

# ESTABLISHMENT OF UNIVERSITY OF BALTISTAN, SKARDU



## VOLUME II SPECIFICATION CIVIL (STRUCTURE AND ARCHITECTURE) TENDER

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**DIVISION 4 – MASONRY****SECTION 04810 - UNIT MASONRY ASSEMBLIES****Part 01****1 SCOPE OF WORK**

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all the operations in connection with block masonry work complete in strict accordance with the specifications herein and the applicable drawings and subject to the terms and conditions of the contract.

**Part 02****2.1 MATERIALS****2.2 CEMENT**

Cement shall be Portland cement meeting the requirements specified under clause of section of "Concrete".

**2.3 Aggregates**

Aggregates used shall meet the requirements specified under clause of section of "Concrete".

**2.4 Water**

Water shall be as specified under clauses of the section of "Water".

**2.5 Concrete Masonry Units**

1- General: Provide shapes indicated and as follows:

- i) Provide special shapes for corners, jambs, sash, control joints, headers, bonding, and other special conditions.
- ii) Provide square-edged units for outside corners, unless indicated as bullnose.

2- CMU units designations: Currently, six ASTM standards apply to units intended primarily for construction of concrete masonry walls, beams, columns, or specialty applications:

Type of Unit is Non-load bearing Concrete Masonry Units and ASTM Designation is C 129

3- Concrete Masonry Units: ASTM C 129 and as follows:

- i) Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 13.1 MPa [7.5 MPa on gross area].
  - a) Normal-weight units: more than 125 lb/cu. ft. (2002 kg/cu. m)
- ii) 2. Weight Classification: Normal weight, unless otherwise indicated.

4- Concrete masonry units shall be made on the project site and shall be of the sizes required by the drawings and / or as directed by the **Engineer**.

5- The blocks shall be solid or hollow as required and shall be carefully made so that they are true in line and face with square corners and free from all defects.

- 6- The concrete for the blocks shall be mixed in the proportions of one (1) part of cement, three (3) parts of sand and six (6) parts of well graded coarse aggregate not exceeding ½” in size.
- 7- Concrete blocks shall be machine moulded. The concrete shall be well worked in the moulds, vibrated tamped and pressed to ensure that the blocks are dense and free from voids.
- 8- The blocks shall be cured by keep moist continuously for a period of at least ten (10) days and then shall be allowed to dry in a shady location for at least eight (8) days before being used in masonry.
- 9- Where blocks are to be exposed to view they shall have clean, cut straight and true, edges, smooth dense faces of uniform appearance without voids, honeycombs, projections or variation in texture and shall be free from cracks, chips, ragged edges or other defects detrimental of their appearance.
- 10- Where blocks are to be plastered the exposed surfaces shall have a coarse texture suitable for bonding the plaster as approved by the Engineer.
- 11- The average compressive strength of any five blocks picked at random shall be not less than the strength as specified for Class ‘D’ concrete under clause of the section of “Concrete”.
- 12- The average moisture content of all concrete masonry units shall not exceed 30% of the total absorption of the units.

## 2.6 HANDLING AND STORAGE

Concrete masonry unit shall be stacked on platforms and covered or stored in any other manner approved by the Consultants to protect from contact with the soil and exposure to weather. Care shall be taken in handling to avoid chipping and breakage. Storage piles stacks, or bins shall be so located as to avoid being disturbed or shall be barricaded to protect the blocks from damages by construction operations.

## 2.7 MORTAR FOR MASONRY

2.7.1 General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1) Do not use calcium chloride in mortar or grout.
- 2) 2. Use mortar cement mortar unless otherwise indicated.
- 3) 3. For exterior masonry, use mortar cement mortar.

2.7.2 Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a pre blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site. Comply with ASTM C 270 Property Specification:

- 1) Wet mix life: <1.5 hours

- 2) 2. Initial adhesion at 28 days: > 0.3N/mm<sup>2</sup>
- 3) 3. Bending strength: around 1N/ mm<sup>2</sup>
- 4) 4. Compressive strength : not less than 5 ±1 N/ mm<sup>2</sup>
- 5) 5. Min. cement sand mix: 1:3-4
- 6) 6. Testing: ASTM C 780

2.7.3 Mortar for Unit Masonry: Comply with ASTM C 270 Property Specification. For job mixed mortars, minimum properties shall be as follows:

- 1) Compressive strength : not less than 5 ±1 N/ mm<sup>2</sup>
- 2) 2. Min. cement sand mix: 1:3-4
- 3) 3. Bending strength: around 1N/ mm<sup>2</sup>
- 4) 4. Testing: ASTM C 780

2.7.4 Property specification ASTM C 270:

Mortar	Type	Average Compressive Strength at 28 days, min, psi (MPa)	Air Content Max %
	S	1800 (12.4)	12
	N	750 (5.2)	14
	O	350 (2.4)	14

Aggregate Ratio (Measured in Damp, Loose Conditions): Not less than 2 1/4 and not more than 3 1/2 the sum of the separate volumes of cementitious materials Minimum water retention 75 %

- 1) For masonry below grade or in contact with earth, use Type M.
- 2) For reinforced masonry, use Type S.
- 3) For mortar parge coats, use Type S or Type N.
- 4) For exterior, above-grade, non-load-bearing walls and parapet walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

2.7.5 Grout for Unit Masonry: Comply with ASTM C 476.

- 1) Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  - 2) Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified
  - 3) 28-day compressive strength indicated, but not less than 14 MPa.
  - 4) Provide grout with a slump of 203 to 279 mm as measured according to ASTM C 143/C 143M.
- PART

2.7.6 Cement shall be Portland as specified under Clause of the Section of “Concrete”.

2.7.7 Fine aggregate shall be clean, hard, durable particles free from laminated material well graded from No. 4 to 100 sieve.

- 2.7.8 Water shall be clean and free from injurious acids, alkali and organic impurities.
- 2.7.9 All mortar for masonry shall be proportion of one (1) part of cement and four (4) parts of sand (fine aggregate) and the ingredients shall be mixed by volume.
- 2.7.10 Mortar shall be mixed thoroughly in a drum type batch mixer for a period of not less than three minutes, using the quantity of water required to obtain the desired workability. Hand mixing shall be subject to approval by the Engineer and if he allows the mortar materials shall be mixed in a light mortar mixing box. In no case the mixing of mortar shall be done on open platform.
- 2.7.11 The mortar shall be subject to compressive strength test and the average compressive strength of three numbers 50 mm (2") cylinders of mortar shall be not less than 1,800 lbs per sq. inch at 28 days.
- 2.7.12 Mortar shall be used in the masonry within half an hour from addition of water into the mortar. The mortar which has already set shall not be used in the masonry.

## 2.8 MASONRY AND JOINTING

- a) All masonry shall be laid plumb, true to the line and level and accurately spaced coursed and with each course breaking joints with the course below. Bond shall be keeping plumb; corners and reveals shall be plumb and true. Chases, grooves, reglet blocks and raked out joints shall be kept free from mortar and other debris.
- b) The thickness and length of various walls shall be as indicated on the drawings.
- c) Unless otherwise shown on the drawings or specified the spaces around forms and other built in items shall be solidly filled with mortar except that joints that are to be caulked shall be raked out 20 mm (3/4").
- d) Work required to be built in with masonry including anchor, wall plugs and accessories shall be built in as the work progresses. Wood plugs and blocking shall not be built into masonry.
- e) All horizontal and vertical joints shall be completely and solidly filled with mortar when and as the blocks are laid.
- f) (1/2") deep when the mortar is still fresh so as to give proper bond to the plaster.
- g) Where masonry abuts RCC columns or walls it shall be anchored thereto by means of wire anchors of galvanized metal not less than 10 gauge or 25 mm (1") wide G.I. strip 22 gauge located at every fourth horizontal joint.
- h) The top course of partitions under slabs beams shall not be laid until the forms have been

removed and the roofing placed.

- i) Masonry walls shall be cured for at least ten days from the day it is erected.

## 2.9 MATERIALS

### a. Mortar

### b. Cement

Comply with requirements of BS 12: 1989. Use ordinary Portland cement (grey) unless specified otherwise.

### c. Sand

Comply with requirements of BS 1200: 1976 with Amendments 1, 2 & 3, for "Building sands from natural sources". Grading S of table below is preferred.

BS Sieve	Percentage by mass passing BS sieves	
	Type S	Type G
mm		
6.30	100	100
5.00	98 – 100	98 – 100
2.36	90 – 100	90 – 100
1.18	70 – 100	70 – 100
microns		
600	40 – 100	40 – 100
300	5 – 70	20 – 90
150	0 – 15	0 – 25
75	0 -5*	0 – 8**

\* 0-10% for crushed stone sands

\*\* 0-1 2 % for crushed stone sands

Store sand at the Site in such a manner that it is not mixed with foreign matter. Methods employed by the Contractor for unloading, loading, handling and storage shall be subject to the approval of the Engineer. Maintain sufficient quantity at the Site at all times to ensure continuous work.

### i) Water

Do not use seawater or brackish water containing more than 100 ppm chloride ion or 2000 ppm sulphate ion for mixing or curing concrete. Water shall be clean and free from harmful matter and

shall comply with the requirements of appendix A of BS 3148: 1980. Avoid contamination during storage.

- ii) Mortar composition  
Cement to dry sand ratio by volume as specified.
- iii) Mortar batching and mixing  
Employ methods and equipment for mixing mortar so as to accurately determine and control the amount of each separate ingredient entering into the mortar, subject to the approval of the Engineer. Unless mixing by hand is allowed by the Engineer, mix mortar in a mixer which shall be of approved design and the mixing time after all the ingredients are in the mixer, except for the full amount of water, shall not be less than two minutes. Mix mortar only in quantities just sufficient for immediate use and waste all mortar not used within 30 minutes after addition of water to the mix. Do not re-tamper mortar. Thoroughly clean and wash mixing troughs and pans at the end of each day's work.
- d. Metal ties  
Unless approved otherwise by the Engineer or shown on drawings:
  - i) Cavity wall ties - comply with the requirements of BS 1243: 1978 as approved by the Engineer.
  - ii) Ties for jointing concrete and blockwork - 6mm dia x 300mm long, MS galvanized.

## 2.10 TIES AND ANCHORS

- 2.10.1 Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
  - i) Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/ A 153M, Class B-2 coating.
  - ii) Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
  - iii) Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
  - iv) Stainless-Steel Sheet: ASTM A 666, Type 316.
  - v) Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 2.10.2 Corrugated Metal Ties: Metal strips not less than 22 mm wide with corrugations having a wavelength of 7.6 to 12.7 mm and an amplitude of 1.5 to 2.5 mm made from 1.52-mm- thick, steel sheet, galvanized after fabrication.
- 2.10.3 Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 16-mm cover on outside face. Outer ends of wires are bent 90 degrees and extend 50 mm parallel to face of veneer.
- 2.10.4 Individual Wire Ties: Rectangular units with closed ends and not less than 100 mm wide.
  - i) Z-shaped ties with ends bent 90 degrees to provide hooks not less than 50 mm long may be used for masonry constructed from solid units.
  - ii) Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 32 mm.

- iii) Wire: Fabricate from 6.35-mm- diameter, hot-dip galvanized steel wire.
- 2.10.5 Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
- i) Anchor Section for Welding to Steel Frame: Crimped 6.35-mm- diameter, hot-dip galvanized steel wire.
  - ii) Tie Section: Triangular-shaped wire tie, sized to extend within 25 mm of masonry face, made from 6.35-mm- diameter, hot-dip galvanized steel wire.
- 2.10.6 Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
- i) Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 2.66-mm- thick, steel sheet, galvanized after fabrication.
  - ii) Tie Section: Triangular-shaped wire tie, sized to extend within 25 mm of masonry face, made from 6.35-mm- diameter, hot-dip galvanized steel wire.
  - iii) Corrugated Metal Ties: Metal strips not less than 22 mm wide with corrugations having a wavelength of 7.6 to 12.7 mm and an amplitude of 1.5 to 2.5 mm made from 2.66-mmthick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 25 mm of masonry face.
- 2.10.7 Provide Adjustable Anchors for Connecting to Structural Steel Framing or Concrete made of stain- less steel sheet or wire where required for location and directed by Engineer.
- 2.10.8 Partition Top anchors: 2.66-mm- thick metal plate with 9.5-mm- diameter metal rod 152 mm long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication. I. Rigid Anchors: Fabricate from steel bars 38 mm wide by 6.35 mm thick by 610 mm long, with ends turned up 51 mm or with cross pins unless otherwise indicated.
- i) Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

## 2.11 MISCELLANEOUS MASONRY ACCESSORIES

- 2.11.1 Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- 2.11.2 Preformed Control-Joint Gaskets: Material as indicated below, Made from styrenebutadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- 2.11.3 Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- 2.11.4 Weep/Vent Products: Use one of the following unless otherwise indicated:



- i) Wicking Material: Absorbent rope, made from UV-resistant synthetic fiber, 6 to 10 mm in diameter, in length required to produce 50-mm exposure on exterior and 450 mm in cavity. Use only for weeps.
- ii) Plastic Weep Hole/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, designed to fill head joint with outside face held back 3 mm from exterior face of masonry, in color selected from manufacturer's standard.

#### 2.12 DELIVERY AND STORAGE

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the bricks nor delay the use of mixed mortar.

Masonry materials shall be so stored that at the time of use the materials are clean and structurally suitable for use.

#### 2.13 SCAFFOLDING

Provide and erect safe scaffolding of adequate strength for use of workmen at all levels and heights. Do not use scaffolding which in the opinion of the Engineer is unsafe, until it has been strengthened and made safe for use of workmen.

#### 2.14 MEASUREMENT AND PAYMENT

All the items of work covered by this section of the specifications shall be measured by the standard method of measurements and paid in accordance with unit rates entered in the Bill of Quantities. No separate payment will be made for masonry anchors etc. required.

**END OF SECTION 04810**

## DIVISION 5 – METALS

### SECTION 05500- METAL FABRICATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

##### 1.2 SUMMARY

- A. This Section covers items fabricated from steel, stainless steel or aluminum and are not covered under other Specification Sections, including, but not limited to, the following:
1. Miscellaneous framing and supports.
    - a. Concealed applications where framing and supports are required.
    - b. Countertop support.
    - c. Vanity supports
    - d. Steel framing and supports for mechanical and electrical equipment.
    - e. Steel framing and supports for Architectural applications.
  2. Elevator machine beams, hoist beams, and divider beams.
  3. Support angles for elevator door sills.
  4. Shelf angles.
  5. Loose bearing and leveling plates.
  6. Steel welded plates and angles for casting into concrete not specified in other Sections.
  7. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.

This Section includes the following metal fabrications:

8. Ladders.
9. Floor plate and supports.
10. Cast nosings, treads, and thresholds.
11. Pipe guards.
12. Pipe bollards.
13. Column protection guard.

Products furnished, but not installed, under this Section include the following:

14. Loose steel lintels.
15. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

Related Sections include the following:

16. 3.0 Section "Cast-In-Situ Concrete" for corner guards to be placed in forms of reinforced concrete columns and for concrete footings required for metal fabrications.
17. 4.0 Section "Unit Masonry Assemblies" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
18. 9.0 Section "Painting" for field applied paint finishes.

### 1.3 DESIGN REQUIREMENTS

- A. Design Requirements: Design, engineer, fabricate, and install work in compliance with specified standards, performance requirements, material selections, and requirements of this Section and related sections.
19. Provide work to withstand thermal movement, wind pressure, gravity loads, seismic loads and movement of building structure without failure. Work to remain free from defects.
    - a. **Seismic Load:** Uniform Building Code, 1997 Edition, zone 2A.
    - b. **Wind Loads:** Provide exterior metal fabrications that withstand design wind pressure calculated according to Uniform Building Code (UBC), 1997 Edition, Exposure C, Basic Wind Speed 130 Km/hr.
    - c. **Thermal Movements:** Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
      - 1) Temperature Change (Range): 35 deg C, ambient; 65 deg C, material surfaces.
- B. The design shall ensure that all components including anchors and connections shall comply with the allowable stresses as per relevant ASTM Standards. Load combinations shall be chosen to ensure that no element shall exceed the allowable stresses under any case of loading.

### 1.4 SUBMITTALS

- a. **Product Data:** for non-slip aggregates and non-slip aggregate surface finishes, cast nosings, treads and thresholds, steel floor plate, paint products, and grout.
- b. **Shop Drawings:** Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  - i. Provide templates for anchors and bolts specified for installation under other Sections.
- c. Samples representative of materials and finished products as may be requested by Engineer.
- d. **Mill Certificates:** Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- e. Welding Certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

- f. **Qualification Data:** For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and owners, and other information specified.

### 1.5 QUALITY ASSURANCE

- a. **Quality System:** Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.
- b. **Fabricator Qualifications:** A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units, without delaying the work.
- c. **Engineering Responsibility:** Engage a fabricator who utilizes a qualified and experienced structural engineer to prepare design calculations, shop drawings, and other structural data.
- d. **Welding:** Qualify procedures and personnel according to the following:
- i. AWS D1.1, "Structural Welding Code--Steel."
  - ii. AWS D1.2, "Structural Welding Code--Aluminum."
  - iii. AWS D1.3, "Structural Welding Code--Sheet Steel."
  - iv. AWS D1.6, "Structural Welding Code--Stainless Steel."
  - v. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
  - vi. Qualification tests according to the Structural Steel Code of Practice Prevailing in the country or other international Code or standard may also be accepted by the Engineer.

### 1.6 PROJECT CONDITIONS

- a. **Field Measurements:** Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- i. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

### 1.7 COORDINATION

- a. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**PART2 - PRODUCTS****2.1 METALS, GENERAL**

- A. **Metal Surfaces, General:** For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

**2.2 FERROUS METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36M, Tensile strength 400 Pa and minimum yield point 250 MPa.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Stainless Steel:
- Grade and type designated below for each form required:
    - Tubing: ASTM A 554, Grade MT 316
    - Pipe: ASTM A 312M, Grade TP 316.
    - Castings: ASTM A 743M, Grade CF 8M.
    - Plate: ASTM A 167, Type 316.
    - Bar Stock: ASTM A 276.
  - Finish: Bright, directional polish; match AISI No. 4 finish.
- D. Rolled-Steel Floor Plate: ASTM A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: Product type (manufacturing method) and as follows:
- Cold-Formed Steel Tubing: ASTM A 500.
    - Provide tubing with hot-dip galvanized coating per ASTM A 53.
- G. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- Provide galvanized finish for all steel pipes.
- H. Malleable-Iron Castings: ASTM A 47M, Grade 22010.
- I. Gray-Iron Castings: ASTM A 48M, Class 200, unless another class is indicated or required by structural loads.
- J. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- Threaded or wedge type; galvanized ferrous castings, either ASTM A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

- K. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

### 2.2.1 ALUMINUM

- a. Aluminum Extrusions: ASTM B 221M, alloy 6063-T6.  
b. Aluminum-Alloy Rolled Tread Plate: ASTM B 632M, alloy 6061-T6.

### 2.2.2 PAINT

- a. **Shop Primers:** Provide primers that comply with 9.00 Section "Painting."  
b. **Shop Primer for Ferrous Metal:** Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.  
c. **Shop Primer for Ferrous Metal:** Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.  
d. **Galvanizing Repair Paint:** High-zinc-dust-content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.  
e. **Bituminous Paint:** Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

### 2.2.3 FASTNERS

- a. **General:** Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn, where built into exterior walls. Select fasteners for type, grade, and class required.  
b. **Bolts and Nuts:** Regular hexagon-head bolts, ASTM F 568M, Property Class 4.6; with hex nuts, ASTM A 563M; and, where indicated, flat washers.  
c. **Anchor Bolts:** ASTM F 1554, Grade 36.  
d. **Machine Screws:** ASME B18.6.7M.  
e. **Lag Bolts:** ASME B18.2.3.8M.  
f. **Wood Screws:** Flat head, carbon steel, ASME B18.6.1.  
g. **Plain Washers:** Round, carbon steel, ASME B18.22M.  
h. **Lock Washers:** Helical, spring type, carbon steel, ASME B18.21.2M.  
i. **Expansion Anchors:** Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.  
i) Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.  
ii) Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 738M and nuts complying with ASTM F 836M.

- j. **Toggle Bolts:** FS FF-B-588, tumble-wing type, class and style as needed.

#### 2.2.4 GROUT

- a. **General:** Grout shall meet the requirements of 3.0 section, "Cast-in-Place Concrete".
- b. **Non-shrink, Metallic Grout:** Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- c. **Non-shrink, Nonmetallic Grout:** Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

#### 2.2.5 CONCRETE FILL

Concrete Materials and Properties: Comply with requirements in 3.0 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 20 MPa, unless otherwise indicated.

#### 2.2.6 FABRICATION, GENERAL

- a. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- b. Shear and punch metals cleanly and accurately. Remove burrs.
- c. Ease exposed edges to a radius of approximately 1 mm, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- d. Weld corners and seams continuously to comply with the following:
- i) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - ii) Obtain fusion without undercut or overlap.
  - iii) Remove welding flux immediately.
  - iv) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- e. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- f. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- g. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- h. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

- i. Remove sharp or rough areas on exposed traffic surfaces.
- j. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- k. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

### 2.2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- a. General: Provide steel framing and supports indicated or not indicated that are not a part of structural-steel framework as necessary to complete the Work.
- b. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - i) Fabricate units from slotted channel framing where indicated.
  - ii) Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 32 mm (1.25") wide by 6 mm (1/4") thick by 200 mm (8") long at 600 mm (24") o.c., unless otherwise indicated.
  - iii) Furnish inserts if units must be installed after concrete is placed.
- c. **FINISH:**
  - i) Interior: Prime painted, unless indicated as galvanized.
- d. Prime miscellaneous framing and supports with zinc-rich primer.

### 2.2.8 RECEIVING STEEL CAGES

Receiving steel cages are to be included in the steelwork package. Cages are to be designed to incorporate the following:

- a. Total 7 cages size shown on drawings and 10'-0" high.
- b. Cage are to be constructed from steel frames with wire mesh wall and roof cladding. Wire mesh is to be ¼" bars @ maximum 2" centres both ways
- c. All cages to have 2 roller shutter doors as indicated on the architectural plans. Doors to type 1 cage to have aluminum doors in accordance with the architectural specifications. Roller shutter door controls to incorporate facility that only one door per cage may be open or partly open at any one time.
- d. Design, supply, and insulation to including all fixings, claddings, and flashings required to construct the cages.
- e. All materials to be painted in accordance with specifications.



### 2.2.9 SHELF ANGLES

- a. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 19-mm 3/4" bolts, spaced not more than 150 mm 6" from ends and 600 mm 24" o.c., unless otherwise indicated.
  - i) Provide mitered and welded units at corners.
  - ii) Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 50 mm 2" larger than expansion or control joint.
- b. Galvanize shelf angles located in exterior walls.
- c. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

### 2.2.10 LOOSE BEARING AND LEVELING PLATES

- a. Column base plates are not included in this category.
- b. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

### 2.2.11 STEEL WELD PLATES AND ANGLES

Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

### 2.2.12 MISCELLANEOUS STEEL TRIM

- a. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.
- b. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 150 mm 6" from each end, 150 mm 6" from corners, and 600 mm 24" o.c., unless otherwise indicated.
- c. Galvanize miscellaneous steel trim in the following locations:
  - i) Exterior.

- ii) Interior, where indicated.

### 2.2.13 LOOSE STEEL LINTELS

- a. Unless otherwise indicated on Drawings, provide steel lintels as follows.
- b. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- c. Weld adjoining members together to form a single unit where indicated.
- d. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 200 mm 8", unless otherwise indicated.
- e. Galvanize loose steel lintels located in exterior walls.

### 2.2.14 STEEL LADDERS

- a. **General:** Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
  - i) Comply with ANSI A14.3, unless otherwise indicated on Drawings.
- b. **Side rails:** Continuous, 500 x 10 mm (20" x ½") steel flat bars, with eased edges, spaced 460 mm (19") apart.
- c. **Bar Rungs:** 20-mm (¾") - diameter steel bars, spaced 300 mm (12") o.c maximum.
- d. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- e. Support each ladder at top and bottom and not more than 1500 mm (5'-0") o.c. with welded or bolted steel brackets.
  - i) Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 150 mm (6").
  - ii) Extend side rails using 30-mm (1.25) diameter galvanized steel pipes to a height of 0.90 m above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access
- f. Provide non-slip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- g. Galvanize ladders, including brackets and fasteners.
- h. Finish is to be field-applied alkyd paint system of color and gloss as selected by the Engineer.

### 2.2.15 METAL FLOOR PLATE

- a. Fabricate raised-pattern floor plates from rolled-steel floor plate of thickness indicated below:
  - i) Thickness: As indicated.
  - ii) Pattern: As selected from manufacturer's standard patterns.
- b. Fabricate raised-pattern floor plates from rolled-aluminum-alloy tread plate of thickness indicated below:

- i) Thickness: 6.00 mm (1/8”), unless otherwise higher thickness is indicated.
- c. Include steel angle stiffeners, and fixed and removable sections as indicated.
  - i) Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

#### 2.2.16 CAST NOSINGS, TREADS AND THRESHOLDS

- a. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with an integral abrasive finish. Furnish in lengths as required to accurately fit each opening or conditions.
  - i) Cast units with an integral abrasive grit consisting of aluminum oxide, silicon carbide, or a combination of both.
- b. Drill for mechanical anchors with countersunk holes located not more than 100 mm from ends and not more than 300 mm (12”) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by the manufacturer.
  - i) Provide 2 rows of holes for units over 125 mm (5”) wide, with 2 holes aligned at ends and intermediate holes staggered.
- c. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.
- d. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated.

#### 2.2.17 PIPE BOLLARDS

- a. Fabricate pipe bollards from Schedule 40 steel pipe.
  - i) Cap bollards with 6-mm (1/8”) - minimum steel plate.
- b. Fabricate bollards with 10-mm (1/2”) - thick steel base plates for bolting to concrete slab. Drill base plates at all four corners for 19-mm (3/4”) anchor bolts.
  - i) Where bollards are to be anchored to sloping concrete slabs, angle base plates for plumb alignment of bollards.
- c. Finish is to be factory-applied manufacturer’s standard thermo setting coating including rust inhibition coat and of minimum dry film thickness of 60 microns.

#### 2.2.18 COLUMN PROTECTION GUARDS

- a. **Metal Protection:** Formed steel plates with welded lugs for building into concrete filling. Galvanize protection after fabrication to be not less than 300 gm/m<sup>2</sup> (28 gm/sft zinc coating intensity).
- b. **Pads:** Prefabricated from ASTM D2000, extruded synthetic rubber with type A shore durometer Hardness of 75, plus or minus 5 when tested according to ASTM D2240. Furnish in thickness as recommended by manufacturer for traffic type, but not less than thickness indicated on Drawings.

- c. **Filling Concrete:** As specified in this Section.
- d. **Finish:** Is to be field-applied epoxy paint system to exposed surfaces of steel and concrete as specified in 9.0 Section "Painting".

### 2.2.19 FINISHES, GENERAL

- a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- b. Finish metal fabrications after assembly.

### 2.2.20 STEEL AND IRON FINISHES

- a. **Galvanizing:** For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:
  - i) ASTM A 153 for galvanizing iron and steel hardware.
  - ii) ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.76 mm thick or thicker.
- b. **Preparation for Shop Priming:** Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
  - i) Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - ii) Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- c. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
  - i) Stripe paint corners, crevices, bolts, welds, and sharp edges.

### 2.2.21 STAINLESS-STEEL FINISHES

- a. Remove tool and die marks and stretch lines or blend into finish.
- b. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- c. Bright, Directional Polish: No. 4 finish.
- d. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### 2.2.22 ALUMINUM FINISHES

- a. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- b. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

- c. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: no specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating but with no less 0.025 mm or thicker) complying with AAMA 611.
- d. For powder coat finishes, AAMA 2605 is the high-performance exterior specification. Depending on the manufacturer, a 2605 powder coat may or may not utilize a fluoropolymer resin (PVDF). These finishes are resistant to moisture, weathering, ozone and UV radiation. An application for this finish would include architectural projects that require long term cosmetic and functional protection.

### PART3 - EXECUTION

#### 3.1 PREPERATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.
- C. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

#### 3.2 INSTALLATION, GENERAL

- A. **Fastening to In-Place Construction:** Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. **Cutting, Fitting, and Placement:** Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. **Field Welding:** Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. **Corrosion Protection:** Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

#### 3.3 SETTING, BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.4 INSTALLING NOSING, TREADS AND THRESHOLDS

- A. Install with anchorage system indicated to comply with manufacturer's written instructions.
- B. Center nosings on tread widths.
- C. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- D. Seal thresholds exposed to exterior with elastomeric sealant complying with 7.0 Section "Joint Sealants" to provide a watertight installation.

### 3.5 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.
- B. Fill bollards solidly with concrete, mounding top surface.

### 3.6 ADJUSTING AND CLEANING

- A. **Touchup Painting:** Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 0.05-mm (1/32") dry film thickness.
- B. **Touchup Painting:** Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in 9.0 Section "Painting."
- C. **Galvanized Surfaces:** Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

**END OF SECTION 05500**

## 4.0 RCC BOUNDRY WALL WITH PRE-CAST PANEL & COLUMNS

### 4.1 INTRODUCTION

This work procedure is prepared to describe the work procedure for construction and erection of precast boundary wall.

### 4.2 SCOPE OF WORK

Construction Methodology for Pre-cast Panels as per relevant specification And approved drawings.

### 4.3 CONSTRUCTION MACHINERY

Sr.No	DESCRIPTION	CAPACITY	NO	STAND BY	Remarks
1	Batching Plant / Transit Mixers	30/6 cum/hr.	1		Approved by Engineer in Charge
2	Concrete Vibrators	3 HP	1	1	
3	Concrete Needles	40/25mm dia.	1/1	1/1	
4	Hydra F-15 Escort	8 ton	1	1/1	
5	Welding Machine		1		

### 4.4 CONSTRUCTION METHODOLOGY

#### 4.4.1 PANEL CASTING

##### **PANEL MOULDS:**

10 Moulds for pre-cast panel casting shall be fabricated & erected as per drawing Along with necessary supporting assembly for casting of Panels. Similarly adequate moulds for casting of columns should also be arranged as per the Drawing followed. If required, depending upon the work progress and site requirement, further moulds may be fabricated.

### 1. Sequence of Casting Panels:

- i. Clean the bottom shutter of the mould and apply shutter release oil.
- ii. Place the reinforcement cage in position for casting of Panel.
- iii. Fix the four sides formwork of mould.
- iv. If railing is to be provided, then fix the insert plate of size 2700×75×6 mm for Railing as per the approved drawing.
- v. Cast the Panel & column.
- vi. De-shutter the Panel by removing the four sides formwork of panel.
- vii. Carry out de-moulding operation with the help of Hydra.
- viii. Curing the cast panel for a period of 14 days in stacking yard. Process/steps will be repeated till the total required casting is completed.

### 2. Concreting:

The concrete required (M-25) shall be produced as per the approved design mix at the centralized batching plant and transported by transit mixers to the pouring location. Before pouring, concrete slump of 110+/-30mm shall be checked at pouring location. Concrete placement will commence from one end to another in the same manner till completion. Concrete should be poured by the use of chute ensuring that height of fall of Concrete is not more than 1.5 M. The concrete shall be vibrated using 40mm/25mm diameter needle vibrators. Concrete cubes shall be taken for testing of compressive strength as per IS: 456-2000 at pouring location. Proper care shall be taken to see that concrete temperature shall not exceed 40 degree C.

### 3. De-shuttering:

The de-shuttering shall be commenced after the concrete has attained 7.5 MPA Crushing Strength.

### 4. Lifting of Panels:

The Precast Panels shall be lifted from 2 nos. Lifting hooks provided for the purpose in the top surface of panel using suitable hydra crane and place in stacking yard.

## 10.4.2 COLUMN CASTING

### COLUMNS MOULDS:

Adequate moulds (Minimum 5) for pre-cast column casting shall be fabricated & erected as per drawing along with necessary supporting assembly for casting of column. If required, depending upon the work progress and site requirement, further moulds may be fabricated.



## 1. Sequence of Casting Panels:

- i. Clean the bottom shutter of the mould and apply shutter release oil.
- ii. Place the reinforcement cage in position for casting of column.
- iii. Fix the all sides formwork of mould.
- iv. Cast the column.
- v. De-shutter the column by removing the four sides formwork of column.
- vi. Carry out de-moulding operation.
- vii. Curing the cast panel for a period of 14 days in stacking yard. Process/step will be repeated till the total required casting is completed.

## 2. Concreting:

The concrete required (M-25) shall be produced as per the approved design mix at the centralized batching plant and transported by transit mixers to the pouring location. Before pouring, concrete slump of 110+/-30mm shall be checked at pouring location. Concrete placement will commence from one end to another in the same manner till completion. Concrete should be poured by the use of chute ensuring that height of fall of Concrete is not more than 1.5 M. The concrete shall be vibrated using 40mm/25mm diameter needle vibrators. Concrete cubes shall be taken for testing of compressive strength as per IS: 456-2000 at pouring location. Proper care shall be taken to see that concrete temperature shall not exceed 40 degree C.

## 3. De-shuttering:

The de-shuttering shall be commenced after the concrete has attained 7.5 MPA (OR 3 days) compressive strength.

## 4. Lifting of Panels:

The Precast Panels shall be lifted carefully by using suitable device to avoid corner damage purpose in the top surface of panel using suitable hydra crane and place in stacking yard.

### 4.4.3 PANEL ERECTION

Erection of pre-Cast Panel and columns shall involve the following steps

#### 4.4.3.1 Transportation

#### 4.4.3.2 Pre-inspection

- i. Lifting & fixing
- ii. Alignment

iii. Reinforcement & shuttering

iv. Concreting

#### 10.4.3.1 **Transportation of Panel:**

Loading of Panel will be done by Hydra of suitable capacity in casting yard. It will be tied with the trailer with the help of rope/slings properly .Panel will be shifted to required location by trailer. Either Panel may be unloaded directly by hydra crane during lifting or unloaded at site on ground with the help of suitable capacity hydra crane. Panels will be lifted directly from trailer for launching. Car shall be taken to ensure that Panels will be unloaded on ground exactly below the Lifting location.

#### 10.4.3.2 **Pre-inspection of Panel:**

Panels shall be checked against any damage during transportation. It should also be checked for status of reinforcement dowel.

### **1. Launching of Panel:**

#### a) **Lifting of Panel:**

Lifting of Panel will be done with the help of hydra crane either from ground or from trailer. Crane will be positioned at the suitable location to access maximum length. Sling will be attached with lifting hook for lifting. Panels lifted will be brought in pre-determined location. They will rest over deck in position required at respective location followed by fixing the Panels with U-bar. Lifting & fixing of Panels will be repeated as above procedure.

#### b) **Alignment:**

Panel's alignment to be done by using suitable props. Then for final alignment it shall be checked with respect to Centre line.

#### c) **Reinforcement Fixing:**

For fixing of reinforcement for columns, bar bending schedule shall be prepared as per the approved construction drawings. The re-bars should

Be rust free, or if required, it may be cleaned with wire brush. The Reinforcement shall be cut using cutting machines or manually as required and bent. The reinforcement shall be transported to location trailer/truck to the location or manually depending upon the lead.

**d) Fixing of reinforcement:**

The reinforcement shall be manually fixed into its position as shown the construction drawing. Lap length of 50D should be provided. The reinforcement fixed shall be checked by Engineer in charge or his Representative.

**e) Shuttering:**

Before placing the shuttering, shuttering oil shall be applied on shutter Face in contact with the concrete, to ensure easy removal of shuttering & proper concrete finish. For preventing leakages from joints, rubber Strip/foam strip shall be provided at the joints of shuttering plates.

**f) Concreting:**

The required grade of concrete, as per approved drawings shall be produce as per the approved design mix at the centralized batching plant and transported by transit mixers to the pouring location. Before

Pouring concrete, slump of 90mm to 125 mm shall be checked at pouring location. The concrete shall be placed by Concrete Bucket. Concrete placing will commence from one end to another in cascading manner till completion. The concrete shall be vibrated using 25mm/40mm diameter needle vibrators. Concrete cubes shall be taken for testing of compressive strength as per IS: 456-2000 at pouring location. Proper care shall be taken to see that concrete temperature shall not exceed 40 degree C.

**g) Miscellaneous works:**

Special care shall be taken for curing the concrete for 14 Days.

**4.4.4 SAFETY, HEALTH AND ENVIRONMENT:**

For Panels casting to be carried out in scheduled location, approved barricading shall be provided. All site personnel shall wear Personal Protective Equipment. For other activities such as handling of reinforcement, electrically operated equipment etc. Safety devices/ precautions will be taken as per the approved safety plan. All precautions will be taken for carrying out the activity.

**Precautions:**

- Caution boards indicating danger will be fixed at proper place.
- Safe access should be provided.
- During night floodlight shall be used for lighting up the area.
- All the workers and supervisory staff's shall wear PPE s (Personal Protective Equipment) during the execution.
- The work methodology of the activity will be explained to all the key personnel and workmen involved in that activity and standing instruction will be given.
- Daily inspection checklist to be completed by site engineers and safety personnel before starting the work.
- The safety manager, through deputing safety personnel at the site, round the clock, will look after all safety aspects of the job.
- Tool Box meeting to be conducted before starting the work.
- All the workmen will follow the safety rules.
- All plants and lifting equipment used in work shall be tested by third party competent person wherever required.

**4.4.5 QUALITY ASSURANCE AND QUALITY CONTROL:**

Quality control and assurance shall be strictly followed as per approved by Engineer-in-charge.

**4.4.6 MEASUREMENT**

The unit of measurement of item which will be paid as per the unit rate quoted in the Bill of Quantities. Appended to the contract and in accordance with applicable condition of the contract.