

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.

1.6.2 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 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.

2.2.1 Portland 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.

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

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

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

2.2.5 Use 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.

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

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

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

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

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

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

2.4 PERFORMANCE REQUIREMENTS — CURING MATERIALS

2.4.1 When 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.

2.4.2 When 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

- 3.5.5 When 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, unbonded 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 15 minutes.

3.6 JOINTS

- 3.6.1 Construction 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.
- 3.6.2 For weakened planes, use contraction joints or expansion joints such that there shall be no unnecessary breakage for the concrete.
- 3.6.3 Ensure 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.
- 3.6.4 For 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.
- 3.6.5 When 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.
- 3.6.6 Dry-cut joints are acceptable provided that it is positioned on the pavement within 1-4 hours after the completion of pouring and finishing.
- 3.6.7 Install 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

- 3.7.1 Refer to the site development plan details to identify the correct location and details of curbs.
- 3.7.2 Ensure that required cross-section, lines, grades, finish and jointing are as specified for the formed concrete.
- 3.7.3 In case of curb inlet manholes, refer to the technical working drawings in the Site Development and Drainage plan.

3.8 CONCRETE FINISHING

- 3.8.1 Smooth concrete finishes by screeding and floating. The use of mechanical floating device is preferred.
- 3.8.2 When the use of a mechanical floating and screeding device is not possible, ensure that hand power methods deliver consistent finishes, free from unwanted lumps.
- 3.8.3 For 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.
- 3.8.4 For burlap finishes, use damp burlap across float finished concrete. Ensure that the texture is uniformly installed.
- 3.8.5 For fine textured-broom finish, use a soft bristle broom across float-finished concrete surface.
- 3.8.6 For medium to coarse texture broom finish, use a soft bristle broom to etch 1.6mm to 3mm deep marks on the concrete surface.
- 3.8.7 Check all technical working drawings for the appropriate application areas of respective concrete finishes.
- 3.8.8 Check all planes and slope marks of the finishes.
- 3.8.9 When 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

- 3.9.1 Do not allow any traffic on the concrete during first fourteen (14) days of curing.
- 3.9.2 Refer to Division 3 provisions of this specification for specific curing methods depending on area of application.

3.10 REPAIRS AND PROTECTION

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02 78 0	Unit Pavers	1 of 5

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.

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.

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 contractor.
- 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.

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.

- 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.

- 2.1.7.3 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.

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

1.5.5 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