

TRIPOLI EMERGENCY FUND

CONSOLIDATION OF BUILDING

Lot # 2054 - BT

Volume 3

PARTICULAR SPECIFICATION

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TECHNICAL SPECIFICATION

REINFORCED CONCRETE JACKETING OF EXISTING COLUMNS, DROP BEAMS, RIBBED AND SOLID SLABS

1. SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, supervision, testing, temporary works, shoring, propping, scaffolding, and incidentals required for the strengthening and rehabilitation of existing reinforced concrete columns, drop beams, ribbed and solid slabs through reinforced concrete jacketing, encasement, section enlargement, or overlay systems as indicated on the drawings.

The works shall include:

- Temporary shoring and propping.
- Removal of deteriorated, delaminated, and contaminated concrete.
- Exposure and treatment of corroded reinforcement.
- Supplementation or replacement of deteriorated reinforcement.
- Installation of epoxy-anchored dowels and shear connectors.
- Installation of additional reinforcing steel.
- Placement of reinforced concrete jackets, beam enlargements, and slab overlays.
- Formwork and falsework.
- Concrete.
- Curing.
- Testing and quality control.
- Final finishing and protection.

The strengthening works may include:

Columns

- Enlargement of column cross-section on four or three sides.
- Installation of confinement reinforcement.
- Improvement of axial, flexural, and seismic capacity.

Drop Beams

- Enlargement of beam width and/or depth.
- Addition of flexural reinforcement.

- Addition of shear reinforcement.
- Improvement of stiffness and load carrying capacity.

Solid Slabs

- Thickening of slab sections.
- Addition of top and/or bottom reinforcement.
- Composite concrete overlay systems.
- Improvement of flexural capacity and serviceability.

Ribbed Slab

- Enlargement of Ribs width and/or depth.
- Addition of flexural reinforcement.
- Addition of shear reinforcement.
- Improvement of stiffness and load carrying capacity.
- Hollow blocks removal and cover.

The following standards shall apply:

- ACI 318-19 – Building Code Requirements for Structural Concrete
- ACI 301 – Specifications for Structural Concrete
- ACI 302 – Guide for Concrete Floor and Slab Construction
- ACI 546 – Concrete Repair Guide
- ASTM C31 – Making and Curing Concrete Test Specimens
- ASTM C39 – Compressive Strength Testing
- ASTM C143 – Slump Test
- ASTM C494 – Chemical Admixtures

2. REINFORCEMENT INSTALLATION**2.1 Column Reinforcement**

New longitudinal bars and ties shall be installed around the perimeter of existing columns as indicated on drawings.

- U-shaped stirrups anchored into slabs.
- Epoxy-anchored dowels.

- Mechanical connectors where specified.

2.2 Drop Beam Reinforcement

Additional reinforcement shall be installed to enhance flexural and shear capacity.

The works may include:

- New bottom longitudinal reinforcement.
- New top reinforcement over supports.
- Closed stirrups.
- U-shaped stirrups anchored into slabs.
- Epoxy-anchored dowels.
- Mechanical connectors where specified.

2.3 Solid Slab Reinforcement

Additional slab reinforcement shall consist of:

- Bottom reinforcement mesh where accessible.
- Distribution reinforcement.
- Shear connectors and dowels.

All reinforcement shall be adequately anchored into adjacent beams, walls, or columns as indicated on approved drawings.

2.4 Concrete Cover

Minimum concrete cover shall be:

Structural Element	Internal Exposure	External Exposure
Columns	30 mm	40 mm
Beams	30 mm	40 mm
Slabs	25 mm	30 mm

Unless otherwise specified on drawings.

3. FORMWORK AND FALSEWORK

Formwork shall be designed to withstand all construction loads and maintain required geometry.

Column Jacketing

Formwork shall be made of smooth surface wood to provide **FAIR FACED CONCRETE** surface

- Be rigid and leak-proof.
- Permit proper concrete placement.
- Prevent segregation.
- All edges should be CHAMFERED using 3x3 cm good quality Chamfers.

Drop Beam Jacketing

Beam soffit formwork shall be made of smooth surface wood to provide **FAIR FACED CONCRETE** surface.

- Be supported by approved shoring systems.
- Remain in place until required strength is achieved.
- Maintain beam alignment and dimensions.

Slab Thickening

Falsework shall be of smooth surface wood to provide **FAIR FACED CONCRETE** surface and slab support systems shall:

- Support existing slab and construction loads.
- Prevent excessive deflection.
- Remain in place until concrete strength requirements are achieved.
- All edges should be CHAMFERED using 3x3 cm good quality Chamfers.

4. PLACEMENT OF CONCRETE

4.1 General

Existing concrete surfaces shall be prepared to SSD condition before placement of cementitious repair materials.

4.2 Column Jackets

Concrete shall be placed continuously around the column perimeter.

Special attention shall be given to:

- Beam-column joints.
- Congested reinforcement zones.
- Areas beneath existing beams.
- Casting of concrete should be at least at 2 phases

4.3 Drop Beam Jackets

Concrete shall be placed in a manner ensuring:

- Complete filling beneath beam soffits.
- Full encapsulation of reinforcement.
- Absence of voids around dowels and stirrups.

Where access is limited, self-compacting concrete or non-shrink micro-concrete shall be used.

4.4 Slab Overlays and Slab Jacketing

Concrete overlays shall be placed continuously to maintain monolithic behavior.

The contractor shall ensure:

- Proper bonding to the existing slab.
- Uniform thickness.
- Continuous reinforcement coverage.
- Adequate finishing and curing.

5. QUALITY CONTROL

Additional Testing for Beam and Slab Rehabilitation

The Contractor shall perform:

- Pull-out testing of installed anchors.
- Concrete compressive strength testing.
- Cover meter verification of reinforcement.
- Core testing where required.

Particular attention shall be given to the bond between existing and new concrete.

6. PROTECTION OF WORKS

Prior to commencement of beam and slab strengthening works, the Contractor shall install temporary shoring and propping in accordance with approved temporary works drawings.

No concrete shall be removed from columns, beams, or slabs until:

- Shoring systems are installed.
- Stability is verified.
- Approval is obtained from the Engineer.

Temporary supports shall remain in place until:

- Design concrete strength is achieved.
- Load transfer is approved by the Engineer.

7. MEASUREMENT AND PAYMENT**BOQ item 4.1 – Reinforced Concrete Column Jacketing**

Unit: Number

Includes:

- Surface preparation and removal of existing plaster.
- Temporary support systems between columns in both directions.
- Excavation around the column to check for foundation type.
- Removal of existing tiles, debris and any kind of materials.
- Reinforcement.
- Dowels and anchors.
- Formwork and Chamfers.
- Epoxy
- Concrete placement.
- Testing and curing.

BOQ item 4.2 – Reinforced Concrete Beam and Solid Slab Jacketing.

Unit: Square Meter (m²)

Includes:

- Surface preparation and removal of existing plaster.
- Beam preparation including removal of plaster and roughness of all surface.
- Reinforcement installation and epoxy work.
- Shear connectors.
- Formwork.
- Concrete placement.
- Coring.
- Temporary support systems.
- Coring works.

BOQ item 4.3 – Reinforced Concrete Ribbed Slab Reconstruction.

Unit: Square Meter (m²) or Cubic Meter (m³) as specified in the BOQ.

Includes:

- Demolition of existing slab using SAWCUT equipment and low vibration rotary hammers.
- Propping and formwork installation.
- Steel reinforcement.
- Hollow blocks work.
- Coring works.
- Concrete works.
- Surface finish of concrete including leveling and surface protection.
- Curing.
- Testing.

The unit rates shall include all labor, materials, equipment, testing, temporary works, scaffolding, shoring, propping, supervision, and incidentals necessary to complete the works.

BOQ item 4.4 – Reinforced Concrete Drop Beam Jacketing.

Unit: Linear Meter (LM)

Includes:

- Surface preparation and removal of existing plaster.
- Beam preparation including removal of plaster and roughness of all surface.
- Reinforcement installation and epoxy work.
- Shear connectors.
- Formwork.
- Concrete placement.
- Temporary support systems.
- Coring works including removal of finish material from upper floor such as tiles, and reinstatement of surface as per existing materials.

BOQ item 4.5 – Rehabilitation of concrete surface.

- Surface preparation and removal of existing plaster.

BOQ item 4.6 – Rehabilitation of concrete surface (parking area – Ground floor)

Unit: Square Meter (m²)

Includes:

- Cleaning of Surface area including, debris removal, dewatering, surface cleaning with water jet, cracks repair using non shrink grout, leveling and execution of 3-5 cm thick concrete pad.
- Reinforcement mesh.
- Concrete overlay.
- Finishing.
- Curing.

8. Propping and shoring

Props shall consist of steel item with all accessories like connectors, clips, and Timber ends.

The arrangement of props shall be as directed by the engineer and minimum to:

- Double rows of adjustable steel props under adjacent beams.
- Props at 1.2–1.5 m spacing.
- Shoring extending one bay beyond the repaired column in all directions.
- Retention of props until the jacket concrete reaches at least 28 MPa (or 90% of design strength confirmed by tests).
- The contractor shall submit the propping layout for each column for the approval of the engineer

Measurement and payment

The price of propping shall be included by the Contractor in his unit rates for the various items in the Bill of Quantities and shall not be paid for separately.

9. POXY ADHESIVE FOR DOWELS AND REINFORCEMENT ANCHORS

9.1 SCOPE

This section covers the supply, installation, testing, and quality control requirements for epoxy adhesive anchoring systems used for installation of reinforcement dowels, starter bars, and post-installed reinforcing steel in existing concrete members.

9.2 APPLICABLE STANDARDS

The epoxy anchoring system shall comply with:

- ACI 318-19, ACI 355.4, ASTM E488.
- Manufacturer's current technical data sheets

9.3 APPROVED PRODUCTS

The epoxy adhesive shall be a two-component, high-strength structural anchoring adhesive suitable for cracked and uncracked concrete.

Acceptable products include or equivalent to:

- Hilti HIT-RE 500 V4
- Hilti HIT-HY 200
- Sika AnchorFix-3001
- Fischer FIS EM Plus

Contractor shall submit product data sheets, installation instructions, and design capacities for approval.

9.4 PERFORMANCE REQUIREMENTS

Bond Strength

The adhesive shall develop the full yield strength of the anchored reinforcement without bond failure.

Chemical Resistance

The adhesive shall be resistant to:

- Water
- Chlorides
- Sulfates
- Mild acids and alkalis
- Carbonated concrete environments

9.5 DRILLING REQUIREMENTS

Hole Diameter

Unless otherwise approved:

Bar Diameter	Drill Diameter
T12	16 mm
T16	20 mm
T20	25 mm
T25	32 mm

Actual hole diameters shall follow manufacturer's recommendations.

Hole Depth

Minimum embedment:

- 12db for non-structural applications
- 15db to 20db for structural strengthening applications
- As indicated on approved drawings

Where:

db = reinforcing bar diameter

9.6 HOLE CLEANING PROCEDURE

Each drilled hole shall be cleaned using the following sequence:

1. Blow with oil-free compressed air.
2. Brush using approved steel brush.
3. Blow again.
4. Brush again.
5. Final air cleaning.

No adhesive shall be injected into uncleaned holes.

9.7 EPOXY INSTALLATION**Mixing**

Adhesive shall be mixed using manufacturer's static mixing nozzle. Hand mixing is not permitted.

Injection

Epoxy shall be injected from the bottom of the hole outward. The hole shall be filled approximately two-thirds full.

Bar Installation

Reinforcing bars shall:

- Be clean and free from rust scale, oil, and grease.
- Be inserted using a slow twisting motion.
- Reach full design embedment depth.

Excess adhesive shall be removed immediately.

9.8 CURING

No loading shall be applied until the adhesive has fully cured.

Typical curing periods:

Temperature Minimum Cure Time

5°C 48 hours

10°C 24 hours

20°C 12 hours

30°C 6 hours

Follow manufacturer's recommendations where more stringent.

9.9 TESTING

Proof Load Testing

Minimum 5% of installed anchors shall be tested.

Pull-Out Testing

The minimum proof load shall be:

- 1.25 times design load; or
- As specified by the Engineer.

Failure shall not occur by adhesive pull-out.

Acceptance Criteria

Anchors shall show:

- No displacement exceeding specified limits.
- No bond failure.
- No concrete cone failure below design load.

9.10 MEASUREMENT AND PAYMENT

The rate of epoxy works shall be deemed in the contractor unit BOQ items and shall not be measured separately.

The rate shall include:

- Drilling, Cleaning, Epoxy adhesive, Reinforcement bars, Installation, Testing, Waste disposal, All labor, equipment, and incidentals Required for complete installation.

