1.6.1.4 For loose stone aggregates used as site decoration, submit actual samples of the aggregate sample attached to the Product Approval Form. Ensure that the product code and other unique identifiers of the sample are clearly indicated on the approval form.

1.6.1.5 Ensure that all horizontal and vertical exposed surfaces are smooth, continuous, and straight, unless otherwise indicated on the technical working drawings. Refer to the technical working drawings for other details.

1.6.2EXECUTION APPROVAL ATTACHMENTS

1.6.2.1 Detailed work methodology, indicating at least the following

1.6.2.1.1 Date and time of application

1.6.2.1.2 Area of application

1.6.2.1.3 Restoration procedures upon completion of work.

2. PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS (CONCRETE MIX)

Mix concrete using the standard Portland cement, aggregated, sand, and water combination and ensure that the compressive strength is 3000psi minimum at the 28th day of curing, unless otherwise stipulated by the structural designer. Ensure that the concrete slump limit is at 75mm or 3 inches and that the air content is at maximum 5% to 8%. Comply with requirements of Division 03 Section "Concrete Floor Topping" for details on concrete mix design, sampling and testing, and quality control.

2.2 PERFORMANCE REQUIREMENTS CONCRETE MATERIALS (PAVEMENT)

Follow as indicated in the structural consultant/designer plans. Ensure the following qualities of concrete, unless otherwise specified by the structural designer. In which case, the specifications of the structural designer prevails.

2.2.1Portland Cement: ASTM C 150, Type I; Furnish Grey cement

2.2.1.1 Normal Weight Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as indicated in Structural Consultant's Specifications.

2.2.2Ensure that fine Aggregates are free of materials with deleterious reactivity to alkali in cement.

2.2.3Ensure that the sizes, color and percentage of exposed decorative aggregates are as intended for the project. Refer to the technical working drawings for details.

2.2.4Use aggregate Mix Type 1B: 10mm size; percentage as intended for the project.

2.2.5Use aggregate Mix Type 1A: 3mm size; percentage as intended for the project.

2.3 PERFORMANCE REQUIREMENTS — STEEL REINFORCEMENTS

Ensure the following qualities of steel reinforcements, unless otherwise specified by the structural designer. In which case, the specifications of the structural designer shall prevail.

2.3.1Use Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3.2Use Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

2.3.3Use Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60, deformed.

2.3.4Use Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

2.3.5Use Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

2.3.6Use Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed

2.4 PERFORMANCE REQUIREMENTS — CURING MATERIALS

2.4.1When using curing materials, use liquid-membrane forming and sealing curing compound. Comply with ASTM C 309, Type I, Class A and ensure that moisture loss is no more than 0.055 gr./sq.cm. When applied at 200 sq ft/gal., unless specified otherwise on the technical working drawings or by the structural designer.

2.4.2When using anti-spalling compound, use a combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.

2.5 PERFORMANCE REQUIREMENTS — EXPANSION JOINT MATERIALS

Refer to and comply with requirements of Division 07 Section "Joint Sealants".

2.6 PERFORMANCE REQUIREMENTS — FORMS

2.6.1Use standard form materials, i.e. plywood, metal, metal-framed plywood, phenolic boards, and other standard form materials available in the market.

2.6.2When curved surfaces are indicated on the technical working drawings, ensure the use of flexible forms or curves.

2.6.3All forms must be attached with a commercially formulated form-release agent that does not damage the resulting concrete surface.

3. PART 3 EXECUTION

3.1 SURFACE PREPERATION

3.1.1Compact sub-base surface and remove all loose material before concrete placement. Check any unstable areas and conduct additional compaction when needed.

3.1.2Commence paving works only when all compaction work has been corrected.

3.2 FORM CONSTRUCTION

3.2.1Check technical working drawings to determine accurate setting of forms as to required grades and lines.

3.2.2Check the alignment of the assembled formwork. Ensure that the displacement tolerance of the resulting concrete work is not more than 3mm for horizontal faces and not more than 6mm for vertical faces. Install secure braces on the formworks to ensure alignment.

3.2.3Ensure that forms are applied with the appropriate form-release agent prior to installation to make sure that separation from cured concrete will not incur any damages.

3.2.4Clean forms after each use.

3.3 REINFORCEMENT

3.3.1Refer to the drawing and specifications of the structural designer for the installation of reinforcements. For details in execution, check Division 03 sections of this specification.

3.4 CONCRETE PLACEMENT

3.4.1Comply with requirements of Division 03 sections for mixing and placing concrete.

3.4.2Check all line and grade of forms before concrete placement.

3.4.3If a dampened conditions are required at the time of concrete placement, ensure that the sub-base is properly moistened.

3.4.4Ensure that elevations and alignments of concrete manholes are accurate before placing concrete.

3.4.5Only use concrete placement methods that prevent segregation of the concrete mix.

3.4.6Use internal vibrator to consolidate concrete along face of forms and areas adjacent to transverse joints. Use square-faced shovels via hand spreading to consolidate concrete placed near joint assemblies, reinforcement, or side forms. Do not use a vibrator to consolidate concrete in these areas. Consolidate with care such that dislocation of reinforcing, dowels, and joint devices is avoided. In case of dislocation, make sure to correct the alignment prior to concrete setting.

3.4.7Make sure that a bonding agent is used at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4.8Make sure that concrete placement in horizontal surfaces is as continuous as possible. If the interruption between concrete placements is more than thirty (30) minutes, use a construction joint.

3.4.9For pavement lanes adjacent to each other and placed separately, do not allow equipment to pass through the lane with previously poured concrete until the lane has cured enough to gain the concrete strength required to carry loads.

3.5 FABRICATED BAR MATS

3.5.1Ensure that fabricated bar mats are clean and free from excessive rust and dust.

3.5.2Check that bars are not distorted in a way that affects its strength or that it deviates away from the indications of the structural engineer.

3.5.3When arranging bar mats, follow the technical working drawings issued by the structural engineer.

3.5.4 Establish a minimum of 2-inch mat overlaps for adjacent maps.

3.5.5When placing concrete on mats with a required finish surface, place the concrete in two batches. The first concrete placement batch should be up to beneath the finish surface level only. The second batch will be dedicated to the surface finish. Check the thickness of the surface finish according to technical working drawings. If not indicated, un-bonded toppings should be at least 70mm thick. A 50mm topping thickness is acceptable only if bonding agents are used. The time gap between the placements should not be more than 15minutes.

3.6 JOINTS

3.6.1Construction joints must be installed where necessary such as at the end of concrete placements and in between concrete placements that have a huge time gap between placements. Install dowels for concrete placements designed to withstand heavy loads.

3.6.2For weakened planes, use contraction joints or expansion joints such that there shall be no unnecessary breakage for the concrete.

3.6.3Ensure that the layout of contraction joints are as square-shaped as possible. The length to width ratio of the square must never exceed 1 ½ to 1.

3.6.4For expansion joints between concrete curbs and pavements, catch basins and manholes, inlets, structures, walks, and other objects, use a pre-molded filler to ensure the smooth plane of the abutments.

3.6.5When using joint fillers, ensure that full width and depth of the joint is not less than 12.7mm or 25mm. The joint filler must be flushed with the finished concrete surface. Refer to Division 07 Section "Joint Sealants" for material and installation performance requirements of joint sealers.

3.6.6Dry-cut joints are acceptable provided that it is positioned on the pavement within 1-4 hours after the completion of pouring and finishing.

3.6.7Install isolation joints at the intersections of horizontal and vertical surfaces such as slabs and columns, walls and footings and where curbs or sidewalks meet other concrete structures.

3.7 CURBS AND GUTTERS

3.7.1Refer to the site development plan details to identify the correct location and details of curbs.

3.7.2Ensure that required cross-section, lines, grades, finish and jointing are as specified for the formed concrete.

3.7.3In case of curb inlet manholes, refer to the technical working drawings in the Site Development and Drainage plan.

3.8 CONCRETE FINISHING

3.8.1Smooth concrete finishes by screeding and floating. The use of mechanical floating device is preferred.

3.8.2When the use of a mechanical floating and screeding device is not possible, ensure that hand power methods deliver consistent finishes, free from unwanted lumps.

3.8.3For float finishes, ensure that floating works begin only when bleed-water sheen is no longer visually present on the concrete surface. Check that the concrete of the surface being finished is stiff. Refer to technical working drawings whether the indicated area is dedicated as float finish.

3.8.4For burlap finishes, use damp burlap across float finished concrete. Ensure that the texture is uniformly installed.

3.8.5For fine textured-broom finish, use a soft bristle broom across float-finished concrete surface.

3.8.6For medium to coarse texture broom finish, use a soft bristle broom to etch 1.6mm to 3mm deep marks on the concrete surface.

3.8.7Check all technical working drawings for the appropriate application areas of respective concrete finishes.

3.8.8Check all planes and slope marks of the finishes.

3.8.9When finishing, ensure that the slope marks as indicated in the technical working drawings are followed. Avoid surfaces that allow for water accumulation unless indicated in the technical working drawings.

3.8.10 Check that the texture of the final finish is approved. Submit a mock-sample of the concrete finish to the designers and secure an approval prior to completion of work. Indicate the area of application.

3.8.11 Use an edging tool to round-finish edges of slabs, gutters, back top edge of curb, and formed joints. Round up to 12.7, radius unless otherwise indicated on the technical working drawings.

3.8.12 Eliminate all excess moisture or surface sheen on the concrete

3.9 CURING

3.9.1Do not allow any traffic on the concrete during first fourteen (14) days of curing.

3.9.2Refer to Division 3 provisions of this specification for specific curing methods depending on area of application.

3.10 REPAIRS AND PROTECTION

Ensure that all finished concrete surfaces are properly protected until acceptance of work. In case of damages and any chipping, repair all chipped or damaged portions. Use a bonding agent when repairing damages to ensure proper adhesion to the original concrete surface.

Make sure that all concrete surfaces are washed clean and free of stains, discolorations, dirt and other foreign material.

END OF SECTION

1. **PART 1 GENERAL**

1.1 RELATED DOCUMENTS

1.1.1 Technical Drawings
1.1.2 Specifications
1.1.3 Shop Drawings – Tile Setting Layout

1.2 SUMMARY

This section includes provisions and recommendations on the installation of unit pavers along parking areas and other areas as indicated in the technical working drawings.

1.3 RELATED SECTIONS

1.3.1 Concrete Finishes
1.3.2 Concrete Floor Topping

1.4 GENERAL PROVISION

1.4.1 For all unit pavers to be installed on site, submit an actual sample to the technical team for approval. Verify shape and pattern of concrete pavers on the working drawings. Submit product samples as per specified items on drawings. Refer to the technical drawings for the cut, pattern, design, material size and prescribed dimensions of the unit pavers if any.
1.4.2 If pavement unit designs available in the market significantly differ from the specified items, request for product substitution and justify. Products approved by IPFDU designers will prevail over specified unit designs.
1.4.3 Prior to complete installation, prepare a mock-up sample on site at least 1000mm X 1000mm and have it approved by the IPFDU prior to complete installation. Attach photos of the mock-up to the official request for approval and request for the architect and/or the architect's representative to see the actual mock-up. Refer to Division 01 for procedures on request for approval.
1.4.4 Verify all indications on the technical working drawings and issue Requests for Clarification in case of conflicting indications. Refer to Division 01 for procedures on requests for clarification.
1.4.5 Implement all unit paver works such that safe access is maintained on site, as required for construction and other activities. Zone the pavement works such that ample vehicular and pedestrian access is maintained on site to continue other construction activities.
1.4.6 Do not modify the surface texture of approved unit paver samples. Do not paint, polish or scratch the unit pavers installed on site such that its visual and compressive properties are substantially altered by the modification. Install unit samples as originally approved.

1.5 MAINTENANCE

1.5.1 In case of damages during installation, take care to remove the defective units and replace with fully functioning and visually acceptable units. Ensure that the replacement of unit pavers do not damage the adjacent pavers already installed.
1.5.2 Keep the installed pavements clean and free of discoloration, foreign substances, and other elements. In case of stained unit pavers, make sure to clean, wipe, and restore the stained units to its original surface quality.
1.5.3 For phased construction work, make sure to protect all completed pavement work subject to damages due to exposure to heavy equipment. Restore any damages incurred during construction work.

1.6 SUBMITTALS

1.6.1 PRODUCT APPROVAL ATTACHMENTS
1.6.1.1 Submit samples of unit pavers for approval. Refer to the technical working drawings for the indicated area of application. Label and code the samples according to the area of application. If the architect finds unacceptable and unapproved samples installed on site, these items are subject to re-work. Samples without proper are not acceptable.

1.6.1.2 Indicate the compressive capacity of the sample. Ensure that the sample submitted for approval is labeled as "for vehicular traffic" if the compressive capacity of the unit paver is suitable for heavy vehicular access. If the capacity of the sample submitted for approval is only for pedestrian traffic, indicate "for pedestrian traffic only" on the sample label. Check the technical working drawings and verify the appropriate area of application. In case of conflicts, submit a request for clarification. Refer to section "01 26 63 Requests for Interpretation.
1.6.1.3 Sample data showing compressive strength and water absorption capacity.
1.6.1.4 If the unit paver is concrete, submit data showing the concrete, water, and aggregate mixture proportioning.
1.6.1.5 If the unit paver is stone, submit data showing the abrasive Hardness of the stone, the compressive strength. Attach engineering test analysis results or compressive strength certifications for stone unit pavers.

1.6.2 EXECUTION APPROVAL ATTACHMENTS
1.6.2.1 Submit a detailed work methodology, indicating at least the following
1.6.2.1.1 Date and time of application
1.6.2.1.2 Area of application
1.6.2.1.3 Curing period and certifications of shortened curing periods by manufacturers, if any.
1.6.2.1.4 Shop drawings showing the tile layout, with complete indications on the start and end of the tile layout. Legibly indicate the sloping and drainage direction of surface water runoff. Be sure that shop drawing submittals are in the correct and legible scale. Include detailed shop drawings on the configuration of the paving unit, showing height, width, length, thickness dimensions, etc. for every unit paver design specified on site.
1.6.2.1.5 When using stone unit pavers on thresholds, stair units nosing, stair steps and risers, be sure to indicate in the shop drawings the mortar bedding method and the dimensions of the proposed lippage.

1.7 QUALITY ASSURANCE

1.7.1 Guarantee that installers are experienced and have successfully completed paver installations similar to the approved sample.
1.7.2 The contractor is responsible for sourcing the materials.
1.7.3 In case of multiple sources or suppliers, confirm and guarantee that the installed pavers are similar by seeking the approval of the design team through the assistance of the construction manager. When proposing to utilize unit pavers from a second source, submit both the existing sample on site from the original source, and the second sample from the new source. Label the samples properly and accordingly. Indicate areas of application and indicate whether the sample is for pedestrian or vehicular access. Repeat approval process for every new unit sample from a new source supplier, in case of multiple sources.
1.7.4 Install a mock-up at least 1000mm x 1000mm on site. Notify the architect at least one week in advance to request for a site visitation and have the mock up approved by the architect through a request for execution approval. Attach a photo of the mock-up the approval form. The photo should be properly labeled with the following information: (1) location of installation, (2) date of mock-up approval. Wrongly installed unit pavers without mock-up approvals will be subject to re-work.
1.7.5 When weather during unit paver work is extremely hot, ensure that the substrate or the area of application is cooled enough such that temperature and humidity conditions will not cause excessive evaporation of setting beds and grout. Do not install pavement units on wet areas.

1.8 DELIVERY STORAGE, AND HANDLING

1.8.1 When unit paver items are delivered on site prior to installation, ensure that the pavers are stored without any damages. Properly discard unit pavers with chipped corners, split pavers with hairline cracks, and other cracks that affect the quality of the unit both visually and strength-wise. Do not install defective unit pavers on site.
1.8.2 Stored unit pavers must be kept clean. Store unit pavers away from substances, i.e rain, chemicals, and other materials that can cause discoloration and disintegration on the pavement units affecting its strength and visual quality.
1.8.3 Store grout and mortar materials in areas where it will not be damaged by excessive moisture content and unfit temperature. Keep the storage location of mortar and grout materials dry, or enclose the items in water proof containers.
1.8.4 If using combustible grout and mortar materials, ensure that the storage location of items on site are away from fire, heat, or other flammable conditions.
1.8.5 The contractor is responsible for replacing unusable items due to damages incurred during site storage.

2. PART 2 PRODUCTS

2.1 PEDESTRIAN CONCRETE PAVERS

2.1.1 Concrete mix used for pavers is a mixture of Portland Cement Type II or Type III, Fine and Course Aggregates at ASTM 33.
2.1.2 Concrete strength shall be 20Mpa (3000-psi) compressive strength attained at 28 days of curing, ASTM C 39
2.1.3 Water absorption maximum 5%

2.2 VEHICULAR CONCRETE PAVERS

2.2.1 Verify shape and pattern of concrete pavers on the architectural working drawings.
2.2.2 Concrete mix used for pavers is a mixture of Portland Cement Type II or Type III, Fine and Course Aggregates at ASTM 33.
2.2.3 Concrete strength shall be 55Mpa (8000-psi) compressive strength attained at 28 days of curing, ASTM C 39.
2.2.4 Water absorption maximum 5%

2.3 STONE UNIT PAVERS FOR VEHICULAR TRAFFIC

2.3.1 Ensure that all stone unit pavers for vehicular traffic are at least 750mm thick, unless otherwise indicated on the drawings.
2.3.2 For, stone unit pavers under 750mm thickness but with compressive capacity equal or greater to 55MPa (8000-psi), submit product data certifying the compressive strength and submit engineering/test analysis if any.
2.3.3 Ensure that the minimum abrasive hardness of stone unit pavers are at 12.0 unless otherwise indicated in the technical working drawings.
2.3.4 Check technical working drawings to verify stone patterns. Submit samples that are exact or nearest to the required color, size, dimensions, and properties of each stone unit paver as indicated on the drawings.
2.3.5 Check joint width between stones in accordance to the technical working drawings. If not indicated, submit a request for clarification to the architectural design team.
2.3.6 Ensure ASTM conformance of stone unit pavers as follows:
2.3.6.1 Granite: ASTM C615; verify dimensions on area of application as indicated in technical working drawings.
2.3.6.2 Limestone: ASTM C568; verify dimensions on area of application as indicated in technical working drawings.
2.3.6.3 Marble: ASTM C503; verify dimensions on area of application as indicated in technical working drawings.
2.3.6.4 Quartz-based Stone: ASTM C616; verify dimensions on area of application as indicated in technical working drawings
2.3.6.5 Slate: ASTM C629; verify dimensions on area of application as indicated in technical working drawings.
2.3.6.6 Serpentine: ASTM C1526; verify dimensions on area of application as indicated in technical working drawings.
2.3.6.7 Travertine: ASTM C1527; verify dimensions on area of application as indicated in technical working drawings.

2.4 PORTLAND CEMENT MORTAR SETTING BED

2.4.1 Verify the correct area of application in the technical working drawings. In case of queries, submit appropriate requests for clarification.
2.4.2 Use Portland Cement ASTM C 150 Type I or Type II.
2.4.3 Use Hydrated Lime ASTM C 207, Type S of ASTM C207. When using hydrated lime, be sure to wet out the lime in the mixing procedure. Check the execution requirements for lime mixing.
2.4.4 Use aggregates complying to ASTM C 144.
2.4.5 Use potable water that is free of oils, acids, alkalis, salts, organic materials or other substances that are damaging to mortar or any metal in the wall.
2.4.6 When using reinforcing wire fabric, use galvanized welded wire fabric 100mm X 100mm (W1.4/W1.4), ASTM A 185.

2.5 MORTAR MIXES

2.5.1 Use Portland Cement/Lime Setting-bed Mortar, Type M of ASTM C 270 with at 2500psi.
2.5.2 Ensure high compressive strength of the mortar mix to avoid re-works and breakage on site.

2.6 ACCESSORIES

2.6.1 Use tile spacers when possible to ensure consistency of distances.

2.6.2 Assume 5mm grout thickness, unless otherwise indicated on the technical working drawings. Verify grout-grout distances on the technical working drawings.

3. PART 3 EXECUTION

3.1 PROJECT CONDITIONS

Ensure that on-site weather is suitable for unit paver works. Do not install unit pavers during extremely hot weather conditions in order to ensure good quality of work. Use industrial cooling fans and other appropriate cooling methods on site to ensure that the temperature of the substrate is ready for accepting the mortar setting beds and unit pavers. Do not apply mortar to substrates with temperatures of 38 degree C (100 degree F) and above.

Contractor must keep traffic off the completed installation works for at least 48 hours, unless otherwise required or certified by the unit paver manufacturer.

3.2 PREPARATION

Make sure that substrates and areas subject for work are free of dirt dust, debris, and loose particles. Sweep, vacuum, or wash the substrate area clean prior to application. When washing the substrate clean, take care to remove any excessive amounts of water from the surface before beginning mortar setting and unit paver layout.

3.3 INSTALLATION, GENERAL

3.3.1 Allowable grouting between units is from 0mm minimum to maximum 5mm.
3.3.2 Use motor-driven masonry equipment when cutting unit pavers.
3.3.3 Ensure that modified pavement units are cleanly and sharply cut, and free of unchipped edges.
3.3.4 Double-check the patterns and cut the units accordingly to fit and match the ***approved*** tile layout.
3.3.5 For portions of the pattern requiring full units, use full unit pavers. Do not adjoin cut pavers to make one full unit.
3.3.6 Do not hammer cut the units to avoid chipping and wastage.
3.3.7 For unit pavers adjoining curbs, slabs, and other homogenous surfaces, do not exceed 1mm vertical flush or lippage to the abutting faces, especially for pavement areas with pedestrian access. Ensure that the finish surfaces are level and following the slope requirements indicated in the technical working drawings.
3.3.8 For stone pavers,

3.4 REPAIR, POINTING, CLEANING, AND PROTECTION

3.4.1 Neatly remove excess grout from exposed surfaces. Scrub and wash the surfaces clean and take care not to damage the original surface condition of the unit pavers.
3.4.2 Point the grout following the requirements of the technical working drawing. For flush pointing, ensure that the grout is level with the unit pavers allowing for no more than 0.20mm lippage. For bucket handle, recessed, and weather struck pointing, a maximum depression of up to 0.30mm is tolerable, unless otherwise indicated in the technical architectural drawings.
3.4.3 Protect all completed unit pavement work so that it stays free of damages.
3.4.4 Remove and replace all unit pavers damaged during installation.

END OF SECTION

DIVISION 03
CONCRETE

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1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

1.1.1 Technical Architectural Drawings
1.1.2 Specifications
1.1.3 Shop Drawings – Setting Layout

1.2 SUMMARY

This section includes provisions and recommendations on cast-in-place and pre-cast concrete works with both architectural and structural purposes, foundations, floors and slabs on grade, equipment pads and anchors, light pole bases, thrust blocks, manhole bases, pits and vaults.

Architectural precast works include pre-cast partitions for interiors, wall panels, concrete pads for mechanical equipment, wheel stops, interior precast concrete as indicated in the Architectural technical working drawings.

Verify instructions for specialized architectural concrete elements particularly statues, concrete louvres and any architectural element with specialized aesthetics. For specialized architectural concrete elements, refer to specifications on technical working drawings or to the specifications of a designated designer if any.

Control, expansion and contraction joint devices associated with concrete work not part of pavement work, including joint sealants, are also discussed in this section.

1.3 RELATED SECTIONS

1.3.1 Concrete Pavement
1.3.2 Concrete Finishes
1.3.3 Concrete Floor Topping
1.3.4 Final Cleaning

1.4 GENERAL PROVISION

1.4.1 Ensure that all concrete mixes follow the specifications of structural designers and architects.
1.4.2 Verify all indications on the technical working drawings and issue Requests for Clarification in case of conflicting indications.
1.4.3 Do not modify the appearance, strength, and durability of the concrete architectural elements without any approval issued by the architect of record and the structural designer of record. Submit a request for approval for any modifications proposed. Any modifications found on site without corresponding approvals are subject to re-work at the expense of the contactor.
1.4.4 Do not modify designs as indicated in the drawings. If modifications are necessary due to actual site conditions, submit shop drawings and annotate reasons for modification. Take care to highlight and explain the portion to be modified by indicating annotated technical drawing clouds.
1.4.5 Comply with all local codes and ordinances governing the project site. If the local standards are more stringent or conflicting with that indicated on drawings, submit a request for clarification and indicate the code or cause of conflict. Do not implement any such code standards without verifying with the architect.
1.4.6 Secure an official advice from the Architect via a Request for Clarification prior to implementing any work that deviates from the technical working drawings.
1.4.7 Implement all concrete casting work such that safe vehicular and pedestrian access is retained and maintained on site, as required for construction and other activities.
1.4.8 Always use form-release agents on formwork surfaces prior to concreting. Refer to the formworks portion of this section.

1.4.9 Contractor may request for design mix substitution to be approved by the structural designer. Refer to the Section 01225 13 Product Substitution Procedures of this specifications for product substitution procedures.
1.4.10 Never overlay fresh concrete on existing concrete found on site unless otherwise approved by the structural consultant. Refer to the execution portion of this section for instructions on batch-laid concrete casting. Ensure that the maximum strength of the concrete is attained. Submit concrete samples subject to laboratory test work. Refer to submittal attachments required for details.
1.4.11 For exposed concrete finishes with specialized texture and color, secure an approval of the final finish from the architect of record. Refer to Division 03 35 0 Concrete Finishes.

1.5 MAINTENANCE

1.5.1 Maintain the quality of poured concrete surfaces as indicated and make sure that removal of forms do not tarnish, destroy, or impair the concrete surface.
1.5.2 Keep the casted concrete free of discoloration, foreign substances, and other elements.
1.5.3 Keep pre-cast concrete delivered on site free of discoloration, foreign substances, and other elements. Refer to the delivery, storage, and handling portion of this Section for details.
1.5.4 In case of damages or surface alterations as a result of on-going construction work and other similar activities that modify the qualities of the concrete after pouring, ensure that the quality of the concrete surface is restored according to indications on the technical working drawings or by the approved shop drawings before final turnover.

1.6 SUBMITTALS

1.6.1 PRODUCT APPROVAL ATTACHMENTS
1.6.1.1 Submit manufacturer's product data, particularly application and installation instructions for cement, cementitious materials, additives, admixtures, bearing pads, and other materials used. Submit material certificates as signed or certified by manufacturers.
1.6.1.2 For concrete surfaces subject to weather exposure and surface water run-off, submit the manufacturer's data of the approved waterproofing material. Include manufacturer's application and installation instructions for waterproofing, particularly data on concrete surface finish and conditions as needed.
1.6.1.3 Submit mix design for each concrete mix to be used.
1.6.1.4 Submit a minimum of three properly labeled samples of each concrete mix delivered on site and for every mix approved by the designers.
1.6.1.5 Submit separate sample cylinders for every 115 cubic yards of concrete mix delivered.
1.6.1.6 Label all concrete cylinder submittals properly and submit laboratory test reports indicating the concrete mix performance for every 7th, 21st, and 28th day of curing. Laboratory test results should include:
1.6.1.6.1 Slump requirement
1.6.1.6.2 Air content requirement
1.6.1.6.3 Project number
1.6.1.6.4 Project name
1.6.1.6.5 Project location
1.6.1.6.6 Area of application (Indicate in drawings)
1.6.1.6.7 Sample date
1.6.1.6.8 Cure type
1.6.1.6.9 Actual slump according to test
1.6.1.6.10 Actual air content according to test
1.6.1.6.11 Unit Weight (Fresh)
1.6.1.6.12 For areas with exterior exposure, indicate water absorption test results.

1.6.2 EXECUTION APPROVAL ATTACHMENTS
1.6.2.1 Detailed work methodology, indicating at least the following
1.6.2.1.1 Date and time of application
1.6.2.1.2 Area of application
1.6.2.1.3 Restoration and cleaning procedures upon completion of work.
1.6.2.1.4 Shop drawings showing fabrication details, for items i.e. concrete railings, if any, wheel stoppers, and other similar architectural elements. Include plans, elevations, shapes and cross-sections in drawings. All drawings must be properly labeled, drawn to scale, and complete with dimensions. Include reinforcement details, locations, tolerances,

and dry joint treatments if casting is in multiple phases. If the architectural concrete will be accepting veneer, i.e. stone units, indicate relationship of architectural pre-cast concrete units to adjacent materials.

1.6.2.1.5 On shop drawings submitted with proposed modifications, clearly indicate modifications through drawing clouds.

1.7 QUALITY ASSURANCE

1.7.1 Comply with ACI 117-90 for Tolerances for Concrete Construction and Materials, unless otherwise indicated on drawings and specifications.

1.7.2 Unless, otherwise specified by the designer, comply with ACI 301 for specifications for Structural Concrete for Buildings.

1.7.3 Comply with field-testing requirements as specified in ACI 301.

1.7.4 Ensure that testing agencies for field tests of concrete samples as required shall be by an ACI Concrete Field Testing Technician Grade I certified in accordance with ACI CPI or equivalent. Ensure that testing agencies are independent and qualified according to ASTM C 1077 and ASTM E 329.

1.7.5 For pre-cast architectural concrete fabricated off site, ensure that the fabricator is experienced in producing architectural pre-cast concrete units similar to items specified in the project.

1.7.6 Measure the fresh concrete temperature at the point and time of discharge in accordance with ASTM C 1064/C1064M. Frequency of temperature determination shall be in accordance with ASTM C 94/C 94M and at the option of the inspector.

1.7.7 When working in hot weather, ensure that the temperature of freshly produced concrete at discharge will not exceed the maximum allowable concrete temperature as specified by structural designers or herein specified standards.

1.7.8 Reduce hot temperatures on site bay casting shade on aggregate stockpiles, sprinkling water on coarse aggregate stockpiles; using chilled water for concrete production; substituting chipped or shaved iced for portions of the mixing water; and cooling concrete materials using liquid nitrogen. Submit work methodologies on concrete cooling methods that will be used. Indicate the order of initiation in the case of multiple methods.

1.7.9 For pre-mixed concrete freshly delivered on site, ensure that deliveries are in accordance with ASTM C 94/C 94M. As such, discharge pre-mix fresh concrete within 1-1/2 hours or before the truck-mixer drum has revolved 300 revolutions, whichever comes first.

1.7.10 Conduct concrete placement and finishing operations as quickly as on-site conditions will allow.

1.7.11 In hot weather, control concrete surface bleed-water evaporation with application of evaporation reducers, plastic sheeting fog spray, or wind breaks. Use materials and method in accordance with ACI 308.1

1.7.12 Cure concrete in accordance with ACI 308.1. Maintain curing conditions until specified levels of durability in the concrete have been achieved. Apply ACI 308R "Standard Practice for Curing Concrete", unless otherwise specified.

1.7.13 The Contractor is required to provide impermeable, watertight concrete and joints in structures and divider walls designed to hold water or other solution.

1.7.14 Repair honeycomb, cracks and such imperfections developed in casted concrete at the Contractor's expense until such is approved. Concrete work or joints with imperfections that cannot be successfully repaired are subject to rework at the contractor's expense.

1.7.15 Test concrete surfaces exposed to surface water run-off by filling each basin, tank, or compartment with water to within one 300mm of the top of the structure. If the water level in the basin, tank or compartment being tested falls more than 25mm in 24 hours, determine and repair the cause of leakage until water tightness is achieved.

1.7.16 All repair work required as a result of the tests for water-tightness shall be the Contractor's expense.

1.8 PERFORMANCE REQUIREMENTS

1.8.1 FIRE PERFORMANCE RATING

1.8.1.1 Comply with 1 hour fire resistance rating for party walls and corridor walls.

1.8.1.2 Comply with 2 hour fire resistance rating for fire-barrier walls, particularly vertical fire exits and shafts.

1.8.1.3 Comply with requirements of the governing Fire Code of the Philippines (RA 9514) and the Philippine Building Code (PD 1096).

1.8.2 STRUCTURAL PERFORMANCE

1.8.2.1 Ensure compliance of load requirements for dead load, live loads, seismic loads, and other applicable loads as computed and designed by the Structural consultant and designers.

1.8.2.2 Provide positive anchorage for pre-cast, pre-fabricated architectural concrete attached to the building. Anchorage details must be properly evaluated and approved by qualified professionals and structural designers.

1.8.2.3 Ensure compressive strength of 7.0 to 10.5Mpa unless otherwise stated in specifications by structural designers.

1.8.2.4 Check concrete weight at 185.53 to 307.59 kg/sqm unless otherwise specified or approved by structural designers.

1.8.3 TERMITE RESISTANCE

Ensure that concrete walls are free of cracks, such that termite entry is prevented.

1.8.4 MOLD RESISTANCE RATING

Ensure that all concrete elements and walls are properly treated such that walls are free of food sources that encourage mold growth.

1.8.5 SOUND PERFORMANCE RATING

If possible, attain 51 to 62 Sound Transmission Class (STC) in decibels (dB).

1.8.6 ZOCALO

Provide 100mm high reinforced concrete upstand zocalo at floor level for all toilet and kitchen applications, and where indicated by the architect. Provide proper anchorage and ensure waterproofing requirements. Refer to Division 7 Thermal and Moisture Protection.

1.8.7 VISUAL APPEARANCE OF CONCRETE WALLS

All finished concrete surfaces should be consistent in appearance unless otherwise indicated in the technical working drawings.

1.9 DELIVERY AND STORAGE

1.9.1 Store all raw materials, equipment, and accessories for cast-in-place concrete in an organized manner such that it doesn't obstruct any on-going construction works.

1.9.2 Allocate proper spaces in anticipation of pre-mixed concrete delivery trucks. Time the delivery so as not to obstruct other on-going construction works, and day-to-day activities within the project site vicinity.

1.9.3 Store pre-cast concrete units properly to prevent contact with soil, staining, cracking, distortion, warping, or other physical damage.

1.9.4 Organize stored pre-cast units so labels are clearly visible and items are easily identifiable. Avoid arrangement of pre-cast units that could cause cracking or damage.

1.9.5 Arrange on-time delivery of architectural precast concrete units in quantities and at times that does not disrupt agreed construction schedule.

1.9.6 During delivery, take care to protect pre-cast units during shipment on non-staining shock-absorbing material. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that could cause cracking or damage.

1.9.7 Lift, transport, and handle the transfer of units to the installation site properly such that items are kept free of deformities.

1.10 WARRANTIES

Ensure a Five (5) year warranty for all interior pre-cast concrete items and ten (10) years for exterior concrete specified under this section, for protection against water penetrations, air penetrations, sealant disengagement, falling-off of surface finish resulting to breakdown in weather-tightness and thermal resistance; failure on mold, termite and seismic resistance. Warranty count shall begin from date of substantial completion and project turnover.

2. PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 CEMENTITIOUS MATERIALS

2.1.1.1 Use Portland Cement: ASTM C 150, Type I or III, standard gray or white cement.

2.1.1.2 Do not use fly ash and gray silica fume for exposed exterior surface applications.

2.1.1.3 Limit use of fly ash to 20 to 40% replacement of Portland cement by weight; ground granulated blast-furnace slag to 15 to 25% of Portland cement by weight; and metakaolin and silica fume to 10% of Portland cement by weight.

2.1.1.4 When using fly ash, comply with ASTM C 618, Class C or F with maximum loss on ignition of 3%.

2.1.1.5 When using metakaolin, comply with ASTM C 618, Class N.

2.1.1.6 When using Silica Fume, comply with ASTM C 1240 with optional chemical and physical requirements.
2.1.1.7 When using coloring admixtures, comply with ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures. Use non-fading color admixture. Check stable temperature.
2.1.1.8 Ensure that chemical admixtures are certified by manufacturers as compliant and compatible with other admixtures. Components of admixtures cannot contain calcium chloride or more than 0.15% chloride ions or other salts by weight of admixture.
2.1.1.9 When using water-reducing admixture, comply with ASTM C 494/ C 494M, Type A.
2.1.1.10 When using, Retarding Admixture, comply with ASTM C 494/ C 494M, Type B.
2.1.1.11 When using, Water-Reducing and Retarding Admixture, comply with ASTM C 494/ C 494M, Type D.
2.1.1.12 When using, Water-Reducing and Accelerating Admixture, comply with ASTM C 494/ C 494M, Type E.
2.1.1.13 When using, High-Range, Water-Reducing Admixture, comply with ASTM C 494/ C 494M, Type F.
2.1.1.14 When using, High-Range, Water-Reducing and Retarding Admixture, comply with ASTM C 494/ C 494M, Type G.
2.1.1.15 When using plasticizing Admixture to increase plasticity of concrete, comply with ASTM C 1017/ C 1017M.

2.1.2AGGREGATES
2.1.2.1 Source aggregates from a uniform supplier or ensure that the quality of aggregates for use are consistent and in accordance with specifications.
2.1.2.2 Comply with PCI MNL 117, ASTM C 33, for normal weight coarse aggregates Class 5S requirements. Provide and stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
2.1.2.3 Check that selected coarse Aggregates are hard, durable; free of material that reacts with cement or causes staining; to match selected finish sample.
2.1.2.4 Check that selected fine Aggregates, natural, or manufactured sand are of a material compatible with coarse aggregate selected to match selected sample finish.
2.1.2.5 Check that backup concrete aggregates comply with ASTM C 33 or C 330.
2.1.2.6 Comply with PCI MNL 117, ASTM C 330, for light weight aggregates. Check that absorption less than 11%.

2.1.3WATER
Use potable water free from any deleterious materials affecting color stability, setting, durability or strength of concrete. Check that the resulting concrete will comply with ASTM C 1602/ C 1602M within chemical limits of PCI MNL 117.

2.1.4STEEL, PLATES, ANGLES, ANCHORS, AND EMBEDMENTS
2.1.4.1 When using Carbon-Steel Shapes and Plates, comply with ASTM A 36 / A 36M.
2.1.4.2 When using Carbon-Steel Headed Studs, comply with ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1 / D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
2.1.4.3 When using Carbon-Steel Plate, comply with ASTM A 283 / A 283M.
2.1.4.4 When using Malleable Iron Castings, comply with ASTM A 47 / A 47M, Grade 32510 or 35028.
2.1.4.5 When using Carbon-Steel Castings, comply with ASTM A 27 / A 27M, Grade 60-30 (Grade 415-205).
2.1.4.6 When using High-Strength, Low-Alloy Structural Steel, comply with ASTM A 572 / A 572M.
2.1.4.7 When using Carbon-Steel Structural Tubing, comply with ASTM A 500, Grade B or C.
2.1.4.8 When using Wrought Carbon-Steel Bars, comply with ASTM A 675 / A 675M, Grade 65 (Grade 450).
2.1.4.9 When using Deformed-Steel Wire or Bar Anchors, comply with ASTM A 496 or ASTM A 706 / A 706M.
2.1.4.10 When using Carbon-Steel Bolts and Studs, comply with ASTM A 307, Grade A or C (ASTM F 568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A 563 / A 563M, Grade A); and flat, unhardened steel washers (ASTM F 844).
2.1.4.11 When using Studs, include stud stock and threaded bolts.
2.1.4.12 When using High-Strength Bolts and Nuts, comply with ASTM A 325 / A 325M or ASTM A 490 / A 490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel units, (ASTM A 563 / A 563M) and hardened carbon-steel washers (ASTM F 436 / F 436M). Use high-strength bolts for friction-type connections between steel members. Do not high strength bolts between steel and concrete to avoid concrete creep and crushing. As per ASTM A 490 / A 490M do not use galvanized bolts.
2.1.4.13 Non-galvanized steel items shall be of Shop-Primed Finish, except those surfaces to be embedded in concrete and as such shall comply according to requirements in Steel Structures Painting Council, Surface Preparation SSPC-SP3 and shop-apply lead-and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

2.1.4.14 When using Zinc-Coated Finish for steel items in exterior walls and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123 / A 123M, after fabrication, ASTM A/ A 153M, or ASTM F 2329 as applicable or electro-deposition according to ASTM B 633, SC 3, Type 1 and 2 and F 1941 and F 1941M.
2.1.4.15 For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03% or to between 0.15 and 0.25% or limit sum of silicon content and 2.5 times phosphorous content to 0.09%.
2.1.4.16 Galvanizing Repair Paint: High zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20. Comply with manufacturer's requirements for surface preparation.

2.1.5CONCRETE MIX
2.1.5.1 READY-MIX CONCRETE
2.1.5.1.1 The Contractor is solely responsible for amount of water added and resulting strength of concrete. If concrete strength does not conform to 28 day compressive strength requirements, it shall be removed and replaced at no cost.
2.1.5.1.2 Comply with requirements of ASTM C94, with the following exceptions:
2.1.5.1.2.1 During hot or cold weather conditions affecting the compressive strength of the concrete upon the 28th day of curing, only add or remove water to the mix with the approval of the structural designers and engineers.
2.1.5.1.2.2 When air temperature is between 85o F and 90oF, reduce mixing and delivery time from 90 to 75 minutes.
2.1.5.1.2.3 When air temperature is above 90oF, reduce mixing and delivery time to 60 minutes.

2.1.5.2 DESIGN CONCRETE MIXES
2.1.5.2.1 Provide normal weight concrete with the following properties, as indicated on applicable details:
5,000 psi 28-day compressive strength. (Type II Cement).
4,000 psi 28-day compressive strength. (Type II Cement).
3,000 psi 28-day compressive strength. (Type II Cement).
2.1.5.2.2 For Slump Limits, proportion and design mixes to result in concrete slump at point of placement as follows:
Reinforced foundation systems and treatment tanks — Not less than 1 inch or more than 4 inches.
Concrete with high range water reducing admixtures — Not more than 8 inches.
Ramps and sloping surfaces — Not more than 4 inches.
Slabs and floors - Not less than 1 inch and not more than 3 inches.
Miscellaneous Concrete — Not less than 1 inch and not more than 4 inches.
2.1.5.2.3 The maximum permissible water-cement ratio will be as follows:
5,000 psi concrete — maximum water/cement = 0.40
4,000 psi concrete — maximum water/cement = 0.45
3,000 psi concrete — maximum water/cement = 0.50
2.1.5.2.4 The minimum cement content utilized for the concrete mix design shall be as follows:
5,000 psi concrete — 715 pounds per cubic yard.
4,000 psi concrete — 611 pounds per cubic yard.
3,000 psi concrete — 564 pounds per cubic yard.

2.1.6GROUT MATERIALS
2.1.6.1 When using sand-cement grout, use Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement.
2.1.6.2 When using non-metallic, non-shrink grout, use pre-mixed, packaged non-ferrous aggregate, noncorrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing admixtures, complying with ASTM C 1107, Grade A for dry-pack and Grades B and C for flowable grout and of a consistency suitable for application within a 30-minute working time.
2.1.6.3 When using Epoxy-Resin Grout, use two-component mineral-filled epoxy-resin complying with ASTM C 881/ C 881M to suit type, grade, and class requirements as specified.

2.1.7FORMWORK
2.1.7.1 Use standard form materials, i.e. plywood, metal, metal-framed plywood, phenolic boards, and other standard form materials available in the market.
2.1.7.2 When curved surfaces are indicated on the technical working drawings, ensure the use of flexible forms or curves.

2.1.7.3 All forms must be attached with a commercially formulated form-release agent that does not damage the resulting concrete surface.
2.1.7.4 Store formworks to minimize task hazards, i.e. tripping, unnecessary deformation and damages to formworks.
2.1.7.5 Provide appropriate bracing to formworks to avoid warping and other deformations detrimental to the quality of the resulting concrete surface.
2.1.7.6 Erect formworks systematically and progressively such that it is stable and safe.
2.1.7.7 Whether using traditional or modular formwork systems, comply with loadings and general principles of formwork erection according to ACI 347: Guide Formwork for Concrete.
2.1.7.8 Use formwork materials and equipment fit for the intended purpose and design of the concrete item being cast.
2.1.7.9 Unless otherwise specified by the structural engineer, follow a safety factor of 2.0 in the design and implementation of all formwork accessories, except formwork anchors supporting form weight, concrete pressures, wind loads, construction personnel live loads.
2.1.7.10 For formwork supporting form weight, concrete pressures, wind loads, personnel live loads, use Safety Factor 3.0.

3. PART 3 EXECUTION

3.1 MOCK-UPS

3.1.1 Construct full-sized mockups to verify selections approved via sample submittals.
3.1.2 Build mock-ups in the location and of the size indicated in the technical working drawings.
3.1.3 Notify architect in advance to secure mock-up approvals prior to implementation.
3.1.4 During construction, maintain mock-ups so as not to incur any damages during construction.
3.1.5 Demolish and remove mock-ups if found unacceptable, or if directed by written notice.

3.2 EXAMINATION AND PREPARATION OF WORK AREA

3.2.1 Verify that subsurface and field conditions are acceptable and ready to receive work. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
3.2.2 Verify requirements for concrete cover over reinforcement.
3.2.3 Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete. In case of inconsistencies in drawings, submit a request for clarification.
3.2.4 Do not place concrete against surfaces of absorbent materials that are dry.
3.2.5 Do not place concrete against surfaces that have free water.
3.2.6 Prepare all materials required for accepted evaporation control measures and have them available on site so that specified measures can be executed as needed. Initiate accepted evaporation control measures when concrete and air temperatures, relative humidity of the air, and the wind velocity have the capacity to evaporate water from a free water surface at a rate that is equal to or greater than 1000 sq.m per hour, unless otherwise specified.
3.2.7 Inspect and complete formworks, reinforcing steel, and items to be embedded or cast-in-place.
3.2.8 ***Notify other trades to check slope, degrees, and positioning of conduits and other embedment, and secure approval from involved trades prior to casting.***
3.2.9 Install homogenous vapor barrier under interior slabs on grade. If using multiple sheets, lap joints should be minimum 150 mm and seal with watertight sealant applied between overlapping edges and ends.
3.2.10 In case of damaged vapor barriers during casting, repair remaining vapor barrier with 150 mm laps over damaged seal watertight.

3.3 PLACING CONCRETE

3.3.1 GENERAL PROVISIONS
3.3.1.1 Place concrete in accordance with ACI 301, ACI 304, ACI 305, ACI 306 and ACI 318.
3.3.1.2 Ensure approved reinforcement, inserts, embedded parts, and formed expansion and contraction joints are not disturbed during concrete placement.
3.3.1.3 Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken for each structural pour.

3.3.1.4 Place concrete continuously between predetermined expansion, control, and construction joints. Do not interrupt successive placement; do not permit cold joints to occur.

3.3.2 CONCRETE CAST IN FORMS
3.3.2.1 Deposit concrete into forms continuously or up to thickness levels and layers such that no concrete will be placed on concrete which has hardened to cause formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
3.3.2.2 Deposit concrete in forms in horizontal layers not deeper than 600mm. Avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
3.3.2.3 Use mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping, to consolidate placed concrete. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
3.3.2.4 Do not use vibrators to transport concrete inside forms.
3.3.2.5 Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of machine. Consolidate placed layers and at least 150mm into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

3.3.3 CONCRETE CAST IN SLABS
3.3.3.1 Deposit and consolidate concrete slabs in a continuous operation, within accepted standard limits of construction joints, until the placing of a panel or section is completed.
3.3.3.2 Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3.3.3.3 Bring slab surfaces to correct level with straightedge and strike off. Refer to correct levels and slope requirements as indicated in the technical working drawings. Double check and verify the surface finish requirements and finish the concrete surface accordingly such that it is ready to accept the finish as specified in the technical working drawings.
3.3.3.4 Use bull floats to smooth surface, free of humps or hollows.
3.3.3.5 Do not disturb slab surfaces prior to beginning finishing operations.

3.4 CONCRETE FINISHES

3.4.1 Request for an execution approval from designers to clarify concrete finish if not clearly indicated in the technical working drawings floor and wall finish plan. Include shop drawings showing plans, elevations, and sections, clarifying the final finish for all textures.
3.4.2 Upon removal of forms, maintain concrete surfaces in form-finish and refer to the technical working drawings Floor and Wall finish schedule, and Concrete Finishes section of this Division for surface finish specifications and appropriate area of application.
3.4.3 Repair and patch concrete surfaces defected due to formworks, i.e. tie patches and tie holes, and other defective portions, i.e. excessive honeycomb or damages on the concrete surface caused by embedded debris.
3.4.4 When working patches, utilize the appropriate concrete adhesive to ensure durable patchwork and comply with ACI 301, or until the work is approved and accepted.
3.4.5 Commence surface work within 24 hours of form removal. Moisten concrete surfaces and smoothen with an abrasive tool until a uniform color and texture is produced.
3.4.6 Un-exposed concrete finishes, i.e. areas for water cistern, may be maintained as form-finished, unless otherwise indicated in the technical working drawings. Repair areas affected by form-facing materials such as tie holes. Repair and patch defective areas so as to avoid detrimental water seepage. Use concrete adhesives in all patchworks.
3.4.7 For Horizontal surfaces, i.e. tops of walls, horizontal wall offsets and surfaces occurring adjacent to formed surfaces, verify form finish as indicated on the technical working drawings. Attach shop drawings to request for clarifications if not indicated.
3.4.8 On monolithic slab surfaces to receive membrane or elastic waterproofing, membrane or elastic roofing, verify instructions with manufacturer of the approved waterproofing material. Attach manufacturer's recommendations for concrete finish on the request for execution approval. Refer to waterproofing specifications

divisions for performance requirements of waterproofing membrane for approval. Submit waterproofing material approval prior to commencement of concrete casting for surfaces subject to waterproofing. Allot proper time schedules so as not to affect timely delivery of work.

3.4.9 After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven or manual floats. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.

3.4.10 Check and level surface plane to a tolerance not exceeding 5mm in every 1meter, unless otherwise specified on the drawings and the Concrete Finish section of this Division. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. For horizontal surfaces with critical drainage slope requirements, i.e. slab on grade with drainage inlets, roof slabs with roof drainage, canopies, toilets and baths, slab work in exterior corridors, and other surfaces with exposure to wet weather, ensure precision in sloping such that surface water will run-off to the desired direction as indicated on the drawings.

3.4.11 For flooring and walls with specific finish plans, verify the wall and floor finish floor plans to check appropriate concrete finish as specified in the Concrete Finishes Section of this specifications and the technical working drawings.

3.5 SURFACE SEALING

Comply with Division 03 Section 03 35 0 Concrete Finishes.

3.6 PROTECTION OF WORK

Protect the concrete against thermal shrinkage cracking due to rapid drops in concrete temperature greater than 22 °C (40 °F) during the first 24 hours unless otherwise specified. Acceptable protection materials to prevent excessive temperature drops are insulating blankets, batt insulation with moisture-proof covering, layers of dry porous material such as straw, hay, or multiple layers of impervious paper meeting ASTM C 171. Do not apply protection materials until the concrete surface temperature has become steady or is beginning to decline.

3.7 CLEANING

3.7.1 Comply with Division 01 Section 01 17 10 Final Cleaning.

3.7.2 Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to installation.

3.7.3 Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

3.7.4 Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, dirt, stains and other markings.

3.7.5 Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.

3.7.6 Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.8 JOINT SEALING

3.8.1 Joint sealing between pre-cast concrete and concrete cast-in-place. Separate slabs on grade from vertical surfaces with isolation joint material. Place joint filler in floor slab pattern. Set top to required elevations. Secure to resist movement by wet concrete. Extend joint filler from bottom of slab to within ¼ inch of finished slab surface. Install joint devices in accordance with manufacturer's instructions. Install joint device anchors. Maintain correct position to allow joint cover to be flush with finished surfaces. Install joint covers in longest practical length, when adjacent construction activity is complete.

END OF SECTION

1. PART 1 GENERAL

1.1 RELATED DOCUMENTS

1.1.1 Technical Architectural Drawings

1.1.2 Specifications

1.1.3 Schedule of Finishes

1.1.4 Shop Drawings — Tile Layout

1.2 SUMMARY

Refer to this section parallel to the schedule of floor and wall finishes as indicated in the technical working drawings. This section includes concrete finish provisions in preparation of the final finished surfaces of the project.

1.3 RELATED SECTIONS

1.3.1 Concrete Pavement

1.3.2 Concrete Floor Topping

1.3.3 Thermal and Moisture Protection

1.4 GENERAL PROVISION

1.4.1 Perform patching, when permitted, in compliance with applicable provisions of the Structural Specifications.

1.4.2 Ensure that concrete surface conditions are appropriate and compliant to the requirements of the material for final application on the indicated surface area. Check the Wall and Floor Finishes on the architectural working drawings to identify areas of coverage. Submit Requests for Clarifications in case of queries.

1.4.3 On areas requiring specific concrete finishes to accommodate the final finishing material such as homogenous tiles, pavements, and the like, comply with the concrete surface condition requirements by the manufacturer of the approved finish material. Refer to the manufacturer's printed instructions.

1.4.4 Allow concrete to cure not less than seventy-two (72) hours before commencing surface finish work, unless otherwise acceptable to the Architect or as prescribed by the manufacturer of the final finishing material.

1.4.5 Provide the following concrete finishes appropriate to the requirements of the Schedule of Finishes and Materials:

1.4.5.1 Troweled

1.4.5.2 Floated

1.4.5.3 Brushed

1.4.5.4 Broomed.

1.4.5.5 Fair-faced finish (Rubbed).

1.4.5.6 Straight to finish structural slab and power floated.

1.4.5.7 Smooth form finish

1.4.5.8 Sand Washed Finish

1.4.5.9 Other finishes necessary in conjunction with the required floor finishes.

1.5 FINISHES

Unless otherwise specified in the technical working drawings, take note of the following:

1.5.1 STRUCTURAL SLAB: Steel trowel or power float to give a smooth untextured/textured finish. Provide where required in Schedules to receive hardener/dust proofer, retarder, and other scheduled floor finishes were directed by the Architect as requiring smooth untextured/textured finish. Trowel to Class A tolerance. Moist cure only.

1.5.2 SLABS TO RECEIVE HOMOGENOUS TILES: For slabs to receive thickset homogenous and ceramic tiles, stone flooring and other scheduled flooring finishes requiring lightly roughened textured finish for substrate preparation, provide a roughened texture. Use stiff brush. Trowel to Class A Tolerance. Striate uniformly with fine-haired broom.

1.5.3 SLABS TO RECEIVE WATERPROOFING AND CONCRETE TOPPING: For slabs to receive thin-set homogenous tiles, ceramic tiles, and stone flooring, ensure fins are removed and all honeycombs and voids are repaired. Comply with manufacturer's requirements. Provide even textured finish unless otherwise specified by the manufacturer. Refer to Division 07 Thermal and Moisture Protection.

1.5.4 SLABS TO RECEIVE RESILIENT WOOD FLOORINGS: For slabs to receive laminate wood flooring, vinyl coverings including vinyl tiles, sports floor coverings, and epoxy flooring, use steel trowel to give smooth untextured finish.

1.5.5 SLABS TO RECEIVE THICK-SET STONE PAVING: For concrete slabs to receive pre-cast concrete pavers for vehicular ramps, natural stone paving, use heavy-broomed concrete finish as substrate preparation.

1.6 SUBMITTALS

1.6.1PRODUCT APPROVAL ATTACHMENTS

1.6.1.1 300mm x 300mm sample work for each type of required concrete finish for the color and texture review of the architect.

1.6.1.2 Where used, submit grout samples, complete with manufacturer's data indicating grout color, brand, and other codes of identification.

1.6.2EXECUTION APPROVAL ATTACHMENTS

Detailed work and methodology indicating:

1.6.2.1 Date and time of finishing

1.6.2.2 Area of finish application

1.6.2.3 Restoration and cleaning procedures upon completion of work.

1.6.2.4 Shop drawings indicating area of location.

1.7 QUALITY ASSURANCE

Establish a mock-up surface at least 1000mm x 1000mm to 3000mm X 3000mm, complete with joint and edge termination details if any for the approval of the architect.

2. PART 2 PRODUCTS

2.1 PREMIXED PRE-PACKAGED CEMENTITIOUS GROUT

Request for color approval from the architect. Do not apply grout materials that are not compatible with the finish material as indicated in the schedule of finishes. If used for patching and resurfacing damaged concrete surfaces, use one-component, polymer-modified, shrinkage-compensated renovation mortar.

2.2 EPOXY BONDING AGENT

Unless otherwise approved by structural designer, use two-component solids liquid epoxy bonding adhesive for warm environments.

2.3 CEMENT

Comply with ASTM C150, Type to match original concrete surface.

2.4 AGGREGATE

ASTM C33, one hundred percent (100%) passing the No. 30 mesh sieve.

2.5 BOND COAT MORTAR

Use mortar of the same material as the bond patching mortar and of approximately the same proportions as used for the concrete, excluding coarse aggregates. Mortar ratio shall be (1) part cement to not more than one (1) part sand by damp loose volume.

2.6 PATCHING MORTAR

Use patching mixture of the same materials and of approximately the same proportions as used for the concrete, excluding coarse aggregates. Mortar ratio shall consist of one (1) part cement to not more than two and one-half (2-1/2) parts sand by damp loose volume. White Portland cement may be substituted for a part of the gray Portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete. Implement a trial patch or mock-up prior to commencing work completely. as determined by a trial patch. Use appropriate amount of water needed for handling and placing. Mix patching mortar in advance and allow to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that shall permit placing.

2.7 WATER

Only clean potable water shall be used. Use a calibrated measuring device to measure the proper amount of water to be added to pre-packaged grouts and mortars.

3. PART 3 EXECUTION

3.1 PREPARATION

3.1.1 In repairing surface defects, measure all concrete surface temperatures, and if needed, cool surfaces down to facilitate maximum quality repair.

3.1.2 For honeycombs and other defects, remove down to sound concrete and chip if necessary. Ensure that no reinforcements will be compromised during the chipping process. Always use the appropriate solids-liquid bonding agents during the patching work. Refer to approved material by the structural designer.

3.1.3 Clean and dampen the chipped area for patching and dampen an additional 150mm surrounding it, unless otherwise specified by the manufacturer of the approved bonding agent. Comply with manufacturer's requirements.

3.1.4 Prepare bonding grout mixtures prior to patching.

3.2 CLEAN-UP AND PROTECTION

Clean up and remove concrete chips, dust and debris on all areas of work upon each day of application and upon completion. Prevent migration of airborne dust and debris by using windbreaks. Cooperate with other trades for protection of completed finishes.

3.3 PATCHWORK AND REPAIRS

3.3.1 FLATWORK SURFACES — GENERAL

3.3.1.1 Set bulkheads and screed strips to facilitate continuous concrete placement and to produce cross sections within tolerances specified. For cambered steel or concrete beams, place screed strips or other indicators along the beam centerline to maintain constant slab thickness. Float, trowel, broom, cure, seal and apply other surface treatments to the top of the structural slab or to the top of concrete fills as shown in the Contract Documents.

3.3.1.2 Power Float and Hand Float after water sheen has disappeared to push down aggregate, raise mortar, and level.

3.3.1.3 Power Trowel and Hand Trowel as soon as surface can be worked without cement paste clinging to the blades.

3.3.1.4 Non-Slip: Where non-slip is called for with any finish, embed particles at the rate of 1 kilogram per square meter with the final tooling.

3.3.1.5 Tolerances: 1.Class A: Level to within 3 millimeters in 3 meters (1/1000).

3.3.2 TIE HOLES

Fill tie holes and repair as patchwork unless otherwise specified in the drawings.

3.3.3 SMOOTH FORM FINISH

3.3.3.1 Arrange facing material in a symmetrical and orderly manner to reduce seams.

3.3.3.2 Ground smooth all surface texture defects caused by formworks, such as raised grain, torn surfaces, worn edges, patches,

3.3.3.3 Use patching mortar to fill air voids on formed surfaces.

3.3.4 FAIR-FACED CONCRETE FINISH (RUBBED)

3.3.4.1 Begin surface grinding, using power-driven, abrasive stone grinders, after wearing course has hardened sufficiently to prevent dislodgment of aggregate particles. Keep surfaces wet during grinding process. Remove ground-off material and flush with water.

3.3.4.2 Fill air holes, pits, and other blemishes with cement grout. Spread grout over surface and work into openings with a steel straight edge. Rub grout into surface by use of grinding machine. Keep surface moist an additional three (3) days before final grinding.

3.3.4.3 When surface is in proper condition, begin second or final grinding to remove grout film and polish surface. After final grinding and polishing, wash thoroughly and remove surplus material.

3.3.5Conduct grinding operations and use such techniques as required to provide surface finish to match Architect's samples.

END OF SECTION