

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 by 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.

2.1.2 AGGREGATES

- 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%.

2.1.3 WATER

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.

2.1.4 STEEL, 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.

2.1.5 CONCRETE 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.

2.1.6 GROUT 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.

2.1.7 FORMWORK

- 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



03 00 00	DIVISION 3 CONCRETE	
03 35 0	Concrete Finishes	1 of 4

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

1.6.1 PRODUCT 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.

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

END OF SECTION