8-3. Test Work
## Summary of Test Work

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</table>
1) Column jacketing  
(Re-bar work and concreting after removal of finishing mortar)

2) RC shear wall

3) RC wing wall

4) Steel bracing

5) Carbon fiber wrapping

6) Seismic slit on brick standing wall
7) External framed steel bracing

8) Concrete jacketing on existing column

9) Concrete jacketing on existing beam

10) New beam under floor slab

Figure: Construction methods of Test Work

(Construction sequence is shown by exposing each steps of construction such as anchoring, re-bar work, concreting, and mortar grouting etc.)
Retrofitting Test Works by CNCRP

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PWD Design Division–4

and

Team Leader, Component 3
CNCRP Project

Why Retrofitting Test Work

To know about

• **Material availability** in Bangladesh.
• **Cost** of each proposed retrofitting method.
• **Construction Time** and progress.
• **Difficulties** of construction.
• **Quality control** at the site.

And finally to find

• **Cost Effective** retrofitting methods suitable for Bangladesh.
Methods of Retrofitting

Wing wall
Carbon fiber wrapping

Retrofitting with Column Jacketing

Addl. Main rod
Addl. hoops
New Concrete
Post installed anchor (tie)
Non shrink grout

Section of column at mid span
Section of column at beam-col joint
Retrofitting with Column Jacketing

- Main bar pass through slab
- Non shrink grout at beam-col joint
- New Concrete for jacketing
- Post installed anchor (main bar)

Section of column jacketing

Retrofitting with Column Jacketing

RC Column Jacketing through beam-col joint

Test Work of CNCRP in 2012

Test Work of CNCRP in 2013
Retrofitting with Shear Wall

A

Details of RC Shear wall
Section-A

Reinforcement of Shear Wall

Post installed anchor

Ladder-shape reinforcing bar to prevent splitting

Normal Concrete

Non-shrink grout

Reinforcement of Shear Wall

Providing RC Shear Wall in an open frame

Test Work of CNCRP in 2012
Retrofitting with Wing Wall

RC Wing Wall
Provided at an existing column

Test Work of CNCRP in 2012
Retrofitting with Steel Frame

Details of Steel Frame Bracing

- Non shrink Grout
- Post installed anchor
- Non shrink Grout
- Existing concrete
- Headed Stud
- Post installed anchor bolt
- Spiral bar for prevention of splitting
- Steel Frame

Section E-E
Retrofitting with Steel Frame

Detail of spiral bar

Test Work of CNCRP in 2012
Connection Details, Test Work 2012

Test Work of CNCRP in 2013

Existing concrete
Post installed anchor Bolt
Spiral bar for prevention of splitting

Internal Steel Frame Bracing
External Steel Frame Bracing
Retrofitting with Structural Slit

Seismic Slit is provided at a brick wall

Test Work of CNCRP in 2012
Carbon fiber sheet wrapping

Test Work of CNCRP in 2012
Carbon fiber sheet wrapping

Retrofitting with Beam Jacketing

Typical Detail of Beam Jacketing
Retrofitting with Beam Jacketing

Test Work of CNCRP in 2013

Retrofitting with Beam Insertion

Typical Detail of Beam Insertion (Option-1)
- Tie bar pass through slab
- Non shrink Grout
- Concrete

Typical Detail of Beam Insertion (Option-2)
- Non shrink Grout
- Concrete
Retrofitting with Beam Insertion

Beam is inserted below existing slab

Test Work of CNCRP in 2013

Post-Installed Anchor Work

1. Drilling
2. Marking
3. Absorbent or cleaner
4. Rotary drill
5. Socket
6. Anchor bar
7. Connecting surface
8. Drill
9. Absorbent or cleaner
10. Brush
11. Capsule
12. ii) Cleaning
13. iii) Insert and fill
14. iv) Agitation/adhesion
15. Curing
Post-Installed Anchor Work

Pressurized Grouting Work
• 9 different retrofitting methods has been performed as ‘Test Work’ in the last 2 years.

• More Test Work will be done in the coming year.

• An actual retrofitting work will be done as ‘Pilot Work’

Thank you very much
1st Year Test Work
6 methods
THE PROJECT FOR CAPACITY DEVELOPEMENT ON NATURAL DISASTER-RESISTANT TECHNIQUES OF CONSTRUCTION AND RETROFITTING FOR PUBLIC BUILDINGS IN THE PEOPLE'S REPUBLIC OF BANGLADESH

DRAWINGS FOR TEST WORKS

NOVEMBER, 2011

OYO INTERNATIONAL CORPORATION

MOHRI ARCHIECT & ASSOCIATES. INC AND PUBLIC WORKS DEPARTMENT (PWD)
Steel frame and net should be removed before construction.

EXISTING ELEVATION S=1:100 (ONLY GROUND FLOOR SHOWN)

EXISTING PLAN S=1:100
SECTION B-B  S=1: 100

EXECUTION PLAN  S=1: 100
DETAILS OF COLUMN JACKETING
(PLAN SECTION AT BEAM COLUMN JOINT)

Hoop Ø10 @ 150 C/C

Grooving: Non-shrinkage mortar
(Strength of mortar should not less than 30 N/mm²)

Man Bar 4Ø16 mm

Hoop Ø10 @ 150 C/C at Panel Zone

DETAILS OF COLUMN JACKETING
(PLAN SECTION AT MID HIEIGHT OF COL)

Hoop Ø10 @ 100 C/C

Concrete
(Strength of concrete should not less than 22 N/mm²)

Sub Bar 4Ø16 mm

Man Bar 4Ø16 mm

Hoop Ø10 @ 10 C/C

existing beam

existing column

existing beam

existing column
Concrete strength of concrete should not less than 25 MPa

Grounding: Non-shrinkage mortar
(Strength of mortar should not less than 30 N/mm²)

Concrete strength of concrete should not less than 25 MPa

Concrete strength of concrete should not less than 25 MPa

TIE IS EMBEDDED IN BEAM

Grounding: Non-shrinkage mortar
(Strength of mortar should not less than 30 N/mm²)

Concrete strength of concrete should not less than 25 MPa

Note:
1. Concrete strength not less than 22 MPa
2. Grounding strength not less than 30 MPa
3. Concrete aggregate size: 12mm downgraded
4. Reinforcement: 4 by not less than
   for dia 16mm 400 N/mm²
   for dia 10mm 276 N/mm²
RC Wing Wall : Thickness 200mm, D10 @ 200 both direction double

- Embedment length shall be as per manufacturers guideline
- Tie hoop for prevention of splitting
- Upper portion of RC wing wall should be grouted mortar with pressure as well as concrete jacketing and RC shear wall.

- Existing column
- Remove finishing material
- Post-installed anchor with nut Ø16 @200
- Post-installed anchor with nut Ø16 @200
- Tie hoop for prevention of splitting
- Vertical reinforcing bar at the end of wing wall

300 700
RC Shear Wall: Thickness 150mm, D10 @ 200 both direction double

Embedment length shall be as per manufacturer's guidelines.

Reinforcing bar D13 along interface.

Ladder type reinforcing bar D10.

Grouting:
Non-shrinkage mortar: Strength of mortar should not be less than 30 N/mm².

Existing beam

Infilling wall

Existing beam

Infilling wall
5. Steel Framed Bracing: H-200x200x8x12,
6. Carbon Fiber Sheet Wrapping around RC Column

STEP 2.
Remove finishing material around RC Column

STEP 1.
- Manufacturer's instruction should be followed for epoxy resin and wrapping work.

- carbon fiber sheet

- overlapping shall be made alternately on 4 faces.

- bond carefully and tightly

- wrap and bond laterally at each tier
2nd Year Test Work
4 methods
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ON
NATURAL DISASTER-RESISTANT TECHNIQUES
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CONSTRUCTION AND RETROFITTING FOR PUBLIC BUILDINGS
IN
THE PEOPLE’S REPUBLIC OF BANGLADESH

DRAWINGS
FOR
TEST WORKS

SEPTEMBER, 2012

PUBLIC WORKS DEPARTMENT