

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Labor, materials and accessories for the installation of all concrete work, including reinforcing steel and accessories as indicated on the drawings and/or specified.
- B. Fabricate, place, erect, shore, brace, anchor and remove all formwork.
- C. Fabricate and place all reinforcing bars and accessories and build in all anchors, inserts, sleeves, hangers, chairs, stirrups, and any other such devices, as required by this Section or supplied by other trades for installation under this Section.
- D. Cast-in-place all concrete shown, described, detailed, scheduled or required to complete the work.
- E. Cast-in-place all equipment pads, curbs, inertia bases and the corresponding anchorages.
- F. Furnish and place moisture retarders under slabs on grade.
- G. Place all anchor bolts and embedded weld plates.
- H. Furnish and place all expansion joint fillers.
- I. Cure, clean and surface finish all cast-in-place concrete.
- J. Prepare concrete base slabs to receive equipment pads, toppings or finish where required.

1.2 RELATED WORK

- A. Section 01410: Quality Control Services.
- B. Section 02300: Earthwork.**
- C. Section 03345: Concrete Finishes
- D. Section 04100: Masonry reinforcement and accessories to be cast in concrete.
- E. Section 05999: Metal fabrications to be cast in concrete.
- F. Division 7: Preparing concrete surfaces to receive dampproofing, waterproofing and Foundation perimeter insulation..
- G. Division 15: Mechanical items to be cast in concrete.
- H. Division 16: Electrical items to be cast in concrete.

### 1.3 QUALITY ASSURANCE

- A. Perform cast-in-place concrete work in accordance with ACI 318 and ACI 301, unless specified otherwise in this Section. Maintain a copy of ACI 301 Reference Manual SP-15, "Specifications for Structural Concrete for Buildings" on the project site for reference by the Design/Builder.
- B. Perform concrete reinforcing work in accordance with CRSI, unless specified otherwise in this Section.
- C. Place concrete after the placement of all forms and reinforcement have been inspected and approved by the Design/Builder's superintendent, and the Quality Control Manager.
- D. Place concrete only under the supervision of the Design/Builder's superintendent and the Quality Control Manager.

### 1.4 SOURCE QUALITY CONTROL

- A. The Design/Builder is responsible for the establishment of a quality control program to manage forming, reinforcement, production, delivery, placement, compaction, finishing, curing, protection and patching of all concrete.
- B. Provide the Quality Control Manager and the Project Director with access to the site or to the plant to facilitate inspection of the reinforcement. Submit a schedule, showing the beginning and the duration of the shop fabrication, in sufficient time to allow for the proper inspection.
- C. Provide the Quality Control Manager and the Project Director, with access to the concrete plant to facilitate inspection of concrete. Notify the Quality Control Manager when production of concrete is to commence and the plant location in sufficient time to allow for the proper inspection.

### 1.5 QUALITY CONTROL MANAGER

- A. Inspection and testing will be performed by the Quality Control Manager in accordance with Section 01410.
- B. Provide free access to the work and cooperate with the appointed Quality Control Manager.
- C. Tests of the proposed cement, aggregates and other concrete ingredients will be performed to ensure conformance with the specified requirements.
- D. The Quality Control Manager will take the concrete cylinders and perform all the tests specified in Section 01410.
- E. The Quality Control Manager shall be the only entity authorized to allow the addition of any water to a concrete mix after batching.
- F. The Quality Control Manager shall have the authority to reject concrete prior to or during placement for reasons of non-compliance with the Contract Documents.

### 1.6 REFERENCES

- A. All reference standards must be the most recent and current standards.
- B. ASTM: American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A.
1. A 185 - Steel Welded Wire Fabric, plain, for Concrete Reinforcement.
  2. A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  3. C 33 - Concrete Aggregates.
  4. C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  5. C 94 - Ready-Mixed Concrete.
  6. C 150 - Portland Cement.
  7. C 171 - Sheet Materials for Curing Concrete.
  8. C 260 - Air Entraining Admixtures for Concrete.
  9. C 309 - Liquid Membrane-Forming Compounds for Curing Concrete.
  10. C 494 - Chemical Admixtures for Concrete.
  11. C 595 - Blended Hydraulic Cement.
  12. C 618 - Fly Ash
  13. D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structure Construction (Non-extruding and Resilient Bituminous Types).
- C. ACI: American Concrete Institute, P.O. Box 19150, Detroit, Michigan 48219, U.S.A.
1. 117 - Standard Tolerances for Concrete Construction and Materials.
  2. 211.1 - Standard Practice for Selecting Proportions for Normal, Heavy Weight and Mass Concrete.
  3. 21 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
  4. 301 - Specifications for Structural Concrete for Buildings.
  5. 302 - Guide for Concrete Floor and Slab Construction.
  6. 304R - Practice for Measuring, Mixing, Transporting and Placing Concrete.
  7. 306R - Cold Weather Concreting.
  8. 305R - Hot Weather Concreting.
  9. 308 - Practice for Curing Concrete.
  10. 309R - Recommended Practice for Consolidation of Concrete.
  11. 315 - Details and Detailing of Concrete Reinforcement.
  12. 318R - Building Code Requirements for Reinforced Concrete.
  13. 347 - Formwork for Concrete.
  14. SP-15 - Specifications for Structural Concrete for Buildings ACI 301.
  15. SP-17 - Design Handbook in Accordance With the Strength Design Method of ACI 318: Volume 1.
- D. AWS: American Welding Society, Inc., P.O. Box 351040, 550 LeJeune Road, Miami, Florida 33135, U.S.A.
1. D1.4 - Structural Welding Code, Reinforcing Steel.
- E. CRSI: Concrete Reinforcing Steel Institute, 180 North LaSalle Street, Chicago, Illinois 60601, U.S.A.
1. CRSI - Recommended Practice for Placing Reinforcing Bars.
  2. CRSI - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.

- F. DIN Standards.

## 1.7 SUBMITTALS

- A. Submit certified copies of the mill test reports of each source of the supplied concrete reinforcing, indicating the physical and chemical analysis.
- B. Submit the proposed mix design and admixtures of each class of concrete to the Project Director for review before starting of the work. The submittal must be made on the Mix Design Submittal Form included at the end of this section of the specifications. The submittal shall include the aggregate data including typical gradation, but must be based upon either field experience or laboratory proportions and must be accompanied with the supporting field and laboratory test results. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data. If trial mixes are used, the mix design shall be approved by the Quality Control Manager and shall achieve an average compressive strength of 8.30 MPa higher than the specified strength. This over-design shall be increased to 9.66 MPa when concrete strength of 35Mpa and over is used.
- C. Submit mill certification of the cement identifying all ASTM parameters for each delivery for use on this project.
- D. Submit the location, layout and details of all the planned construction joints to the Project Director.
- E. Prepare shop drawings in accordance with ACI 315, indicating bar sizes, lengths, spacings, types, locations of all reinforcing steel, and welded wire fabric, including bending and cutting schedules, and the necessary supporting and spacing devices.
- F. Submit product data for the joint sealing non-absorptive tape and compounds for review prior to any pertinent work.
- G. Submit product data for the water stops to the Project Director prior to any pertinent work.
- H. Prepare and submit the shop drawings for review in a timely manner prior to performing the work.

## 1.8 STORAGE OF MATERIALS

- A. Store cement, aggregate, admixture, water, embedded items and reinforcing in a manner to prevent deterioration or intrusion of any foreign matter. Do not use frozen, damaged or deteriorated materials.

## 1.9 PROTECTION

- A. Provide adequate protection against rain, hot and/cold weather conditions before concrete is placed, finished and cured.
- B. Furnish adequate protective measures to maintain the temperature of the concrete as specified.
- C. Maintain a minimum of two working concrete thermometers on the job site at all times.

- D. Use the specified non-corrosive, non-chloride accelerating or retarding admixtures to "normalize" the set and early strength in response to the prevailing weather conditions.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MATERIALS

- A. Cement: Normal-Type I Portland cement, ASTM C 150. Cement for all site exposed concrete shall be single source, using the same fuel type and manufacturing process throughout the duration of the work. The color of the cement shall be gray.
- B. Alternatively, the Design/Builder may, at his option and convenience, use Blended Hydraulic Cement in accordance with ASTM C595 provided however, that the Design/Builder warrants that the strength, quality, consistency, finish and durability of the completed structure will meet or exceed that achieved by the use of Normal-Type I Portland Cement complying with ASTM C150.
- C. The quantity of fly ash used in any design mix will be subject to review, testing and approval by the Quality Control Manager and the Project Director.
- D. Aggregates: Aggregates for all exposed concrete shall be single source, of a uniform color and maintain the same gradation throughout the duration of the work. If local aggregates fail to meet the specifications but have been shown by special tests or actual service to produce the required quality concrete, such aggregates may be submitted to the Quality Control Manager and to the Project Director for review.
  - 1. Aggregates for normal weight concrete:
    - a. Concrete is considered normal weight aggregate concrete when the maximum weight does not exceed 2322 Kg/m<sup>3</sup> when cured.
    - b. Fine:
      - 1) Natural sand, ASTM C 33.
    - c. Coarse:
      - 1) Gravel, crushed gravel, crushed stone, approved slag or a combination thereof, ASTM C 33.
      - 2) Coarse aggregate size shall not exceed:
        - a) Slab and beam systems . . . . 20 mm
        - b) Columns and walls. . . . . 25 mm
        - c) Footings and pedestals . . . . .40 mm
      - 3) Materials that contain particles that will discolor the surface shall not be used for any site exposed concrete.
- E. Water:
  - 1. Fresh, clean, potable and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.
  - 2. Do not use water containing 0.05% or more of chloride ions.

## 2.2 REINFORCING STEEL

- |    |              |                               |
|----|--------------|-------------------------------|
| A. | <u>Grade</u> | <u>Minimum Yield Strength</u> |
|    | 420          | 420 MPa                       |
- B. Reinforcing steel: Deformed new billet steel bars conforming to ASTM A 615M, Grade 420 in plain finish.
- C. Welded steel wire fabric: Plain type, ASTM A 185M; in flat sheets in plain finish.

## 2.3 ADMIXTURES

- A. Add air entraining agent conforming to ASTM C260 in concrete to entrain air as required in ACI 301.
- B. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an Independent Testing Laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.
- C. High Range Water-Reducing Admixture (Superplasticizer): The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
- D. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions.
1. Use a water reducing/set-retarding admixture when the expected mix temperature will exceed 80 degrees F.
  2. Non-chloride accelerating admixtures may be used in cold weather concreting only when accepted by the Quality Control Manager. This acceptance will not relax the cold weather placement requirements.
- E. Water Reducing, Retarding Admixture: The admixture shall conform to ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
- F. Pozzolan (flyash): Processed flyash conforming to the requirements of ASTM C618 and having uniform fineness, color, iron content and carbon content maximum LOI 4% with a minimum 80% passing the #325 sieve when wet tested, may be used at a rate not to exceed 20% by weight of the cement.
- G. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.
- H. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required and must be submitted by the admixture manufacturer prior to the mix design review.

## 2.4 ACCESSORIES

A. Bonding and Repair Materials:

1. Bonding Compounds: The compound shall be a polyvinyl acetate type.
2. Epoxy Adhesive: The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.
3. Polymer Patching Mortar: "Thin Top Supreme/Concrete Top Supreme (horizontal repairs), "Verticoat or Verticoat Supreme" (vertical and overhead repairs). These patching mortars may be used when color match of the adjacent concrete is not required.
4. Underlayment Compound: Free-flowing, self-leveling, pumpable cementitious base compound.
5. Repair Topping: Self-leveling, polymer modified high strength topping. The topping shall exhibit the following properties: Chaplin Abrasion Test - 0.02 mm (0.0079") maximum @ 28 days (British Standard 8204).
6. Anti-Corrosive Epoxy/Cementitious Adhesive: This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (24 hour maximum open time).

B. Moisture retarder: 6 mil (0.15 mm thick) polyethylene film, of the type recommended for below grade application.

C. Form coating: For all exposed concrete, use non staining form coating.

D. Form sealer:

1. For wood forms, if required by the manufacturer of the form coating, use pre-form sealer before applying form coating.

E. Curing materials:

1. Clear Curing and Sealing Compound (VOC compliant): The compound shall have 30% solids content minimum, and will not yellow under ultra violet light after 500 hours of test in accordance with ASTM D4887 and will have test data from an Independent Testing Laboratory indicating a maximum moisture loss of 0.039 grams per sq. cm. when applied at a coverage rate of 28 sq. meter. per 3.8 liters. Sodium silicate compounds are not permitted. Do not cure with this compound any surfaces intended to receive clear hardener or penetrating sealer. Water retention shall be documented with the project concrete mix design prior to approval.
2. Non-staining waterproof paper covering shall conform to ASTM C 171.
3. Use polyethylene film for moisture retention that has a permeance not to exceed 0.20 perms when tested according to ASTM E 96, Procedure B.

F. Expansion joint material: Use filler, bituminous fiber non-extruding type, in accordance with ASTM D 1751.

G. Water stops: Use polyvinyl chloride or bentonite waterstop, i.e. Waterstop-RX of the size, type, shape and application as shown on the drawings.

## 2.5 FORM WORK

A. Form lumber:

1. Construction grade Douglas fir.

2. Grade 2 or better southern yellow pine.
  3. An approved equal.
- B. Plywood: Use B-B plyform EXT-APA quality or equivalent.
- C. Metal forms: Use heavy gauge steel of sufficient strength to support without distortion the wet weight of the concrete plus all other construction loads imposed upon them.
- D. Spiral tube forms: Use sono tube or equal of regular thickness.
- E. Fiberglas and plastic forms: Use forms of the proper type and design to produce concrete conforming to the requirements of the drawings, and properly engineered and constructed to withstand the applied stresses without appreciable distortion and deflection. Use clean forms free from imperfections.
- F. Scaffolding and shores: Use adjustable steel tubular tower or adjustable timber shoring if properly braced and designed to safely support the full weight of the forms, wet concrete and all the other construction loads imposed upon them without distortion. Shores shall have bearing plates.

## 2.6 METAL ACCESSORIES

- A. Form ties:
1. Use form ties but do not leave holes larger than 32 mm in diameter in the face of the concrete.
  2. Obtain and use form ties so that when forms are removed, no metal shall be within 25 mm of the finished concrete surface.
- B. Chairs and spacers:
1. Of the size, type and spacing required to maintain the indicated or scheduled position of the reinforcement.
  2. In all exposed concrete, use galvanized or metal bolsters with plastic tips or plastic in contact with the forms.
  3. In footings, use chairs designed for earth bearing or use pre-cast cement or precast concrete cubes placed at regular modular intervals to support the reinforcing steel.
- C. Side form spacers:
1. Use galvanized or plastic tipped steel bolsters or plastic in contact with forms at exterior exposed concrete surfaces, except for sand blasted concrete.
- D. Dovetail anchor slots:
1. Use No. 305 dovetail slots, No. 20 gauge sheet metal in Eraydo zinc, with felt, as manufactured by Hohmann and Barnard, Inc., Woodside, New York, or an approved equal.
- E. Tie wire:
1. Minimum 16 gauge annealed type, or patented system.

## 2.7 SLAB REINFORCING SUPPORTS

- A. Support reinforcing for slabs-on-grade on pre-cast cement, concrete cubes or steel chairs designed for earth bearing, spaced at a maximum of 900 mm on center in each direction.
- B. Place slab-on-grade reinforcement 37 mm down from the top of the slab unless indicated otherwise in the Contract Documents.

## 2.8 REINFORCING BAR SPLICES FOR COLUMNS

- A. See the drawings for the required types.
- B. For the mechanical tension and compression splices using Bar Splice Inc., or approved equal:
  - 1. Identify and record the location of each splice with the name of the person executing the splice. The worker executing the splice shall be trained according to the manufacturers recommendations.
  - 2. Before splicing, prepare the bars in accordance with the manufacturer's recommendations.
  - 3. Examine all reinforcing bars to be spliced for defects such as hairline cracks in the vicinity of the end of the bar before splicing. Remove all defects before splicing.
  - 4. See Section 01410 for the required tests of the splices and the reinforcing bars.
  - 5. Do not encase any splice in concrete until visual inspection and the required tests have been satisfied. If any of the tension test specimens fail to meet the strength requirements, cut out production splices from the same lot represented by the test specimen which failed and tension test them by an approved Independent Testing Laboratory. If one or both of the re-tests fail to meet the strength requirements, all the splices in the lot shall be rejected.

## 2.9 PRE-CONCRETE CONFERENCE

- A. At least 14 days prior to the start of concrete construction the Design/Builder shall hold a meeting to review the detailed requirements of the concrete design mixes and to determine the procedures for producing proper concrete construction.
- B. The Design/Builder shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
  - 1. Project Director's Representatives.
  - 2. Design/Builder's superintendent - Laboratory responsible for the concrete design mix.
  - 3. Quality Control Manager.
- C. Minutes of the meeting shall be recorded, typed and printed by the Design/Builder and distributed to all parties concerned within 5 days of the meeting.
- D. The Design/Builder shall notify the Projector Director at least 10 days prior to the scheduled date of the conference.

## PART 3 - EXECUTION

### 3.1 FORMS AND DETAILS OF CONSTRUCTION

- A. General: The design and construction of the forms is the complete responsibility of the Design/Builder, and shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 301.
1. Relation with other trades: Inserts, hangers, anchors, sleeves, bolts, plates, frames, bucks, nailer strips, reglets, and similar items required by other trades to be cast in the concrete work shall be furnished and located by each trade. Build such items into the forms in a manner that will prevent displacement or damage to them during placing and vibrating of the concrete. Form openings required for ducts and chases and verify the sizes and locations.
  2. Select the best type of forms for the intended purpose, substantially construct, rigidly support and fabricate to shapes and dimensions necessary to form the lines and designs indicated on the drawings and to provide for the special built-in features.
  3. Rigidly support and substantially construct forms, erect to line, shape and dimension, and in precise position to form the lines, surfaces and the design indicated. Construct forms to be removable without prying against the concrete. Make forms tight, without cracks or holes, to prevent the leakage of mortar or loss of fine particles from the concrete. Cover the form tie holes not used in the unexposed concrete with sheet metal.
  4. Fabricate walls and studding adequately, and space to prevent bulging or sagging of the forms.
  5. Hold in place all reinforcing bars in piers, columns, walls, slabs and beams at the specified distances from the side forms by the use of permanent steel bolsters secured to bars.
  6. Construct and locate forms within the tolerances set forth in ACI 347.
  7. Form both faces of the foundation walls and grade beams. Earth forming of grade beams, walls and other vertical concrete components will only be permitted in non-expansive clay soils and when earth banks are firm, neatly trimmed, and when they will retain the concrete in the precise size and shape and are specifically indicated on the drawings.
  8. Support all horizontal forms not on grade by adequate and safe adjustable shores, fully braced and capable of safely supporting all the vertical and lateral loads from wind, construction materials, impact, personnel, equipment, etc.
  9. Check the alignment and elevation of all forms at the start of the concrete placement and maintain during placement by readjusting the shores and the bracing if movement or settlement beyond specified tolerances has occurred.
  10. Camber forms to compensate for the estimated form shortening, shrinkage, and settlement of the mud sills.
  11. Provide temporary openings at the base of the wall and column forms at the backfill side to facilitate cleaning before placing concrete; leave open until the day of concrete placement for removal of extraneous materials.
  12. Ties and spreaders: To form the concrete to the proper thicknesses, use steel rods and cones, or other suitable devices. Where practical, place ties and spreaders symmetrically, in plumb tiers and level rows. No wood, other than built-in bucks or nailing blocks shall be allowed to remain permanently in the forms. Grout all form tie holes with non-shrink grout.
  13. Shores: Substantially construct, locate and install to preclude deflection in excess of 1/360th of the span of the members, under the superimposed loadings. Double-wedge at the bottom on bearing blocks to distribute the construction loads satisfactorily. Keep wedges tight during placing of concrete.
  14. Construct slab forms from the material best suited to the conditions. Slab form materials may be wood sheathing, plywood, fiberglass, plastic, or standard sections of steel forms.
  15. Use screeds to gauge the slab thicknesses and to control the slopes in all horizontal and sloping unformed surfaces. Set all edge forms and intermediate screed strips accurately

to produce the designed elevations and contours in the finished surface. Fabricate screeds sufficiently strong to support adequately the type of equipment required to be supported by them in connection with the concrete placing operation. Align the concrete surface to the contours of the screed strips by the use of strike-off templates or approved compaction type screeds.

16. Construction joints: Locate the construction joints as indicated on the drawings. Place the joints in walls and columns at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Place the joints in slabs and beams perpendicular to the main reinforcement within the mid third of the span unless otherwise noted. Continue all reinforcing steel across the joints. Provide longitudinal keys at least 40 mm deep and inclined dowels in all joints as indicated on the drawings. Prior to placement of subsequent concrete, remove the bulkhead and clean thoroughly the top surface of the concrete at all joints, remove all laitance, roughen in an approved manner and apply the *specified concrete*.
17. Expansion joints: Provide a bulkhead construction to permit installation of the required dowels and accessories, at the required expansion joint locations. After the original concrete section has hardened, remove the bulkhead and place compressible fiber strip of the required thickness and the full width of the concrete section. Secure the strip against displacement during concrete placement, place the top of the strip parallel with the concrete surface and flush with it unless a recess for application of a sealer is required. Form the recesses with removable temporary strips.
18. Contraction joints: Slab-on-grade shall be saw cut immediately after final finishing with a Soff-Cut saw, or similar, or as soon as possible without dislodging the aggregate by a conventional saw. Provide a maximum spacing of contraction joints of 30 times the slab thickness in slabs-on-grade without floor covering unless otherwise shown.
19. Apply an approved form coating to all wood forms. In no instance shall a coating be used that will stain or produce a non uniform color or interfere with the application and/or adhesion of the paint, or any other material to be applied to the surface of the concrete. Seal joints between form panels on faces of concrete with an approved non-absorptive tape, or other approved compound.
20. Waterstops: Use material in long lengths to produce the minimum number of joints. Join ends of abutting strips and form corners in strict accordance with the manufacturer's directions for cutting and sealing. Secure strips in forms to prevent punctures in the material. Render all splices water tight.
21. Equipment pads, curbs and inertia bases: Provide forms for pads, slabs, bases, and curbs as required for the mechanical and electrical equipment. Chamfer exposed corners and round edges. Verify locations, sizes, and heights.
22. Reglets, rebates, seats and pockets: Form as indicated or necessary to receive or engage the work of others. These include, but are not necessarily limited to the provisions for door tracks and the installation of dovetail slots, flashing reglets, and anchors. Verify dimensions and details. Do not permanently cast wood, other than built-in bucks and nailing grounds, in concrete.
23. Openings, chases and recesses: Form as indicated or necessary to receive, pass and clear other work. Before forming, verify sizes and locations with the other trades. Cooperate closely in the location of boxes, cans and sleeves which will be furnished and installed under the Sections requiring these items.
24. Pipe sleeves: Where sleeves or openings are provided through walls and slabs for passage of pipes and ducts, space sleeves or openings not closer together than 3 times the average dimension of the sleeves or openings, but not less than 150 mm center to center for small sleeves. Where reinforcement is interrupted, provide additional bars to maintain the total reinforcement called for. Where these requirements cannot be met, submit details for review before proceeding. Sleeves will not be permitted through columns,

beams or girders unless the specific condition has been reviewed and approved by the Structural Engineer of Record.

25. Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain the strength of the structure at a maximum. Increase the thickness of the concrete so that a minimum of 40 mm cover is maintained.
26. Anchors and rough hardware: Secure all bolts, inserts and other items embedded in the concrete accurately so that they will not be displaced during the placing and compacting of the concrete. Set embedded bolts and sleeves for fans, motors, pumps and other equipment on concrete slabs, bases and foundations in compliance with the setting diagrams or instructions furnished by those furnishing the materials or equipment to be attached.

B. Exposed finish forms:

1. Refer to Section 03345 for the types of finishes.
2. Place forms carefully and accurately and brace to prevent sagging or misalignment in accordance with the tolerances specified in ACI 301.
3. Fabricate and erect forms for all exposed surfaces not otherwise specified or noted on the drawings from B-B Plyform EXT-APA plywood, free of worn edges, patch holes, or other defects which will impair the texture of the concrete surfaces. Plywood sheets shall be as large as possible.
4. Treat all forms with non-staining form coating or release agent as specified before placing any reinforcement in the forms. Do not place any form coating material or release agent on construction joints. Where concrete surfaces are scheduled to receive special finishes or applied coverings use coating material and/or release agents which will not affect the finish objective.
5. Provide chamfered corners on all vertical and horizontal surfaces where adjacent sides of the corner are exposed in its final condition, except as detailed or noted otherwise.
6. Fabricate and erect all forms for sides and soffits of all exposed beams from plywood as specified or otherwise approved. Continuously support butt joints.

C. Removal of forms:

1. Remove forms in a manner to ensure the safety of the structure and the architectural appearance of all surfaces.
2. Maintain in place all forms and supports for the following minimum periods during which the temperature of the concrete is maintained above 10 degrees C:
  - a. Walls . . . . . 24 hours
  - b. Columns and piers . . . . . 24 hours
  - c. Sides of beams . . . . . 48 hours
  - d. Floor slabs . . . . . 7 days or 75% of the specified concrete design strength
  - e. Shoring for beams . . . . . 7 days or 75% of the specified concrete design strength
3. Form removal time may be reduced if high early strength cement has been used in the concrete or if the concrete breaks are indicating consistent high early strengths, and if adequate curing practices are followed.
4. Keep shoring or reshoring in place for not less than two tiers immediately below a floor or a roof slab which is still being concreted to distribute the construction loads to a minimum of two floors of adequate strength or to the ground.

D. Reinforcement:

1. Bending and forming: Fabricate steel bars of the size, gauge, and length indicated, and accurately bend or form to the shapes indicated, by methods that will not injure the materials. Heating of reinforcement for bending will not be allowed, and bars with kinks or bends not scheduled are considered rejected and shall be immediately removed from the Project.
2. Marking and shipment of reinforcement: Bundle reinforcement and metal tag with suitable identification to facilitate sorting and placing and transport to and store at the site in a way to not damage the material. Keep a sufficient supply of steel reinforcement on the site to avoid delays in the work.
3. Cleaning: Before placing reinforcement, and again before concrete is placed, clean reinforcement of loose mill scale, extraneous concrete, oil, etc.
4. Securing in place: Place reinforcement accurately and tie securely in the precise position, using at least 16 gauge annealed steel wire at points where bars cross, to hold them against displacement during the placing of concrete. Tie stirrups to bars at both top and bottom. Support all horizontal reinforcement in strict accordance with the CRSI. Galvanize bar supports within 40 mm of exposed surfaces.
5. Spacing of reinforcement: Exercise particular care when placing and securing reinforcement to maintain the proper distance and clearance between parallel bars and between bars and the forms. Provide steel spreaders and spacers to hold the horizontal steel in the specified position in beams and girders, and elsewhere as necessary. Precast concrete cubes may be used to support reinforcing steel in footings, and in slabs placed on grade. Support steel at proper height, upon galvanized "S" chairs, or "Support Bars" and galvanized "S" chairs, with hangers, or in other manner, as necessary. Support all slab reinforcement as follows:
  - a. 10 diameter bars at 600 mm on center maximum.
  - b. 15 diameter bars at 900 mm on center maximum.
  - c. 20 diameter bars at 1200 mm on center maximum.

Where "support bars" are used to hold the slab reinforcement in place, space chairs under the support bars not to exceed the distances specified above. Where steel is installed over and supported upon plastic membrane, provide the chairs and supports blocks with base plates of a size to reduce the unit stresses under the supports to values that will not damage the membrane.

6. Splices: Do not make splices at points of maximum stress and where made, lap as indicated or necessary to develop the strength of bars. Make horizontal steel at corners with 90 degree bends and 900 mm minimum returns. Where not otherwise shown, make the minimum lap length of 1.3 times the development length as calculated, in accordance with ACI 318, but not less than 300 mm. Maintain a clear space in no case less than 40 diameters between the spliced bars, except where otherwise indicated. Stagger splices in the horizontal wall reinforcement, separate the splices in alternate bars in one face at least 3 m longitudinally. Extend stubs and dowels required to receive and engage the subsequent work, a sufficient length to develop the strength of the bar, or as detailed. Place dowel and stub bars in the forms and secure against any displacement before and during the placing of concrete. Clean stubbed out steel and dowels thoroughly of adhering particles of concrete, before continuing the placing of any subsequent concrete.
7. Fabric sheet reinforcement: Cut to the required size and lay flat in place. Lap the sheets at sides and ends, and wire tie together and to other reinforcement securely at frequent intervals. At edges, at expansion and contraction joints, extend the sheets to within 25 mm of edge. Chair the sheets to the position indicated in the Contract Documents. Laps of the sheets shall be in accordance with ACI 318 and ACI SP-17, Volume 1, tables 7.1 and 7.2.

8. Protect reinforcement by concrete as follows:
  - a. Where concrete is deposited against the ground without the use of forms, not less than 75 mm.
  - b. Where concrete is exposed to the weather, or exposed to the ground, but placed in forms, not less than 50 mm for bars more than 15 diameter in diameter and 40 mm for bars 15 diameter or less in diameter.
  - c. Cover reinforcement for all other concrete with a minimum of 20 mm for slabs and walls, and 40 mm from floor penetration.
9. Provide two 10 diameter bars, 75 mm, four sides of the floor drains in slabs-on-grade. Place the first bar 40 mm from the floor penetration with a minimum length of 610 mm.
10. Cut reinforcing fabric sheets to fit all penetrations. Lap in accordance with ACI 318 and ACI SP-17, Volume 1, tables 7.1 and 7.2.

E. Screeds for slabs-on-grade:

1. Maintain the thickness of slabs on moisture retarder at grade by the use of temporary screeds of standard weight galvanized steel pipe not less than 20 mm inside diameter wired to small pads of concrete spaced 3 m apart or other approved method.
2. Cut tie wires flush with the pads upon the removal of the pipe.

F. Temporary construction openings:

1. Where floor areas may be temporarily omitted for hoists, mechanical or other work, place concrete slabs after the hoists have been removed or the equipment has been installed. Furnish and maintain adequate barricades around all temporary hoist openings.

G. Concrete construction tolerances:

1. Except as otherwise specified, concrete construction tolerances shall conform to *ACI 117*. These allowable tolerances shall not relieve the Design/Builder of the responsibility for the correct fitting of the indicated materials.
2. Surface tolerances for slabs shall be Class AA (4 mm below a 3 meter straight edge) in accordance with ACI 302.1R-80.

### 3.2 QUALITY AND STRENGTH OF CONCRETE

- A. A concrete mix design shall be proportioned to achieve an average strength in excess of the specified strength in accordance with the standard deviation developed from previous tests or by 8.3Mpa if the mix is prepared by the trial mixture method. This factor shall be increased to 9.66MPa when concrete strengths of 35MPa and over are used.
- B. All concrete must contain the specified water-reducing admixture or water-reducing-retarding admixture and/or the specified high-range water-reducing admixture (superplasticizer). All concrete slabs placed at air temperatures below 10 degrees C shall contain the specified non-corrosive, non-chloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. All pumped concrete, concrete for industrial slabs, concrete required to be watertight and concrete with a water/cement ratio below 0.50 shall contain the specified high-range water-reducing admixture (superplasticizer).

- C. Slump: All concrete containing the high-range water-reducing admixture (superplasticizer) shall have a maximum slump of 230 unless otherwise approved. The concrete shall arrive at the job site at a slump of 50mm to 75mm be verified, then the high-range water-reducing admixture added to increase the slump to the approved level. All other concrete shall have a maximum slump of 100 mm for slabs and 125 mm for other members.
- D. Air Content: All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%. All interior slabs subject to vehicular abrasion, shall have a maximum air content of 3%.
- E. Water/Cement Ratio: All concrete subject to freezing and thawing shall have a maximum water/cement ratio of 0.50 or 20MPa at 28 days or more. All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cement ratio of 0.45 or 30MPa at 28 days or more. All reinforced concrete subjected to brackish water or salt spray shall have a maximum water/cement ratio of 0.40 or 35MPa at 28 days or more.

### 3.3 PROPORTIONS AND CONSISTENCY

- A. Select the proportions of the ingredients to produce the proper placeability, durability, strength, and water-cement ratio to produce a mixture which will work readily into the corners and angles of forms and around the reinforcement by methods of placement and consolidation employed on the work, but without permitting materials to segregate or permitting excessive free water to collect on the surface.
- B. Proportions to attain the required strength shall be in accordance with ACI 318, and ACI 301 and as reviewed by the Quality Control Manager. In no case will adjustments be allowed which increase this water-cement ratio for concrete to be exposed to the weather and/or salts.

### 3.4 PREPARATION

- A. All mixing and transportation equipment shall be clean.
- B. Wet board forms thoroughly. Wet down all joints opened by shrinkage sufficiently to swell shut and tape as specified.
- C. Remove all ice, excess water, mud, and other debris from within the forms.
- D. Do not allow the form coating or release agent to puddle in the forms nor to come in contact with concrete at the construction joints or at the reinforcement.
- E. Remove ice, mud, scale or other coatings that might hinder the bond between the reinforcement and the concrete.
- F. Clean all form surfaces before reuse.

### 3.5 MIXING

- A. Conform with ACI 304 and the following.
- B. Normal weight concrete:

1. Mix concrete until there is a uniform distribution of materials. Discharge concrete completely before the mixer is recharged.
2. Adhere strictly to ASTM C 94.
3. Do not load the concrete mixer beyond the manufacturer's rated capacity of the mixing equipment. The speed of rotation of the drum shall be as recommended by the manufacturer of the equipment.

### 3.6 PLACING CONCRETE

- A. Conform with ACI 304.
- B. Convey concrete from the mixer to the forms as rapidly as practical and by methods which will prevent segregation or loss of ingredients.
- C. Deposit as nearly as practical in its final position without segregation during placement.
- D. Provide chutes so that the concrete slides in the chute and does not flow.
- E. Provide chutes with a slope of not less than 300 mm in 600 mm.
- F. Concrete shall not be dropped freely where reinforcing will cause segregation nor shall it be dropped freely more than 3 meters for concrete containing the high range water reducing admixture (super-plasticizer) or 1500 mm for other concrete.
- G. Place concrete before the initial set has occurred, and in no event after it has contained its water content for more than 1-1/2 hours.
- H. Unless otherwise specified, place all concrete upon clean, damp surfaces, free from water, or upon properly consolidated fills, but never upon soft mud or dry porous earth, or frozen ground.
- I. Compact the concrete and work it in an approved manner into all corners and angles of the forms and around reinforcement in a manner to prevent segregation of the coarse aggregate.
- J. Construct forms for the lifts of vertical walls to make all parts of the walls easily accessible for the placement, spading and consolidation of the concrete as specified.
- K. Deposit concrete in the forms as nearly as practical in its final position to avoid re-handling and to maintain, until the completion of the unit, a plastic surface approximately horizontal. Under no circumstances shall concrete that is partially hardened be deposited in the work. Deposit concrete continuously and as rapidly as practical until the unit of operation is completed. If concrete is placed by pump, the line diameter shall be no less than 125 mm except at the discharge end which may be 100 mm. The piston face pressure shall be not less than 14MPa. No mix adjustment may be made to accommodate the pump. Provide an approved pump mix design for each strength of concrete scheduled to be pumped.
- L. Consolidate all concrete by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Conform with ACI 309.
- M. Internal vibrators shall have a minimum frequency of 9,000 vibrations per minute and shall be operated by competent workmen. Over-vibrating and use of vibrators to transport concrete

within forms shall not be allowed. Insert vibrators and withdraw at many points, but not less than the spacing equal to 80% of the diameter in influence observed while the vibrator is immersed in concrete. Plunge the vibrator rapidly to the bottom of a casting but not more than 200 mm into the layer of plastic concrete below the layer being consolidated. Manipulate the vibrator to expel the trapped air and consolidate the mass. The use and type of the vibrators shall conform to ACI 309.

- N. Keep two spare emergency vibrators on the job site during all concrete placing operations.
- O. Furnish vibrators of the internal type; apply directly to the concrete and not through the forms, except in sections too thin to permit the insertion of the internal type, in which case, form vibrators may be employed.
- P. Carry all top surfaces slightly above the forms and strike off by board finish when settlement has taken place, forcing out all excess water.
- Q. After the concrete has taken its initial set, prevent impact or loads on forms or on the ends of projecting reinforcement.
- R. Add concrete to compensate for the settlement produced by vibration, and to bring the surface to the elevation required.
- S. In joining fresh concrete to set concrete, remove all loose and foreign materials from work already in place. ***Scrub this surface with wire brooms and wash clean with water to render these surfaces damp prior to concreting.***
- T. Place and consolidate all concrete in vertical members in place not less than 4 hours before concrete in the horizontal or the vertical members resting thereon is placed.
- U. Make the operation of placing concrete continuous between vertical construction joints. Make the vertical construction joints at approximately the center of a panel or beam with vertical bulkheads to the full depth. Place the scheduled or detailed reinforcement continuously through the joints.

### 3.7 CONCRETE FINISH MEASUREMENT AND TOLERANCES

- A. Time Period for Measurement and Reporting: Measurement of the finished concrete surface profile for any test section shall be made when requested by the Project Director at his option. All measurements shall be made by the Quality Control Manager or designated party within 24 hours after completion of the finishing operations. For the structural elevated floors, measurements shall also be made prior to removal of forms and shores. The Design/Builder shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted as soon as possible and within 72 hours after the finishing operations are complete. The Design/Builder shall take immediate action to correct any work which is outside the specified tolerances as outlined in this section.
- B. Floor Test Sections: For purposes of this specification, a floor test section is defined as the smaller of the following areas:
  - 1. The area bounded by column lines.
  - 2. The area bounded by construction and/or control joint lines.
  - 3. Any combination of column lines and/or control joint lines.

Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.

The precise layout of each test section shall be determined by the Quality Control Manager and shall be submitted for review .

- C. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:
1. Slab-on-Grade Construction – 20 mm.
  2. Top surfaces of formed slabs measured prior to removal of supporting shores – 20 mm.
  3. Top surfaces of all other slabs – 20 mm.
- D. Construction Requirements to Achieve Specified Floor Finish Tolerances:
1. Forms shall be properly leveled, in good condition and securely anchored, including special attention to ends and transitions.
  2. Bearing surfaces for straight edges such as form edges or previously placed slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.
- E. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:
1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
- F. Concrete Floor Finish Tolerance for suspended slab Construction:
1. Concrete Placement: Formwork shall be set and securely braced, so that the soffits are positioned to allow the scheduled concrete member sizes and thicknesses within tolerances specified in ACI 117. Concrete shall be placed and screeded to predetermined marks set on the form surface and conforming to the elevations prescribed on the drawings.
  2. Camber: Formwork camber, as indicated on the drawings, shall be set to provide a uniform, smooth soffit profile in each direction. Minimum slab thickness, as specified on the drawings, shall be maintained throughout the slab surface to a tolerance as specified in ACI 117. Tolerance on camber shall be 6 mm.
  3. Extra Concrete: The Design/Builder shall provide any additional concrete required to achieve the specified slab surface finish tolerance.
- G. Remedial Measures for Slab Finish Construction Not Meeting The Specified Tolerances:
1. Application of Remedial Measures. Remedial measures specified herein are required whenever the construction tolerances are exceeded.
  2. Modification of Existing Surface:
    - a. If, any portion of the substandard work can be repaired without sacrifice to the appearance of serviceability of the area, then the Design/Builder shall immediately undertake the approved repair method.
    - b. The Design/Builder shall submit for review and approval a detailed work plan of the proposed repair showing the areas to be repaired, method of repair and time to affect the repair.
    - c. Repair method(s), may include grinding (floor stoning), planning, retopping with self leveling grout or polymer concrete, or any combination of the above.

- d. The Project Director maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Project Director, the repair is not satisfactory, an alternate method of repair shall be submitted or the defective area shall be replaced.
3. Removal and Replacement:
    - a. If all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Design/Builder shall immediately remove and replace the defective work.
    - b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
    - c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between the new replacement floor and the existing floor.
    - d. The new section shall be reinforced the same way as the removed section and doweled into the existing floor as required by the Structural Engineer of Record. No existing removed reinforcing steel may be re-used. All reinforcing steel shall be new billet reinforcing steel.
    - e. Replacement sections may be retested for compliance at the discretion of the Project Director.

### 3.8 WEATHER CONDITIONS

#### A. Cold weather concreting:

1. Conform to ACI 306.
2. Without adhering to ACI cold weather concrete placing requirements, do not place concrete when the atmospheric temperature is below 4.5 degrees C, Or when the concrete is likely to be subjected to freezing temperatures unless protected with insulation blankets or a heated enclosure. Concrete may be placed on newly excavated ground as long as the ground is kept from freezing prior to placing concrete and the concrete is immediately protected from freezing for 8 days.
3. Do not expose concrete to freezing temperatures for 8 days after placing.
4. Maintain the concrete temperature above 10 degrees C for the first three days after placing.
5. Place heaters within temporary enclosures to provide a uniform curing temperature.
6. Do not use frozen materials or materials containing ice in the concrete.
7. Do not place aggregate with temperatures exceeding 60 degrees C when placed in the mixer.
8. Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride , thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

#### B. Hot weather protection:

1. Conform with ACI 305.
2. When the concrete mix temperature is expected to exceed 30 degrees C, add an approved chemical admixture complying with the requirements of ASTM C494, Type D.
3. Thoroughly wet down dry surfaces before concreting.

4. Provide wind barriers, sun shades or fog spray or mono molecular film in accordance with the requirements of Figure 1 ACI 305 to control the evaporation and surface cracking while concrete is in its plastic state.
5. When concrete slab placements are subject to high temperatures, wind and/or low humidity, the Design/Builder must use evaporation retarder to minimize the plastic cracking. The compound may be required to be applied one or more times during the finishing operation. The initial application is usually made after the strike-off operation.

### 3.9 REPAIRING AND PATCHING

- A. Remove any concrete not formed as shown on the drawings, concrete out of alignment, surfaces beyond required tolerances or defective surfaces which cannot be properly repaired or patched, and replace, including any concrete failing to meet the specified strength.
- B. Clean all bolt and tie holes and then fill with non-shrink grout as soon as practical. Fill honeycombs immediately after removing the forms as specified in paragraphs C, D and E below.
- C. Remove all bulges, projections, honeycomb and all other defects in exposed concrete to sound concrete. Provide a 25 mm minimum thickness of patch.
- D. Cut the perimeter edges of all areas to receive the patching mix perpendicular to the surface or undercut. Featheredge patches will not be allowed.
- E. The specified bonding compound or epoxy adhesive must be used. The polymer patching mortar may be used if the color match is not required. If the color match is required, the patching mix shall be composed of one part Portland cement, 1.5 parts fine sand, and a 50:50 mixture of the specified bonding admixture and water. Mix to achieve the consistency of thick paint. Hold large patches in place with forms matching the original forms. Leave the patched area undisturbed for 1 hour before final finishing. Keep patched areas damp for 7 days. Do not use metal tools to finish patches on exposed surfaces. Add white Portland cement to the trial mix to produce a matching color for the patch.
- F. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of the specified underlayment material. Underlayment application shall achieve the tolerances specified above.

### 3.10 CURING

- A. Conform with ACI 308.
- B. Protect fresh concrete from premature drying.
- C. Maintain the temporary housing, covering, or other protection used in curing in place and intact to a minimum of 24 hours after artificial heating or cooling has been discontinued.
- D. Curing operations shall follow the finishing operations within 2 hours.
- E. Keep water cured concrete continuously moist for 7 days.
- F. Prevent rapid drying at the end of the curing period.
- G. At the Design/Builder's option, accomplish curing by one of the following methods:

1. Ponding or continuous sprinkling.
2. Absorptive mats or fabrics kept continuously wet.
3. All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or "shake-on" hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and architectural concrete, not receiving a penetrating sealer, shall be cured with the specified clear, non-yellowing curing and sealing compound as recommended by the manufacturer.
4. Use non-staining waterproof paper or polyethylene film as specified. Lap joints 300 mm and weight in place.

# I. CONCRETE MIX DESIGN SUBMITTAL FORM

Project: \_\_\_\_\_  
 City: \_\_\_\_\_  
 General Contractor: \_\_\_\_\_  
 Concrete Contractor: \_\_\_\_\_  
 Concrete Strength (Class): \_\_\_\_\_  
 Use (Describe): \_\_\_\_\_

## Design Mix Information

Based on Standard Deviation Analysis  *Please check one*  
 Trial Mix Test Data

## Design Characteristics

Density  pcf  
 Strength  MPa (28 day)  
 Air  % specified

If trial mixes are used the Mix Design is proportioned to achieve  $f'_{cr} = f'_c + 8.3\text{MPa}$   
 (9.7MPa for 35MPa strength and higher strength at 28 days)

<u>MATERIALS</u>	Type/ Source	Specific Gravity	Weightkg.	Absolute Vol. cu m.
Cement				
Flash				
Microsilica				
Fine Aggregate				
Coarse Aggregate				
Water				
Air				
Other				
<i>Total</i>				<i>cu. m.</i>

Water/Cement Ratio (kg. water/kg. cement) = \_\_\_\_\_

<u>ADMIXTURES</u>	Manufacturer	Dosage oz/cwt
Water Reducer		
Air Entraining Agent		
High Range Water Reducer		
Non-Corrosive Accelerator		

Other		
-------	--	--

Slump before HRWR \_\_\_\_\_ mm

Slump after HRWR \_\_\_\_\_ mm

Standard Deviation Analysis (from experience records):

# of Test Cylinders Evaluated:	
Standard Deviation:	

$$f'_{cr} - f'_c + 1.34s \text{ or } f'_{cr} = f'_c + 2.33s - 500 (\text{units in psi})$$

(refer to ACI 301 for increased deviation factor when less than 30 tests are available)

LABORATORY TEST DATA

Compressive Strength

Age (days)	Mix #1	Mix #2	Mix #3
7	MPa	MPa	MPa
7	MPa	MPa	MPa
28	MPa	MPa	MPa
28	MPa	MPa	MPa
28 average	MPa	MPa	MPa

REQUIRED ATTACHMENTS:

Combined Aggregate Gradation Report

Standard Deviation Analysis Summary or Trial Mixture Test Data

Admixture Compatibility Certification Letter

Please check


Note: 8% - 18% aggregate required to be retained on each sieve except the top size and the #100

Submitted by:

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Phone #: \_\_\_\_\_

Main Plant Location: \_\_\_\_\_

Miles from Project: \_\_\_\_\_

Secondary Plant Location: \_\_\_\_\_

Miles from Project: \_\_\_\_\_

Date: \_\_\_\_\_

END OF SECTION 03300