

GUJARAT PIPAVAV PORT LIMITED

REFURBISHMENT, REPAIR AND REHABILITATION OF JETTY-1 AND APPROACH-1 & 2, AT APM TERMINALS PIPAVAV

TECHNICAL SPECIFICATIONS

Document	Tender Technical Specifications
Owner	Gujarat Pipavav Port Limited
Project Location	Pipavav Port, Gujarat
Basis of Specification	Condition Assessment Report, Distress Drawings and BOQ

Document Use

This specification shall be read together with the Conditions of Contract, BOQ, drawings, IRCLASS condition assessment report, approved repair drawings, material data sheets and instructions of the Engineer-in-Charge. In case of conflict, the more stringent requirement shall apply unless otherwise directed in writing by GPPL.

1. Document Purpose and Scope

This document defines the minimum technical, quality, safety, execution, measurement and acceptance requirements for priority refurbishment of Jetty-1 and Approach-1 & 2. The work covers marine access systems, removal of distressed concrete and damaged pile liners, reinforcement restoration, localized electrochemical protection, polymer mortar and micro-concrete repairs, FRP pile liners, crack and drainage repairs, protective coatings, testing, documentation and closeout.

1.1 Reference Documents

Ref.	Document
1	IRCLASS distress location drawings for Jetty-1 beams, piles, pile caps, slab soffit and Approach-1 & 2.
2	BOQ_Jettywise_Final.xlsx, including the sheet for Berth-1 and Approach-1 & 2.
3	Scope of Work for structural stability / condition assessment inspection of RC jetty structure.
4	Existing structural drawings, as-built information and operational restrictions made available by GPPL.

1.2 Work Included

- Mobilization, site establishment, permits, security clearances, marine logistics, rescue provisions and demobilization.
- Design, proof checking, fabrication, erection, inspection, maintenance, relocation and removal of suspended platforms and other access systems.
- Joint pre-repair survey, close visual inspection, hammer sounding, marking, photography, member identification, categorization and measurement of repair areas.
- Controlled removal of loose or delaminated concrete and damaged steel pile liners, without damage to sound concrete or reinforcement.
- Reinforcement cleaning, section-loss measurement, anti-corrosion treatment, supplementary reinforcement, anchors and shear connectors.
- Installation of designed galvanic sacrificial anodes for patch repairs.
- PMM repairs, local micro-concrete reinstatement or jacketing, formwork and core holes for soffit placement where approved.
- Repair of piles and installation of bolted marine-grade FRP sacrificial pile liners with underwater-compatible grout.
- Deck crack repair, slab soffit repair, drainage outlet extensions or sleeves, sealing and making good.
- Protective coating to repaired and specified unrepaired RCC surfaces in splash and non-splash zones.
- Quality control, testing, environmental protection, records, as-built drawings, warranties and completion dossier.

1.3 General Scope Boundaries

The BOQ quantities are provisional and are based on the condition observed during the IRCLASS inspection. Actual repair limits shall be established after access, sounding and removal of unsound material. No repair shall be covered before joint inspection and measurement by the Contractor and Engineer.

Fender replacement, major structural strengthening, global stability verification, redesign for revised operational loads and works outside Jetty-1 and Approach-1 & 2 are excluded unless specifically added through drawings, BOQ or written instruction. Local repairs around fender blocks and embedded items remain included where shown or directed.

2. Operational Interface and Berth Availability

MANDATORY BERTH-FRONT RESTRICTION

Jetty-1 is an operational berth. All berth-front works, including erection, use, shifting or removal of platforms; pile and pile-liner repairs; repairs adjacent to fenders, mooring points and the berthing line; coating; pontoon or boat operations; and any activity capable of obstructing vessel approach, berthing, mooring, cargo operations or unberthing, shall be carried out only during non-vessel operation days and when the berth is vacant. Work may commence only after written or recorded clearance from GPPL Operations / Marine and the Engineer-in-Charge.

- Vessel operations and Port safety requirements shall have absolute priority over the Contractor's work.
- The Contractor shall plan for intermittent and fragmented work fronts, uncertain berth-vacant windows, tidal restrictions, monsoon conditions, permit requirements and short-notice changes in vessel schedule.
- The Contractor shall submit a rolling 14-day look-ahead plan and a detailed berth-vacant execution plan identifying manpower, platforms, boats, materials, contingency arrangements and the minimum safe demobilization time.
- Upon instruction from GPPL, the Contractor shall immediately suspend the affected activity and clear or secure all platforms, pontoons, ropes, hoses, tools, debris, formwork and materials so that vessel operations are not obstructed.
- No platform, rope, pontoon, boat, formwork, temporary support or material shall project into berth front line or obstruct the fender line, mooring arrangement, gangway area, navigational envelope, cargo handling systems, service pipelines, conveyor, drains or emergency access.
- Unless expressly provided otherwise in the Contract, the Contractor shall not be entitled to idle charges, standby charges, loss of productivity, disruption cost or additional payment arising from berth occupancy, vessel movement, tidal restrictions, work permits, operational priorities or temporary non-availability of work front. The Contractor shall include these constraints in its rates, resources and programme.
- The above restriction does not relieve the Contractor of its completion obligations. The Contractor shall maintain sufficient resources and parallel work fronts away from the berth face wherever safely available.

3. Codes, Standards and Performance Basis

Unless specifically stated otherwise, the latest edition and amendments of the following standards in force on the tender base date shall apply. Where requirements differ, the more stringent requirement shall govern, subject to the Engineer's decision.

Discipline	Minimum reference
Concrete and repair	IS 456; IS 516 series; IS 10262; IS 9103; IS 1200; IS 383; IS 1786; BS EN 1504 series; ACI 546R and ACI 562 where relevant.

Discipline	Minimum reference
Anchors	Approved manufacturer's ETA / ICC or equivalent qualification for post-installed reinforcement and anchoring; project-specific design and installation instructions.
Corrosion assessment	ASTM C876; RILEM guidance for concrete resistivity; applicable product qualification for embedded galvanic anodes.
FRP and marine service	Approved manufacturer's design standards and recognised FRP laminate test standards for tensile, flexural, water absorption and resin content.
Coatings	ISO 12944 principles where applicable, BS EN 1504-2 and approved manufacturer's technical data sheets.
Safety and environment	GPPL HSE procedures, permit-to-work system, Indian statutory requirements and approved marine rescue plan.

Brand names stated in the BOQ or this specification indicate the required performance and established systems. Equivalent products may be proposed only with complete technical comparison, test certificates, reference projects, manufacturer support and Engineer's written approval. A mixture of incompatible manufacturers within one repair system shall not be permitted without written compatibility confirmation from all concerned manufacturers.

4. Contractor Responsibilities and Submittals

4.1 Competence and Single-Point Responsibility

The Contractor shall be a specialist in repair of operational marine RCC structures and shall remain fully responsible for access, temporary works, repair design details, product compatibility, workmanship, safety, protection of Port operations and achievement of specified performance. Manufacturer attendance or approval shall not reduce the Contractor's responsibility.

4.2 Pre-Construction Submittals

Project execution plan, baseline programme, and two-week look-ahead format.

- Member-wise repair survey format and proposed zone-wise sequence.
- Design calculations and fabrication drawings for suspended platforms, working decks, lifting points, anchors, lateral restraints and rescue access, signed by a qualified structural engineer and independently proof checked.
- Method statements covering each BOQ activity, including trials, hold points, environmental controls and emergency recovery.
- Quality Assurance Plan, Inspection and Test Plans, material approval schedule, calibration plan and non-conformance procedure.
- Marine HSE plan, task risk assessments, lifting plan, man-overboard and rescue plan, weather and tide limits, hot-work controls and confined-space controls where applicable.
- Design basis and layout for galvanic anodes, including target service life, reinforcement density, chloride exposure assumptions, spacing and electrical continuity checks.
- FRP liner design, laminate schedule, resin system, joint details, bolt material, seals, grout, pressure head, buoyancy and installation methodology.
- Repair drawings showing typical PMM, micro-concrete, rebar replacement, anchor, lap, anode, edge and coating details.
- Material technical data sheets, safety data sheets, certificates, batch control, shelf life, storage requirements and manufacturer authorization.

4.3 Hold Points

Hold Point	Requirement
HP-1	Access platform design and third-party proof check approved before fabrication.
HP-2	Platform inspection, load identification and work-at-height certification before use.
HP-3	Joint marking and measurement of repair area before chipping.
HP-4	Inspection after chipping and reinforcement cleaning; decision on PMM, micro-concrete, rebar replacement and anodes.
HP-5	Inspection of supplementary steel, anchors, anodes and formwork before closing.
HP-6	Approval of substrate and environmental conditions before coating.
HP-7	Final inspection, testing and acceptance before dismantling access to the completed zone.

5. General Materials and Workmanship

- All materials shall be new, within shelf life, clearly batch marked, stored under covered and controlled conditions and used in accordance with approved data sheets.
- Potable water shall be used for washing, mixing and curing unless a product specifically permits another quality.
- No chlorides, calcium chloride accelerators or materials harmful to reinforcement shall be used.
- Repair mortar and micro-concrete shall be compatible with the parent M40 concrete and marine exposure. Their modulus, shrinkage, permeability and thermal behaviour shall be suitable for localized repairs.
- All edges of repair patches shall be saw-cut or neatly formed to avoid feather edges. Reinforcement shall be exposed sufficiently around its perimeter to permit cleaning and compaction of repair material.
- Existing reinforcement shall not be cut, heated, welded or bent without written approval. Welding shall not be used where the existing bar grade or weldability is uncertain.
- No debris, slurry, paint, rust, grout, chemical, cut steel or wash water shall be allowed to enter the sea. Full containment and approved disposal are mandatory.
- Each repair system shall be installed by trained applicators under competent supervision. The Engineer may require manufacturer demonstration and first-work inspection.

6. Detailed Item Specifications

The following clauses apply to the corresponding BOQ items. Rates shall include all work necessary for a complete, safe and accepted installation, whether or not every incidental operation is repeated in the item wording.

A-1 Mobilization, Site Establishment and Marine Support

Scope

One-time mobilization and demobilization of manpower, tools, equipment, marine craft and temporary facilities necessary for executing the complete package in an operational port.

Materials and Performance Requirements:

- Portable cabins and storage compatible with GPPL space allocation.
- Approved boats, rescue boat, pontoons, generators, lighting for approved work hours, communication equipment, barricading, signage, firefighting equipment, life-saving appliances and spill-control kits.
- All electrical equipment shall be suitable for the environment and connected through approved protection and cables.

Execution

- Obtain access passes, CISF / Port clearances, permits and utility approvals.
- Establish material receiving, quarantine, protected storage and batch register.
- Maintain rescue boat and trained rescue crew whenever personnel work over or near water.
- Demobilize and restore all occupied areas after completion.

Inspection and Acceptance

- Pre-mobilization inspection of craft and lifting equipment.
- Monthly verification of rescue, firefighting, electrical and communication equipment.
- Site shall remain orderly and free of marine pollution.

Measurement

One lump sum, payable in approved stages stated in the BOQ or Conditions of Contract. Unless separately stated, 70% may be certified after complete mobilization and 30% after full demobilization and restoration.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

B-1 Suspended / Hanging Platform for Pile Repairs**Scope**

Design, proof checking, fabrication, erection, relocation, maintenance and dismantling of an adjustable working platform underneath deck, around piles, capable of safely supporting personnel, tools and repair materials at required tidal and splash-zone levels.

Materials and Performance Requirements:

- Structural steel shall be of traceable grade, free from significant corrosion and fabricated to approved drawings.
- Decking shall be non-slip and positively secured. Guardrails, toe boards, access ladders, independent lifelines, debris containment and rescue provisions are mandatory.
- Contact surfaces against existing concrete shall have non-damaging pads. No permanent anchorage to piles is permitted unless specifically approved by GPPL and supported by design.

Execution

- Carry out site verification of support points and existing member condition.
- Prefer suspension from sound slab / beam locations. Beams undergoing repair shall not be used as primary support unless specifically designed and approved.
- Use temporary braces to piles only for lateral restraint with rubber or equivalent protective pads. Do not drill or weld to piles.

- Mark safe working load on each platform. Inspect after installation, relocation, heavy weather and any impact.
- Remove temporary anchors, cut flush where approved, fill holes with compatible repair material and make good protective systems.

Inspection and Acceptance

- Design certificate and independent proof check.
- Installation inspection by competent person and Engineer.
- Proof load or load test if directed.
- Daily pre-use checklist and weekly formal inspection.

Measurement

Number of pile platforms installed and accepted at distinct pile locations or cycles, as defined in the BOQ. Repositioning within the same measured location shall not constitute an additional unit unless expressly stated.

Rate shall include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

B-2 Suspended / Hanging Platform for Beams, Slab Soffit and Pile Caps**Scope**

Design and provision of stable working platforms beneath the jetty for beam, pile-cap and slab-soffit repairs, including repeated shifting in accordance with the approved sequence.

Materials and Performance Requirements

- Same minimum safety requirements as B-1.
- Platform layout shall allow full access to the repair surface, safe handling of formwork and micro-concrete, and total capture of debris and wash water.

Execution

- Coordinate platform geometry with berth operations, fender line, service pipelines and conveyor structures.
- Provide sealed catch trays or containment sheets below chipping and coating work.
- No load shall be imposed on a distressed member beyond the approved temporary works design.
- Always maintain clear emergency egress and safe access.

Inspection and Acceptance

- Approved design and proof check.
- Joint measurement of platform plan area actually installed.
- Competent-person inspection before use and after each major relocation.

Measurement

Square metres of usable platform plan area installed, maintained and dismantled for the approved repair work. Overlaps, access ladders, guardrails and repeated relocations required for that measured area are included.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

C-1 Controlled Chipping and Removal of Damaged Concrete**Scope**

Removal of loose, cracked, delaminated, contaminated or unsound concrete from beams, slab soffits, pile caps, piles and associated RCC elements to expose sound concrete and permit durable repair, generally up to 100 mm depth unless otherwise approved.

Materials and Performance Requirements

Lightweight chipping tools, saws and surface preparation equipment suited to localized structural repair. Heavy impact breakers are prohibited.

Execution

- Jointly mark repair boundaries and sound the area. Saw-cut patch perimeter approximately 10 mm deep where safe, avoiding reinforcement.
- Chip from the center toward edges using tools not exceeding the approved energy impact. Stop, if structural cracking, unexpected voids, tendon, major section loss or instability is encountered.
- Remove concrete behind corroded reinforcement as necessary to clean the full bar perimeter and provide space for compaction. Provide a minimum clear gap consistent with repair-material aggregate size and manufacturer requirements.
- Do not reduce sound core concrete without written instruction. Make patch geometry regular and eliminate feather edges.
- Collect every fragment and slurry. Nothing shall fall into the sea.

Inspection and Acceptance

- Engineer inspection of exposed substrate.
- Sound concrete shall be dense, well bonded and free of loose particles.
- Repair area and average depth shall be recorded before further treatment.

Measurement

Square metres of actual chipped and accepted repair surface, measured on the exposed face. Depth beyond the item limit requires prior instruction and an applicable BOQ item or agreed rate.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

C-2 Local Cutting and Removal of Corroded Steel Pile Liner**Scope**

Controlled cutting, removal and disposal or stacking of existing sacrificial steel liner portions that are detached, severely corroded, de-bonded or obstruct pile repair.

Materials and Performance Requirements

Low-vibration cutting equipment, approved hot-work screens and full fire and debris containment.

Execution

- Survey the liner and mark cut limits. Confirm that the liner is sacrificial and not required structurally before removal.
- Obtain hot-work permit and provide fire watch, gas cylinders in approved trolleys, flashback arrestors, firefighting and marine spill controls.
- Cut in manageable pieces without damaging pile concrete or reinforcement. Round or grind sharp residual edges.
- Lift and secure all cut pieces. Do not allow steel or slag to fall into sea. Transport to the designated GPPL location.

Inspection and Acceptance

- Joint measurement before cutting.
- Inspection of resulting concrete surface and retained liner edges.
- Confirmation of complete recovery of cut material and slag.

Measurement

Square metres of liner surface removed, based on actual developed area jointly measured before cutting.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-1 Cleaning and De-rusting of Existing Reinforcement**Scope**

Complete cleaning of exposed reinforcement, including the back and sides of bars, removal of rust scale and application of approved rust-removing treatment where specified.

Materials and Performance Requirements

Approved non-chloride rust remover compatible with the reinforcement primer and repair system. Typical products include Reebaklens RR, Sika Rustoff 100 or approved equivalent.

Execution

- Mechanically clean by rotary wire brush, needle scaler of approved intensity, grit blasting or other approved method until adherent scale and corrosion products are removed.
- Clean behind bars and at intersections. Wash with potable water and remove residue in accordance with the product data sheet.
- Do not apply acid-based cleaner in a manner that remains trapped in concrete. Neutralise and rinse where required.
- Measure representative bar diameters after cleaning and record percentage section loss.

Inspection and Acceptance

- Visual acceptance of clean steel.
- Joint record of bars with more than 20% diameter or cross-sectional loss, or otherwise unserviceable reinforcement.
- No primer shall be applied before inspection.

Measurement

Square metres, taken as the corresponding accepted chipped repair area, unless the BOQ expressly requires measurement by reinforcement surface area.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-2 Supplementary / Replacement Reinforcement**Scope**

Supply, cut, bend and fix new reinforcement where existing bars have significant section loss, are severed, missing or require supplementation for repair detailing.

Materials and Performance Requirements

- High-yield deformed reinforcement conforming to IS 1786, grade Fe500D unless the approved repair drawing requires another grade.
- Binding wire approved mechanical couplers or designed post-installed anchors. Welding shall only be used with confirmed weldable steel and an approved procedure.

Execution

- Replace or supplement reinforcement where cleaned bar diameter loss exceeds 20%, or as directed after structural review.
- Match existing bar diameter and arrangement wherever practicable. Maintain cover, spacing and load path.
- Provide design lap length onto sound cleaned bar on both sides or use approved couplers / anchors where lap is impracticable. Avoid locating all laps at one section.
- Do not cut existing bars without approval. Protect new steel from salt contamination and coat only where required by the approved compatible repair system.

Inspection and Acceptance

- Mill certificates and independent tests as directed.
- Bar-bending schedule and repair sketch approval.
- Inspection of diameter, laps, anchorage, cover and ties before closing.

Measurement

Kilograms of new reinforcement fixed and accepted, calculated from standard unit weights and approved bar-bending schedules. Binding wire, wastage, laps and chairs are included unless stated otherwise.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-3 Shear Keys / Shear Connectors for Repair Overlay**Scope**

Provide post-installed shear connectors to develop composite action between sound existing concrete and local micro-concrete reinstatement or jacket.

Materials and Performance Requirements

- Minimum 10 mm diameter Fe500D deformed bars, unless design requires larger.
- Qualified chemical anchoring system suitable for cracked concrete, marine exposure and post-installed reinforcement, such as Lokfix E55, Hilti HIT-RE 500 V3, Fischer equivalent or approved system.

Execution

- Scan for existing reinforcement and services before drilling. Adjust locations rather than cutting existing bars.
- Drill to the approved diameter and effective embedment. The BOQ nominal arrangement of 14 mm hole and 100 mm depth is subject to design and anchor manufacturer requirements.
- Clean each hole using the approved blow-brush-blow sequence with oil-free air and correct brush. Inject resin from the back to avoid air pockets and insert bar with twisting motion.
- Provide 4 connectors per square metre or 0.5 m centres only where confirmed by approved repair detail; final spacing shall be based on design and patch geometry.
- Observe gel and curing time for actual substrate temperature and moisture condition.

Inspection and Acceptance

- Installation records by location and resin batch.
- Proof / pull-out tests at the frequency in the approved ITP, not less than 1% of installed anchors subject to a practical minimum of 3 per work zone, unless the Engineer approves another statistically justified frequency.
- No loading before complete cure.

Measurement

Number of connectors installed, tested and accepted.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-4 Zinc-Rich Anti-Corrosion Coating to Reinforcement**Scope**

Application of a compatible anti-corrosion primer to cleaned existing and new reinforcement within repair patches.

Materials and Performance Requirements

- Two-component epoxy zinc-rich or approved cementitious passivating system compatible with the selected mortar, bonding agent and galvanic anodes. Typical product: Nitozinc Primer or approved equivalent.
- Minimum dry film thickness shall comply with the approved manufacturer system. Where the BOQ states 40 microns per coat, this is the minimum unless the manufacturer requires more.

Execution

- Apply only to dry or suitably conditioned clean steel within the coating overcoat window.
- Provide continuous coverage, including the back of bars, without runs or missed areas.
- Where galvanic anodes are installed, do not coat the bar within 25 mm of the anode connection or as required by the anode manufacturer, to preserve electrical continuity.

- Do not contaminate concrete bonding surfaces unless the system expressly permits it.

Inspection and Acceptance

- Visual check and wet-film / dry-film verification appropriate to the small-bar geometry.
- Compatibility confirmation from repair-system manufacturer.
- Electrical continuity checks where anodes are used.

Measurement

Square metres based on the corresponding accepted chipped repair area, as stated in the BOQ.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-5 Epoxy Bond Coat**Scope**

Provide a two-component epoxy bonding agent between prepared parent concrete and approved PMM or micro-concrete where required by the selected repair system.

Materials and Performance Requirements

Nitobond EP, Sikadur 32 LP or approved equivalent, with published bond and mechanical properties suitable for marine structural repair.

Execution

- Remove dust, laitance, oil, salt and standing water. Substrate moisture condition shall comply with the product data sheet.
- Mix complete components using a slow-speed mixer. Do not split packs unless proportioning is accurately controlled and approved.
- Brush or scrub a continuous coat into the substrate at the specified coverage. Place repair material while the bond coat is within its tacky / open time.
- If the open time is exceeded, remove or re-prepare and apply a fresh approved coat.

Inspection and Acceptance

- Batch and mixing-time records.
- Coverage checks and verification of overlay time.
- No dry, glossy, contaminated or missed bond areas at placement.

Measurement

Square metres of actual bond-coated repair interface accepted.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-6 Embedded Galvanic Sacrificial Anodes for Patch Repairs**Scope**

Design, supply and installation of discrete zinc galvanic anodes to reduce incipient-anode corrosion adjacent to concrete repairs and provide the specified local protection period.

Materials and Performance Requirements

- Anodes shall contain high-purity zinc compliant with the approved product standard, cast around integral steel tie wires and encased in highly alkaline, ionically conductive mortar. Vector Galvashield XPT / XPI or approved equivalent may be used subject to design.
- Minimum zinc mass, current output and spacing shall be selected for the approved design life, exposure, chloride level, reinforcement density and repair geometry. The BOQ reference of minimum 60 g zinc shall not replace project-specific design verification.
- Embedding and repair mortar around the anode shall be electrically compatible; non-conductive patch materials are not acceptable around the anode.

Execution

- Submit manufacturer's design with anode layout for each repair category and representative member.
- Expose and clean sufficient reinforcement to establish continuity. Secure anodes tightly to clean steel near the repair perimeter, normally within the manufacturer's permitted spacing.
- Do not coat anode, tie wires or the immediate steel connection area.
- Pre-soak or pre-condition only as directed by the manufacturer. Pack embedding mortar to eliminate voids and complete the repair promptly.
- Measure electrical continuity / resistance between anode tie wire and reinforcement before covering and record the result.

Inspection and Acceptance

- Manufacturer training or first-installation supervision.
- Certificates of zinc mass and product batch.
- 100% visual check of location and tie, plus documented electrical continuity for each anode or approved representative protocol where individually checking very large quantities is impracticable.
- As-built anode map by member and grid.

Measurement

Number of anodes installed, electrically verified and accepted. Payment shall be based on approved design quantity, not automatic application of the preliminary BOQ quantity.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-7(a) PMM Repair up to 25 mm Average Thickness**Scope**

Reinstatement of localized cover-zone damage using single-component, fibre-reinforced, shrinkage-controlled polymer-modified cementitious repair mortar.

Materials and Performance Requirements

- Renderoc SP40, Sika MonoTop 122 HS or approved equivalent.
- Minimum 28-day compressive strength 45 MPa, minimum tensile bond strength 1.5 MPa or substrate failure, shrinkage suitable for patch repair, chloride-free and compatible with marine exposure.

- Maximum aggregate size and layer thickness shall suit the patch geometry and cover.

Execution

- Bring cementitious substrate to saturated-surface-dry condition unless an approved epoxy bond coat requires otherwise.
- Mix full bags with measured potable water using a slow-speed forced-action mixer. Do not retemper.
- Compact firmly behind bars and into corners. Apply within approved minimum and maximum thickness. Finish flush with surrounding concrete without feather edges.
- Cure immediately using wet curing, curing membrane compatible with coating, or manufacturer-approved method. Protect against sea spray, rain, direct sun and vibration.

Inspection and Acceptance

- Trial patch and pull-off testing where directed.
- Thickness and surface finish check.
- Hammer sounding after cure; hollow or debonded areas shall be removed and repaired.

Measurement

Square metres of accepted finished repair area at up to 25 mm average thickness.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-7(b) PMM Repair up to 50 mm Average Thickness**Scope**

Same as D-7(a), for deeper localized repair placed in approved layers or in one layer where the product is qualified for that thickness.

Materials and Performance Requirements

- Same as D-7(a).
- Interlayer bonding and timing shall comply with the manufacturer's system.

Execution

- Build in layers of approximately 25 mm where required. Roughen and condition the previous layer if the intercoat window is exceeded.
- Provide temporary support or form-and-pour material where overhead-hand placement cannot achieve full compaction.

Inspection and Acceptance

Same as D-7(a), with depth records.

Measurement

Square metres of accepted finished repair area at greater than 25 mm and up to 50 mm average thickness. No double measurement with D-7(a).

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-8 Watertight Formwork for Micro-Concrete Repairs**Scope**

Design, supply, erection and removal of sealed formwork for beam, pile-cap, pile and slab-soffit micro-concrete repairs, maintaining the original member line and level unless an approved jacket is shown.

Materials and Performance Requirements

Film-faced plywood, steel or FRP forms of adequate stiffness; non-staining release agent compatible with repair and coatings; sealed joints, vents, inspection and pouring ports.

Execution

- Formwork shall resist wet micro-concrete pressure, pumping pressure, vibration and marine movement without leakage or distortion.
- Provide cover spacers and secure reinforcement without drilling sound concrete except at approved locations.
- Seal all joints. Provide head boxes or pumping ports to ensure positive pressure and complete filling, plus high-point vents.
- Remove side and soffit forms only after the approved strength / time has been achieved. Repair tie holes and defects.

Inspection and Acceptance

- Pre-pour inspection for cleanliness, dimensions, steel, anodes, cover, seals, ports and vents.
- No grout loss, fins, honeycombing or misalignment.

Measurement

Square metres of actual concrete-contact formwork area installed and accepted.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-9(a) Polymer-Modified Flowable Micro-Concrete**Scope**

Form-and-pour or pumped reinstatement of sections generally deeper than 40 mm, including local jacketing of Category-I and selected Category-II repairs.

Materials and Performance Requirements

- Prepacked, chloride-free, shrinkage-compensated flowable micro-concrete such as Renderoc RG, SikaRep Microcrete-4 or approved equivalent.
- Minimum 28-day compressive strength 50 MPa unless an approved design specifies otherwise; minimum 1-day strength suitable for operational programme; fresh density and modulus compatible with substrate.
- Extension with clean SSD graded aggregate up to the manufacturer's permitted proportion only when approved by trial mix.

Execution

- Prepare substrate and reinforcement as specified. Use approved bond system.
- Mix complete bags with measured water in a forced-action mixer. Verify flow before placement.
- Place continuously from one point or pump from the lowest point to displace air and water. Maintain an uninterrupted head and use vents. Do not externally vibrate in a way that causes segregation; use rodding or light form tapping as approved.
- For slab soffit repairs, use approved deck core holes only after scanning and structural approval. Fill and make good all holes.
- Cure immediately after form removal for the product's specified period. Protect from early-age vibration and tidal wetting.

Inspection and Acceptance

- Pre-placement flow / consistency test for each batch or lot.
- Compressive-strength cubes at the approved frequency, typically one set per day or per 5 m³, whichever is more frequent, with minimum 3 cubes at 7 days and 3 at 28 days per set unless the QAP specifies otherwise.
- Visual, sounding and dimensional inspection after stripping. Repair voids only by approved method.

Measurement

Cubic metres of accepted micro-concrete, calculated from approved repair dimensions. Material wastage, head boxes and pumping losses are included.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-9(b) Core Holes through Deck Slab for Soffit Micro-Concrete**Scope**

Diamond core drilling of holes generally 50 mm to 100 mm diameter through the deck slab for controlled placement and venting of slab-soffit micro-concrete, followed by permanent repair.

Materials and Performance Requirements

Diamond coring equipment with slurry collection; approved high-strength non-shrink repair material for making good.

Execution

- Scan and mark reinforcement, embedded services and prestressing, if any. Obtain written location approval.
- Core without cutting reinforcement. Collect core and slurry. Protect the area above and below.
- Use holes as pour / vent points, then clean, roughen and fill with approved bonded repair material flush with deck and soffit. Reinstate deck waterproofing / wearing course where affected.

Inspection and Acceptance

- Record location, diameter and core condition.
- No reinforcement or service damage.
- Completed hole shall be dense, sealed and flush.

Measurement

Number of completed and made-good core holes.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-10 Post-Installed Rebar Anchors by Diameter**Scope**

Drilling and anchoring of supplementary reinforcing bars into existing concrete to the approved development depth using a qualified chemical anchor system.

Materials and Performance Requirements

- Approved reinforcement anchoring resin suitable for sustained load, cracked concrete, marine exposure, wet or damp holes as applicable and the service temperature.
- Reinforcement grade and diameter as shown on approved repair drawings.

Execution

- Design embedment shall be based on bar force, concrete strength, edge distance, spacing and approved product data. The BOQ reference of 10d is a minimum nominal value and shall not override design.
- Scan, drill, clean and inject using manufacturer-certified installers. Use a piston plug / extension tube for deep holes. Mark embedment on bars and prevent movement during cure.
- Record hole depth, diameter, resin batch, substrate temperature and installation time.

Inspection and Acceptance

- Pull-out / proof testing to approved ITP, not less than the frequency stated for D-3.
- Failed tests require investigation, increased testing and replacement at Contractor cost.

Measurement

Number of anchors installed and accepted, classified by bar diameter as listed in the BOQ.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

D-11 Marine-Grade FRP Sacrificial Pile Liners with Annular Grout**Scope**

Design, fabrication and installation of split FRP sleeves around repaired piles, including bolted closure, seals, dewatering where feasible, annular-space preparation and underwater-compatible grout. The liner is sacrificial and shall not be assumed to provide structural pile capacity unless expressly designed.

Materials and Performance Requirements

- FRP liner thickness shall be 3 mm to 4 mm minimum as stated in the BOQ, or greater where required by handling, hydrostatic pressure, grout pressure, impact and installation design.

- Marine-grade resin system with low water absorption, UV resistance, chemical resistance and proven long-term seawater performance. Glass reinforcement shall be corrosion resistant and laminate free from dry fibres, voids, blisters and delamination.
- Bolts, washers and nuts shall be marine-grade stainless steel or approved corrosion-resistant material, electrically and chemically compatible with the FRP and environment.
- Seals shall be closed-cell marine-grade gasket / foam and underwater epoxy putty where required.
- Annular grout shall be anti-washout, non-shrink, pumpable and suitable for underwater or damp placement. Minimum 28-day compressive strength shall be 40 MPa unless the approved design requires higher. Typical systems include Conbextra UW, Sikadur-53 UF or approved equivalent.

Execution

- Survey pile diameter, ovality, damaged height, retained liner edges, tide and access. Submit pile-wise fabrication dimensions.
- Complete concrete and reinforcement repairs before sleeve installation unless an approved integrated method is used.
- Provide sleeve overlap above and below the repair and, where practicable, terminate at least 1 m above the splash zone as shown in the approved detail.
- Install split shells, align and torque bolts uniformly. Seal bottom, vertical joint and penetrations. Check water tightness and dewater where feasible.
- Place grout continuously from the lowest point through a tremie or pump hose, avoiding air and water entrapment. Provide vents at high points and control grout pressure to prevent liner distortion or uplift.
- Secure the sleeve against buoyancy and movement until grout has set. Remove temporary supports and seal ports.

Inspection and Acceptance

- FRP manufacturer's laminate certificates and coupon test results as required by QAP.
- Dimensional and visual inspection before installation.
- Trial installation on one pile.
- Grout flow, density and compressive-strength tests; grout-volume reconciliation to identify voids or leakage.
- Final check for alignment, soundness, joint seal, bolt torque and complete filling.

Measurement

Square metres of accepted external developed surface area of installed FRP liner, calculated from final pile circumference and liner height. Grout, bolts, seals, pumping, diving and temporary restraint are included.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

PC-1 Protective Coating to Non-Splash-Zone RCC Surfaces**Scope**

Surface preparation, crack and pore treatment, primer where required, and application of an elastomeric, breathable, anti-carbonation and chloride-resistant protective coating to designated non-splash-zone concrete surfaces.

Materials and Performance Requirements

- Single-component or approved multi-coat acrylic protective system such as Dekguard E2000, SikaGard 550 W Elastic IN or approved equivalent.
- System shall be UV resistant, crack bridging, resistant to carbon dioxide and chloride ingress, vapour permeable and suitable for the marine atmosphere. Target elongation shall be consistent with the BOQ performance requirement.
- Crack filler / fairing coat shall be compatible with the coating system.

Execution

- Allow repaired concrete to cure and dry to the product's moisture limit. Remove salt, laitance, dust, oil, loose coating and biological growth by fresh-water pressure washing and mechanical preparation.
- Test for surface contamination where directed. Repair pinholes and cracks; route and seal active or wider cracks by approved detail.
- Apply primer and coats at the manufacturer's coverage to achieve the specified dry-film thickness. Use contrasting coat colours where practicable for coverage control.
- Do not apply during rain, condensation, excessive wind, unsuitable temperature or humidity, or when sea spray can contaminate uncured coating.

Inspection and Acceptance

- Mock-up area for colour, finish, adhesion and coverage.
- Ambient condition and batch records.
- Wet-film readings during application and dry-film / consumption reconciliation after cure.
- Pull-off adhesion tests at approved frequency, with minimum acceptance as per approved system and substrate condition.
- No pinholes, blistering, runs, missed areas, delamination or unacceptable colour variation.

Measurement

Square metres of finished coated concrete surface accepted. Surface preparation, crack filler, primer and all coats are included.

Rate Shall Include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

PC-2 Protective Coating to Splash-Zone RCC Surfaces**Scope**

Application of a high-build waterproofing and protective coating to designated splash-zone elements subject to frequent wetting, salt spray and tidal exposure.

Materials and Performance Requirements

- Hydrophobic polyester or equivalent marine protective system such as Nitocote PE135 or approved equivalent.
- The complete system shall achieve the BOQ performance requirements, including low water absorption, resistance to water permeability, adhesion greater than 1.0 MPa or substrate failure where specified, UV resistance and chemical resistance.
- Nominal application: two coats to total 400 microns wet-film thickness and approximately 200 microns dry-film thickness, unless the approved system requires a greater thickness.

Execution

- Prepare and condition substrate as for PC-1, with special attention to removal of chloride deposits.
- Plan work within tide and berth-vacant windows so that each coat achieves the required cure before wetting.
- Apply uniformly by approved roller, brush or airless spray, observing recoat intervals. Stripe-coat edges, corners, repaired cracks and penetrations.
- Protect coating from sea spray and mechanical damage until fully cured.

Inspection and Acceptance

- Mock-up, ambient-condition records, wet-film checks, consumption reconciliation, holiday / pinhole inspection where suitable and pull-off adhesion tests.
- Acceptance only after full cure and defect repair.

Measurement

Square metres of finished splash-zone coating system accepted.

Rate shall include

All labour, supervision, materials, consumables, plant, access, marine logistics, temporary works, testing, protection, waste handling and incidentals required to complete and accept the item.

7. Associated Repair Requirements**7.1 Deck Crack Investigation and Repair**

- Classify cracks as screed-only, dormant structural, active, wet or leaking before selecting treatment.
- Remove screed locally, generally 300 mm to 500 mm on each side where required, to establish whether cracking extends into structural concrete.
- For screed-only cracks, remove unsound screed, prepare substrate and reinstate with approved bonded M30 or higher screed matching existing falls and finish.
- For dormant structural cracks, use low-viscosity epoxy injection through sealed nipples at spacing appropriate to crack width and depth. Begin at the lowest point and continue until refusal or resin appears at the next port.
- For active or water-bearing cracks, use an approved flexible polyurethane injection or other designed system. Epoxy shall not be used where movement or active leakage remains.
- Carry out trial injection, record material consumption and verify sealing. Reinstate deck surfacing and drainage.

7.2 Drain Outlet Extension / Oversized Sleeve

- Inspect every designated outlet for leakage, inadequate projection, corrosion damage and blockage.
- Provide a corrosion-resistant sleeve of approved material and diameter that projects sufficiently below the soffit to prevent water running across concrete. Final geometry shall not reduce hydraulic capacity or create a hazard.
- Remove distressed concrete, clean / supplement reinforcement, seal the annulus, rebuild the profile with compatible repair material and reinstate coating.
- Water-test each completed outlet and rectify leakage or backflow.

7.3 Local Defects and Previously Repaired Areas

Previously repaired areas that are hollow, cracked, debonded or incompatible shall be removed to sound material and treated as new repairs. Thin cosmetic overlay over a failed repair is not permitted. Any unexpected structural crack, major bar loss, pile core erosion or member distortion shall be treated as a hold point and referred to the Engineer for repair design.

8. Repair Categorization and Selection

Category	Typical condition	Minimum treatment
Category I, severe	Severely corroded or exposed reinforcement, major section loss, deep spalling, erosion or structural cracking.	Immediate priority. Detailed opening-up; supplementary reinforcement; designed anodes; shear connectors; watertight formwork; micro-concrete; structural review where required.
Category II, moderate	Exposed reinforcement, long corrosion cracking, severe honeycombing or defects likely to become severe.	PMM or micro-concrete based on depth and extent after chipping; anodes where designed; local rebar replacement.
Category III, minor	Minor corrosion cracking, non-structural defects, minor honeycombing or loss of protection.	Controlled patch repair with PMM, crack treatment and protective coating. Upgrade to Category II / I if opening-up reveals deeper damage.

The repair category shown on distress drawings is a pre-tender indication. The final treatment shall be based on actual opened-up condition and approved by the Engineer. The Contractor shall maintain traceability between drawing reference, physical member, repair category, measured quantity, photographs and completed repair.

9. Quality Control and Testing

Work	Test / inspection	Minimum frequency	Stage
Repair substrate	Visual inspection, hammer sounding, cleanliness and geometry	Each patch / repair zone	Before steel treatment and closing
Existing reinforcement	Cleanliness and diameter / section-loss check	Representative bars in every repair zone	After cleaning
Chemical anchors	Installation record and proof / pull-out test	Approved ITP; minimum stated in D-3 / D-10	Before closing
Galvanic anodes	Location, tie, continuity / resistance, batch	Each anode or approved protocol	Before repair material
PMM	Flow / consistency where applicable; cube or prism tests if directed; pull-off and sounding	Trial and approved frequency	During and after cure
Micro-concrete	Flow each batch; compressive cubes; volume reconciliation	Each batch and set frequency in D-9(a)	During placement
FRP liner	Laminate certificates, dimensions, joint and	Each liner	Before and after

Work	Test / inspection	Minimum frequency	Stage
	bolt inspection		installation
Underwater grout	Flow / density, cubes, volume reconciliation	Each shift / grout lot	During grouting
Protective coating	Ambient conditions, batch, WFT, DFT / consumption, adhesion	Each coat and approved test grid	During and after application

The Contractor shall provide calibrated instruments and accredited laboratory support. Test failures shall be investigated through a non-conformance report. Rework, additional testing and reinstatement required because of failure shall be at Contractor cost.

10. Environmental, Safety and Operational Controls

- All work over or near water requires approved fall protection, life jackets, rescue boat, trained rescue personnel, communication and man-overboard drill.
- Platforms shall have guardrails, toe boards, safe access, independent lifelines, load signage and debris containment. Personnel shall not work from unsecured floating arrangements.
- Hot work requires permit, gas-cylinder control, flashback arrestors, fire watch and protection of pipelines, conveyors and operations.
- Pressure washing, chipping and coating shall use full containment. Saltwater, waste, chemical containers, abrasive, slurry and debris shall be collected and disposed at approved locations.
- Pontoons and boats shall operate within approved weather, current, tide and visibility limits and shall not be tied in a manner that damages piles or obstructs vessels.
- No work shall impair fire systems, emergency routes, navigation lights, mooring equipment, fenders, service pipes, conveyor systems or drainage. Any temporary isolation requires GPPL approval.
- The Contractor shall stop work during unsafe weather, lightning, excessive wind, wave action or visibility and shall secure all temporary works.

11. Measurement and Payment Principles

- All quantities shall be jointly measured and supported by member reference, grid, dimensions, category and pre-work / post-work photographs.
- No payment shall be made for areas covered before a required hold-point inspection or for repair beyond approved limits due to Contractor over-break.
- Rates shall include handling under operational, tidal and intermittent-work conditions; repeated small work fronts; normal relocations of access; protection; curing; testing; waste collection and making good.
- Where a BOQ item is measured by area, only the accepted finished or prepared surface specified for that item shall be measured. Overlaps, wastage and manufacturer-required consumption are included in the rate.
- Where repair depth or method changes after chipping, the Engineer shall classify the work under the applicable BOQ item. The same repair volume or area shall not be measured under two reinstatement items.
- Provisional quantities do not guarantee minimum work. Variations shall be managed under the Conditions of Contract.

12. Programme, Sequencing and Workfront Management

- Priorities Category-I elements, severely deteriorated piles / liners, Category-II beam defects and safety-critical areas before widespread Category-III treatment.
- Divide Jetty-1 and Approaches into identifiable zones based on grid lines and operational access. Complete repair and coating records zone by zone.
- Maintain at least two safe alternative work fronts away from the active berth face, subject to GPPL approval, to reduce loss of productivity during vessel occupancy.
- Do not open more repair area than can be protected and reinstated within the approved exposure period. Exposed bars and concrete shall not remain unprotected through prolonged tidal or monsoon exposure.
- Coordinate concrete removal, rebar decisions, anchors, anodes, formwork, repair placement, curing and coating to avoid incompatible interfaces and repeated access.

13. Completion, Handover and Warranty

13.1 Completion Dossier

- Approved method statements, QAP, ITPs and temporary-work designs.
- Material approvals, batch certificates, delivery and shelf-life records.
- Member-wise repair register with original category, actual size and depth, treatment, material batch, date and responsible supervisor.
- Before, during and after photographs referenced to grid and member number.
- Anchor test, anode continuity, repair-material strength, grout, coating and adhesion test reports.
- As-built repair and anode drawings in editable and PDF formats.
- FRP liner schedule, laminate details, bolt records and grout-volume reconciliation.
- Non-conformance reports and evidence of closeout.
- Manufacturer warranty certificates, maintenance instructions and recommended inspection schedule.

13.2 Defects and Performance

During the Defects Notification / Liability Period, the Contractor shall rectify debonding, cracking attributable to workmanship, hollow repairs, grout voids, liner joint failure, coating blistering / peeling, corrosion staining through repaired zones and other non-compliance at its cost. Product warranties shall be backed by the applicator and manufacturer and shall not limit the Contractor's obligations under the Contract.

14. Tenderer Technical Submission Requirements

No.	Required Technical Submission
1	Understanding of operational berth constraints and proposed berth-vacant working strategy.
2	Preliminary zone-wise programme, platform quantities and resource histogram.
3	Proposed access concept, marine craft and rescue arrangement.
4	Proposed repair systems with complete data sheets and compatibility statement.
5	Preliminary galvanic-anode design basis and FRP-liner system details.
6	Similar marine RCC repair experience and key personnel.

No.	Required Technical Submission
7	Quality plan, testing schedule and proposed specialist manufacturers / subcontractors.
8	List of deviations. Silence shall mean full compliance with this specification.

15. Schedule of Minimum Method Statements

Ref.	Method Statement
MS-01	Mobilization, security, storage and marine logistics
MS-02	Suspended platform design, erection, inspection, relocation and rescue
MS-03	Joint distress survey and measurement
MS-04	Concrete chipping and marine containment
MS-05	Pile-liner cutting and hot work
MS-06	Rebar cleaning, section-loss assessment and replacement
MS-07	Post-installed anchors and pull-out testing
MS-08	Galvanic anode design and installation
MS-09	PMM overhead repairs
MS-10	Micro-concrete form-and-pour / pumping
MS-11	Slab core holes and making good
MS-12	FRP liner and underwater grouting
MS-13	Crack injection and drain outlet repair
MS-14	Splash and non-splash protective coatings
MS-15	Berth-vacant mobilization / rapid clearance plan
MS-16	Final inspection and completion documentation

Tender Note

The tender drawings and BOQ shall be checked against this specification before issue. Any item required by the IRCLASS repair methodology but not clearly measurable under the BOQ should be added as a separate BOQ item or expressly included in the relevant rate to avoid post-award ambiguity.