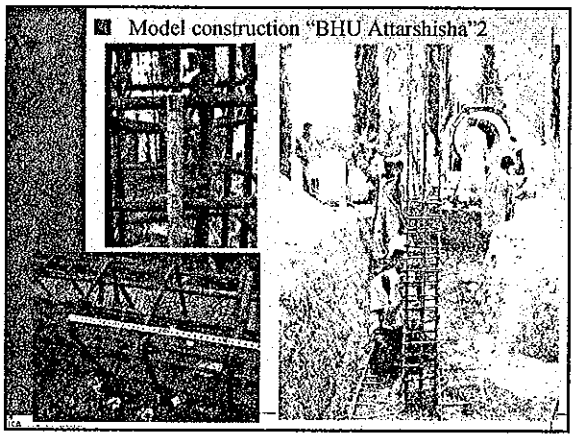

Model construction site "BHU Langerpura"4

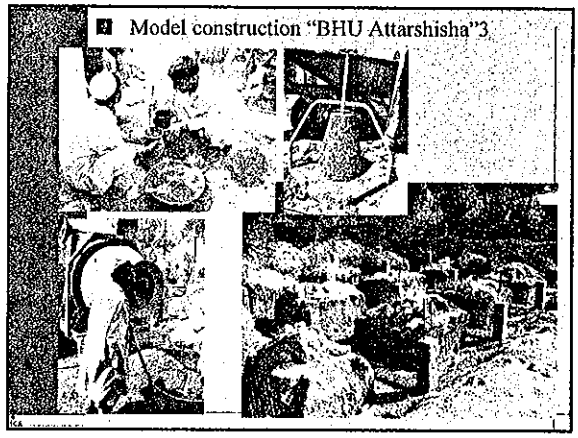

Model construction site "BHU Langerpura"5

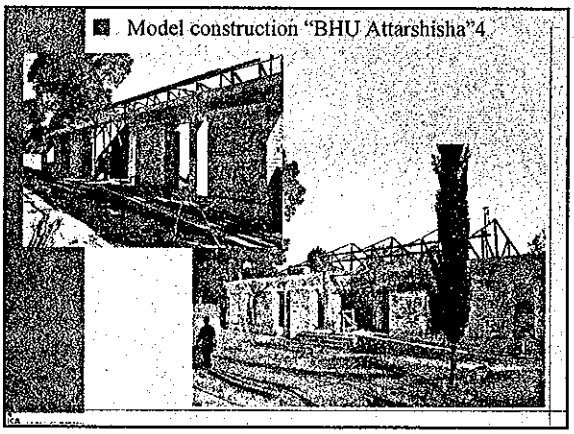

Model construction "BHU Attarshisha"1
New BHU
12G7S
MO house
Staff house
Guard house
①
②
③
Photo①
Photo②
Photo③

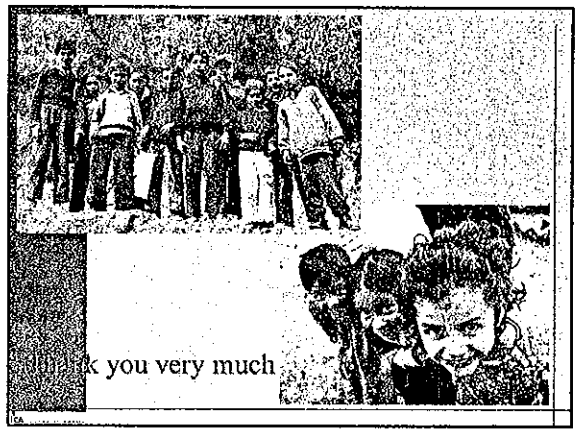

12G7S

5


Model construction "BHU Attarshisha"2


Model construction "BHU Attarshisha"3


Model construction "BHU Attarshisha"4


you very much

6

DESIGNING PROTOTYPE
SISMIC RESISTANT
AND BARRIER FREE
BASIC HEALTH UNITS

Structural Seismic Designing

JICA

STRUCTURAL SEISMIC DESIGN

- Lessons from earthquake damage
- Concept for seismic construction
- Outlines of structural design
- Recommendations

Irregularities and weak joints

Bagh

Lessons from earthquake damage

Shear Failure of Brick Masonry Wall

RHC Muzafafrabad

Lessons from earthquake damage

Insufficient connection

BHU Shawal

Lessons from earthquake damage

Unreinforced masonry wall with poor mortar joints

Out of plane collapse

Dadar

Balakot

Lessons from earthquake damage

1

Slope stability

Lessons from earthquake damage

CONCEPTS of SEISMIC DEDIGN

Dual Mode Design

- Moderate earthquake ground motions will not cause structural damage to the building
- Extremely strong ground motions will not cause damage to human lives
  - Prevent collapse of not only framed structure but also masonry walls

STRUCRURAL DESIGN

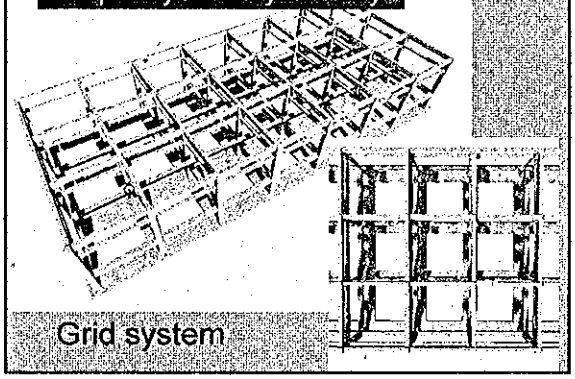
"Reinforced Concrete Frame + Masonry Wall"

- 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 & proposal by Dr. Qaisar Ali, UET Peshawar
- Referring to Uniform Building Code, as well as, to the original structural design by UET,Peshawar

Simplicity and symmetry



Grid system

PROCEDURE of SEISMIC DESIGN

Design of frame based on plan and elevation

↓

Design of section

↓

Allowable unit stress calculation

↓

Calculation of required and retained ultimate horizontal strength

↓

Strengthening design of masonry walls

Comparison of Seismic Design Loads

Base shear coefficient

	Pakistan	Present design	Japanese Code
Allowable unit stress	0.07 for Zone 2 (before	0.15	0.20
Ultimate lateral strength	0.22 UET, Pesh (UBC-9		0.30 s=0.30)

Response Accerelation = 0.75G

Ds : Reduction factor due to damping and ductility

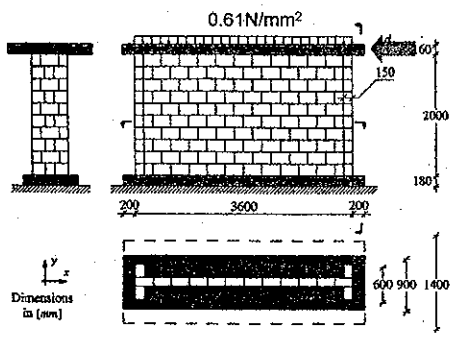
Ultimate Lateral Strength

To protect human lives during extremely large earthquakes ;

1)Framed structure will not collapse
- Deformation and failure mechanism
- Limit state of structure

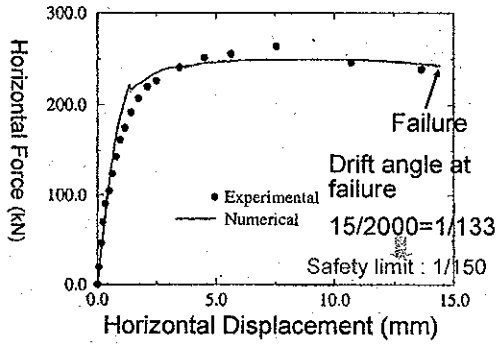
2)Masonry walls will not collapse
- Deformation of structure <
- Safety limit of masonry walls

Experimental Study of Masonry Wall



Lourenco & Rots (1995)

Results (Lourenco & Rots 1995)

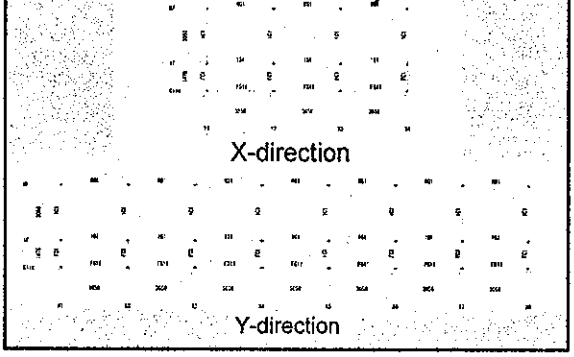


As results, our structural design drawing : similar to original design conducted by Dr. Qaisar Ali, UET Peshawar

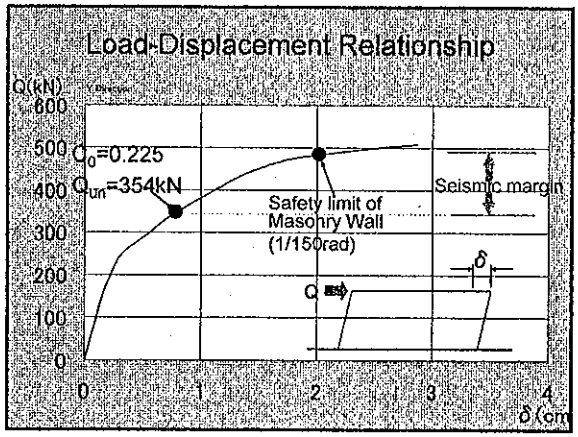
Assumption of Structural Analysis

- Reinforced concrete frame resists earthquake loads
- Masonry walls are non-structural elements (Safety side evaluation)
- Boundary condition of analysis model is based on actual condition of structure

Analysis Model for Step-by-Step Pushover Analysis



Load-Displacement Relationship



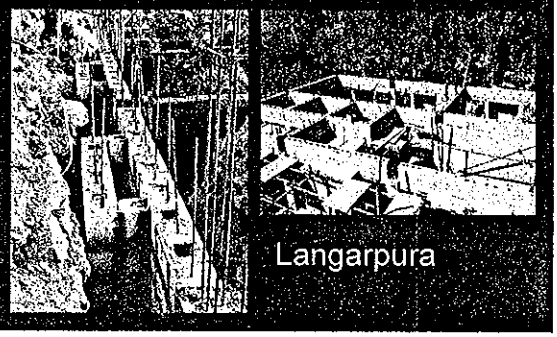
Concrete Strength

Design compressive strength = 2550psi (180kgf/cm²)

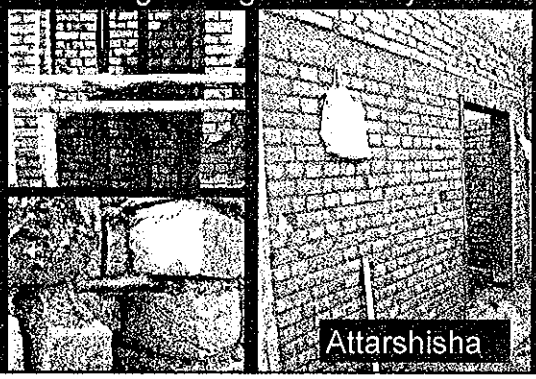
	Test results	Ave.
Laboratory compressive tests of cylindrical specimen	2970psi	2943psi (207kgf/cm²)
	3071psi	
	2788psi	

Sample : Langarpura site,4 weeks

Strengthening of masonry wall



Strengthening of masonry wall



Recommendations

- Ductility, deformability and damageability should be taken into account for seismic construction
- Construction works should be conducted to satisfy structural condition of analysis as engineered structure
- Quality control of concrete should be done by periodical check of strength
- Further study would be needed for strengthening masonry wall in consideration of local availability of materials

DESIGNING PROTOTYPE
SISMIC RESISTANT
AND BARRIER FREE
BASIC HEALTH UNITS

Thank you

JICA

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