PUBLIC BUILDING COMMISSION OF CHICAGO

ADDENDUM NO. 2 TO CONTRACT NO. 1506
FOR

CHICAGO PARK DISTRICT PARK 484
4701 W. 67th Street
New Construction
Project #11150

DATE: February 26, 2010

NOTICE OF CHANGES IN CONTRACT DOCUMENTS

The following changes are hereby made in the Contract Documents.

CHANGES TO BOOK 3 - TECHNICAL SPECIFICATIONS:

Change 1: Specification Table of Contents

a. Page TOC-1, Division 2 – Site Requirements, **ADD** line to read, "02340 – Geotextile Fabric....3".
b. Page TOC-1, Division 2 – Site Requirements, **ADD** line to read, "02832 – Modular Concrete Retaining Wall....9".
c. Page TOC, **ADD** Division 3 – Concrete to read as follows:
"**DIVISION 3 – CONCRETE:**
03300 – Cast-In-Place Concrete....16"

Change 2: **ADD** Section 02340 – Geotextile Fabric, per attached specification section.

Change 3: Section 02700 – Sewerage and Drainage

a. Page 02700-3, Article 2.2 – Pipes and Fittings, Paragraph C, **REVISE** Sub-Paragraph 2 to read, "Wrap perforated subsurface pipes ***and trenches as shown on the drawings*** with Nonwoven Polypropylene Geotextile [Mirafi 140N or approved equal]..."

Change 4: **ADD** Section 02832 – Modular Concrete Retaining Wall, per attached specification section.

Change 5: Section 02870 – Site and Street Furnishings

a. Page 2870-2, **ADD** Article 2.3 – Collapsible Bollards to read as follows:
"2.3 COLLAPSIBLE BOLLARDS
A. 30" high, heavy duty steel, single post, collapsible bollards. Bollards to have maximum clearance of 4" when in collapsed position.
B. Finish: Factory applied powder coat.
C. Color: High visibility safety yellow.
D. Acceptable Manufacturer's / Products:
1. TrafficGuard Single Post, Model No. LPHDHB, as manufactured by TrafficGuard Direct, Inc., Geneva, IL.
2. MaxiForce Traffic Control Bollard, Model No. MC-SP-SS2-U, as manufactured by Blue Ember Technologies, LLC, Sykesville MD."

Change 6: ADD Section 03300 – Cast-In-Place Concrete, per attached specification section.

Change 7: Section 13120 – Exterior Bleachers

a. Page 13120-1, Article 1.1 – Summary, Paragraph B, **DELETE** Sub-Paragraph 5 in its entirety.
b. Page 13120-1, Article 1.1 – Summary, Paragraph B, **REVISE** Sub-Paragraph 11 to read, "Guardrail System at the Rear: Consist of two guard rails (with infill) and be 42 inches in height."
c. Page 13120-1, Article 1.1 – Summary, Paragraph B, **DELETE** Sub-Paragraph 12 in its entirety.
d. Page 13120-1, Article 1.1 – Summary, Paragraph B, **REVISE** Sub-Paragraph 13 to read, "Guardrail System at the Side: Consist of two guard rails (with infill) and be 42 inches in height."

CHANGES TO DRAWINGS:

Change 8: Drawing AS.1, titled, "Architectural Plan"

a. **ADD** "2/AS.1 – Geotextile Fabric Layout", per attached Sketch No. ASK-02.

Change 9: Drawing AS.5, titled, "Junior Backstop Details"

a. At "11/AS.5 – Dugout Bench Section", **REVISE** note along right side of detail reading, "See CPD specifications for footing requirements" to read, "Refer to 8/AS.3 – Typical Footing Detail".

CLARIFICATIONS:

Change 10: The Contractor is responsible for all costs associated with permits and licenses, in accordance with Article 6 of Book 2 of the specifications. There will be a Department of Water Management fee in the amount of $3,000.00 to be borne by the Contractor.

QUESTIONS & ANSWERS:

Q1. Is there a spec for the bollards?
A1. Specifications for the collapsible bollards have been added to Section 2870 –Site and Street Furnishings; see Change 5, above.

Q2. Is there a spec for the retaining wall? (Material type, size, color)
A2. Specification Section 02832 – Modular Concrete Retaining Wall has been added to Book 3 of the Specifications for the project; see Change 4, above.

Q3. Are playing field bases to be provided in this contract? If so, please specify manufacturer.
A3. Bases are not to be provided under this contract.

Q4. GO-6 specifies the bleacher to have "steel" footboards, risers and seats. These components are standard as "aluminum" footboards, risers and seats, and we don't, nor am I aware of any bleacher manufacturer that provides these components in steel. Will aluminum footboards, risers and seat boards are acceptable?
A4. Specification Section 13120 – Exterior Bleachers currently requires all seats, foot boards and riser boards, as well as guard rails and handrails, to be aluminum.

Q5. Section 13120, 1.1.B.5 asks that the bleacher have a 42" x 60" front walkway. Please confirm that this is an error.

A5. The front walkway requirement has been eliminated from specification Section 13120 – Exterior Bleachers; see Change 7, above.

Q6. Section 13120, 1.1.B. This entire section appears to be a left over from a boilerplate for a project that contained a more elaborate bleacher system than the one required at the ball fields; notably items 5, 7, 11, 12, 13 (chain link fence enclosure requirement). Please review and comment.

A6. The items in question have been either modified or eliminated from specification Section 13120 – Exterior Bleachers; see Change 7, above.

Q7. On drawing C3.0 Note 8 (The contractor shall keep all excavated soils on site unless they are required per specifications. In the event soils do not balance on site, the contractors shall grade the site as directed by the engineer. Excess soil shall be placed in the area shown in the plans and graded, topsoiled as directed by the engineer.) Just to make sure we are on the same page, I have done the takeoff's 3 times and am coming up with 6,500 cy of spoils over what is needed on the to get to the proposed grades. Will all this spoil stay on site? Will any spoils need to be hauled off site?

A7. As indicated in Note 8 on Sheet C3.0 (referenced above), the intention is to keep all of the existing soil on site. Any existing soil above and beyond what is required to achieve the proposed grades will be relocated on site as directed by the Engineer.

ATTACHMENTS:

Specification	Section 02340 – Geotextile Fabric, dated 2/25/10 (3 pages, 8.5" x 11" format)
Specification	Section 02832 – Modular Concrete Retaining Wall, dated 2/24/10 (9 pages, 8.5" x 11" format)
Specification	Section 03300 – Cast-In-Place Concrete, dated 2/24/10 (16 pages, 8.5" x 11" format)
Drawing	Sketch No. ASK-02, dated 2/24/10 (1 page, 11" x 17" format)

END OF ADDENDUM NO. 2

SECTION 02340

GEOTEXTILE FABRIC

PART 1 GENERAL

1.01 GENERAL

A. This work must consist of furnishing and placing geotextile fabrics on the proposed subgrade as shown on the Plans and Drawings. The work under this Section is subject to the requirements of the Contract Documents.

PART 2 MATERIALS

2.01 GEOTEXTILES

A. Fibers, used in the manufacture of geotextiles, and thread, used in joining geotextiles by sewing, must consist of long chain synthetic polymers, composed of at least 95%, by weight, polypropylene or polyester. The material must be free of defects and tears and must meet or exceed the material requirements as listed below.

B. The geotextile must meet or exceed the minimum property values in Table 1.

TABLE 1
Physical Property Requirements

Test	Woven[1]
Grab Tensile Strength (ASTM D-4632)	270 lbs
Puncture Resistance (ASTM D-4833)	100 lbs
Trapezoid Tear Strength (ASTM D-4533)	100 lbs
Apparent Opening Size (ASTM D-4751)	< 0.3 mm
Permittivity (ASTM D-4991)	>1.5 sec^{-1}
Flow Rate (ASTM D-4991)	> 70 gpm/ft^2
Ultraviolet Degradation (ASTM D-4355)	> 70% strength 500 hrs exposure

1Values shown are minimum average roll values with strength values based on the weaker principle direction. Specification conformance of the geotextile must be based on the ASTM D-4759 procedure.

C. In addition to the above requirements, the following limitations will also apply:

1. If the fabric must be in contact with asphalt, it must be capable of withstanding temperatures of 338 degrees F without any negative effect on material's properties.

PART 3 SUBMITTALS

3.01 CERTIFICATE OF COMPLIANCE

A. Before starting the work, the Contractor must submit:

1. A Certification of Compliance from the geotextile manufacturer that the product(s) delivered to the Project will have property values equal to or greater than those specified, and

2. Factory test results of materials certified by the manufacturer as being similar, showing conformance with the requirements of these Specifications. Certified property values must be equal to the average value less two standard deviations. A swatch of the geotextile to be used must be submitted with the certification letter.

B. For quantities over 10,000 square yards, the Contractor must furnish to the Owner's Representative, at least 10 working days prior to use in the work, a sample of five square yards of the geotextile from the shipment of materials to be used on the Project of verification testing. The lot number of the roll and the location of the sample obtained must be documented.

C. After Contract award, upon request, the geotextile manufacturer must make available quality control test results for the materials delivered to the Project. Quality control sampling must be done in accordance with ASTM D-4354, and the samples must be tested according to ASTM standards to grab tensile strength, trapezoidal tear strength, and puncture resistance. At least one AOS and one permeability test must be performed per lot number.

PART 4 PACKAGING, STORAGE, AND HANDLING OF MATERIALS

4.01 PACKAGING

A. Geotextile materials delivered to the site must be furnished with an outer plastic wrapping, suitable for protection against moisture and extended ultraviolet exposure prior to placement. An opaque tarp must be placed over all rolls where the outer wrap is removed or damaged, such that the geotextile is exposed.

B. Each role of geotextile must be externally labeled or tagged to provide product identification sufficient for field identification, as well as inventory and quality control purposes. As a minimum, external tagging must include:

1. Name of Manufacturer

2. Product Type and Style

3. Product Grade

4. Lot Number

5. Physical Dimensions (Length and width)

C. The product grade, manufacturer's name, and lot number must be clearly marked directly on the geotextile at the beginning and end of each roll of product.

D. Rolls must be stored in a manner which protects them from the elements. If stored outdoors, they must be elevated and protected with a waterproof cover.

PART 5 INSTALLATION

5.01 GENERAL

A. The installation site must be prepared by clearing and grading the areas, as indicated on the Plans. Remove all sharp objects, large stones, stumps, etc.

B. The geotextile must be unrolled as smoothly as possible with no wrinkles or folds (except in curved sections and corners) on the prepared subgrade in the direction of construction traffic. Adjacent rolls must be overlapped 12 inches or greater, as shown on the Plans. Adjacent rolls may be connected by sewn or sealed seams, provided the seam meets or exceeds the grab strength requirement in Table 1.

C. For curves, the geotextile must be folded or cut and overlapped in the direction of the turn. Overlaps must be 12 inches or greater. Folds in geotextile must be stapled or pinned five feet on center.

D. The frost protection material must be placed onto the geotextile from the edge of the fabric or over previously placed aggregate. The first lift of aggregate must be spread and graded down to a minimum depth of 12 inches or to the design thickness, if less than 12 inches. A minimum lift of six inches compacted thickness must be maintained in all cases. Compaction of the first lift must be performed by "tracking" with a dozer, followed by compaction with a smooth-drum roller to the specified density. Construction vehicles that create ruts in the apron surface of greater than three inches will not be allowed. All ruts occurring during construction must be filled with additional aggregate and compacted to the specified density. Sudden stops and starts must be avoided where possible.

E. Holes, tears, or otherwise damaged geotextiles, as determined by the Owner's Representative, must be repaired immediately at the Contractor's expense. The damaged area must be cleared of all fill material, a suitable distance from the damaged area, to allow placement of a geotextile patch which extends 3 feet beyond perimeter of the damaged area. Aggregate removed must be replaced to the specified lift thickness and density.

SECTION 02832

MODULAR CONCRETE RETAINING WALL

PART 1 - GENERAL

1.1 DESRIPTION

A. Work shall consist of furnishing and installing a modular concrete block retaining wall system in accordance with these specifications and to the lines, grades, design, and dimensions shown on the plans.

B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.

C. Work includes furnishings and installing geogrid soil reinforcement as required to provide a complete modular retaining wall system installation.

1.2 RELATED SECTIONS

A. Section 02211 – Rough Grading

B. Section 02230 – Site Clearing

C. Section 02312 – Topsoil Placement and Finish Grading

D. Section 02318 – Acceptance of Backfill, Topsoil, and CU Structural Soil

1.3 REFERENCE DOCUMENTS

A. American Society for Testing and Materials (ASTM)
1. ASTM C1372 Standard Specification for Segmental Retaining Wall Units
2. ASTM C1262 Evaluating the Freeze Thaw Durability of Manufactured CMU's and Related Concrete Units
3. ASTM D422 Gradation of Soils
4. ASTM D698 Moisture Density Relationship for Soils, Standard Method
5. ASTM C140 Sample and Testing Concrete Masonry Units
6. ASTM D4595 Tensile Properties of Geotextiles by the Wide-Width Strip Method
7. ASTM D5262 Test Method for Evaluating the Unconfined Creep Behavior of Geogrids
8. ASTM D6638 Grid Connection Strength (SRW-U1)
9. ASTM D6916 SRW Block Shear Strength (SRW-U2)
10. ASTM D6706 Grid Pullout of Soil

B. Geosynthetic Research Institute (GRI)
1. GRI-GG4 Grid Long Term Allowable Design Strength (LTADS)

1.4 DEFINITIONS

A. Modular Concrete Block Retaining Wall Unit: Concrete retaining wall element machine made from Portland cement, water, and aggregate.

B. Structural Geogrid: Structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.

C. Unit Drainage Fill: Drainage aggregate, which is placed within and immediately behind the modular concrete units.

D. Reinforced Backfill: Compacted soil, which is placed within the reinforced soil volume.

1.5 SUBMITTALS

A. Submittals shall be made a minimum of 30 days prior to commencing construction.

B. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

C. Shop drawings showing all information needed to fabricate and construct the retaining walls including:
1. An elevation or profile view showing top and bottom of wall, finished grade and reinforcement elevations and type and length of reinforcement
2. Typical cross sections for each design condition
3. A plan view with each wall labeled and the beginning and end of each wall shown with ties into project stationing
4. Standard and project specific details.
5. Wall system specifications.

The shop drawings shall be sealed and signed by a Structural Engineer registered in the State of Illinois

D. The Contractor shall submit construction details and design calculations for the retaining wall system prepared, sealed and signed by a Structural Engineer registered in the State of Illinois. The engineering designs, techniques, and material evaluations shall be in accordance with the Manufacturer's Design Manual, NCMA Design Guidelines For Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges, Section 5.8 (whichever is applicable to designer).

E. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety of 1.5. The connection strength evaluation shall be performed in accordance with NCMA test method SRWU-1.

F. Furnish one unit in the color and face pattern specified.

G. LEED Submittals; LEED Credit MR 4.1 (and MR 4.2) and MR 5: Submit certifications stating the following:

1. The percentage of recycled material in the product demonstrating compliance with specification requirements.
2. The percentage of replacement of Portland Cement by recycled product and the type of product.
3. The product was manufactured within 500 miles of the project site, if so.

1.6 QUALITY ASSURANCE

A. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
   1. Has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.
   2. Has been successfully installed on a minimum of 1 million (1,000,000) square feet of retaining wall.

B. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.

C. Contractor shall provide evidence that the design engineer has a minimum of five years of documented experience in the design for reinforced soil structures. The design engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than $2,000,000.

D. Owner may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide any quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.7 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check all materials upon delivery to assure that the proper material has been received, including, but not limited to, type, grade and color.

B. Contractor shall prevent excessive mud, cementitious material, and like construction debris from coming in contact with the materials.

C. Contractor shall protect all materials from damage. Damaged materials shall not be incorporated into the project (ASTM C1372).

D. Contractor shall check the geogrid upon delivery to assure that the proper material has been received.

E. Geogrid shall be stored above -10 F (-23 C).

F. Contractor shall prevent excessive mud, cementitious material, or other foreign materials from coming in contact with the geogrid material.

PART 2 - PRODUCTS

2.1 MODULAR CONCRETE RETAINING WALL UNITS

A. Acceptable Manufacturers:
   1. Alan Block Corporation, Edina, MN.
   2. Keystone, Minneapolis, MN
   3. Pavestone, St. Louis, MO
   4. Unilock, Aurora, IL

B. Modular concrete units shall conform to the following architectural requirements:
   1. Face Color: Color to be selected from Manufacturer's standard colors.
   2. Face finish: Sculptured rock face in angular tri-planer configuration.
   3. Bond configuration – running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
   4. Exposed surfaces of units shall be free of chips, cracks, or other imperfections when viewed from a distance of 10 feet under diffused lighting.

C. Modular concrete materials shall conform to the requirements of ASTM C1372 – Standard Specifications for Segmental Retaining Wall Units.

D. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with appropriate references:
   1. Compressive strength: ≥ 3000 psi minimum;
   2. Absorption Rate: ≤7.5 lb/cu.ft.;
   3. Dimensional Tolerances: ± 1/8" from nominal unit dimensions not including rough split face, ± 1/16' unit height – top and bottom planes;
   4. Unit Size: 8" (H) x 18" (W) x 12" (D) minimum;
   5. Unit Weight: 110 lbs total weight per sq.ft. of wall face area. Fill contained within the units may be considered 80% effective weight.
   6. Inter-Unit Shear Strength: 600 plf minimum at 2 psi normal pressure;
   7. Geogrid/Unit Peak Connection Strength: 600-plf minimum at 2-psi normal force.

E. Modular concrete units shall conform to the following constructability requirements:
   1. Vertical setback – 1/8"± per course (near vertical) or 1"+ per course per the design.
   2. Alignment and grid positioning mechanism – fiberglass pins, two per unit minimum.
   3. Maximum horizontal gap between erected units shall be – ½ inch.

2.2 SHEAR CONNECTORS

A. Shear connectors shall be ½-inch (12 mm) diameter thermoset isopthalic polyester resin-pultruded fiberglass reinforcement rods or equivalent to provide connection between vertically and horizontally adjacent units. Strength of shear connectors between vertical adjacent units shall be applicable over a design temperature of 10 degrees F to + 100 degrees F (-10 to 40 degrees C).

B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.3 BASE LEVELING PAD MATERIAL

A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.4 UNIT DRAINAGE FILL

A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
1 inch	100
¾-inch (19 mm)	75-100
No. 4	0-10
No. 50	0-5

B. One cubic foot (0.028 m3), minimum, of drainage fill shall be used for each square foot (0.093 m2) of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.

2.5 REINFORCED BACKFILL

A. Reinforced backfill, also known as compacted structural backfill on the plans shall have the following properties:

Unit Weight	Internal Angle of Friction	Cohesion
120 pcf	30 degrees	0

Note: Backfill shall have no organics of debris

B. The maximum aggregated size shall be limited to ¾ inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.

C. Material can be site-excavated soils where the above requirements can be met. Unsuited soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.6 GEOGRID SOIL REINFORCEMENT

A. Acceptable Manufacturers: A manufacturer's product shall be approved by the wall design engineer.

B. Geogrid reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high-density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stipping.

C. Geogrid shall have the minimum property requirements as described within the manufacturer's specifications.

D. Long Term Allowable Tensile Design Load (Ta) of the geogrid material shall be determined as follows:

Ta = Tult / (RFcr*RFd*RFid*FS)

Ta shall be evaluated based on a 75-year design life.

1. Tult, Short Term Ultimate Tensile Strength. Tult is based on the minimum average roll values (MARV)
2. RFcr, Reduction Factor for Long Term Tension Creep. RFcr shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.60 minimum.
3. RFd, Reduction Factor for Durability. RFd shall be determined from polymer specific durability testing covering the range of expected soil environments. RFd = 1.10 minimum.
4. RFid, Reduction Factor for Installation Damage. RFid shall be determined from product specific construction damage testing performed in accordance with GRI-GG4. Test results shall be provided for each product to be used with project specific or more severe soil type. RFid = 1.05 minimum.
5. FS, Overall Design Factor of Safety. FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.

E. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with NCMA SRWU-1 Method for Determining Connection Strength of SRW.

F. Soil Interaction Coefficient, Ci

Ci value shall be determined per GRI:GG5 at a maximum 0.75-inch (19 mm) dicplacement.

E. Manufacturing Quality Control

The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.

The QC testing shall include:

1. Tensile Strength Testing
2. Melt Flow Index (HDPE)
3. Molecular Wright (Polyester)

2.7 DRAINAGE PIPE

A. The drainage pipe shall be perforated or slotted PVC manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with ASTM D-1248.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.

B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.2 BASE LEVELING PAD

A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the modular wall unit.

B. Soil leveling pad material shall be compacted to a minimum of 95% Standard Proctor density per ASTM D-698.

C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.3 MODULAR UNIT INSTALLATION

A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.

B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

C. Install shear/connecting devices per manufacturer's recommendations.

D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.4 STRUCTURAL GEOGRID INSTALLATION

A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignement.

B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the nest course of modular concrete units over the geogrid. The geogrid shall be pull taut, and anchored prior the backfill placement on the geogrid.

D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed sige-by-side to provide 100% coverage at each level. Spliced connections between shorter pieced of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.5 REINFORCED BACKFILL PLACEMENT

A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.

B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction us used, or 8-10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.

C. Reinforced backfill shall be compacted to 95% of the maximum density as determined by ASTM D698. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, -3%.

D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1 mm) from the tail of the modular concrete unit.

E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the grogrid. Tracked vehicle turning should be kept the a minimum to prevent tracks from displacing the fill and damaging the grogrid.

F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.

G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.6 CAP INSULATION

A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.7 AS-BUILT CONSTRUCTION TOLERANCES

A. Vertical alignment: ± 1.5" (40 mm) over any 10' (3 m) distance,

B. Wall Batter: within 2 degrees of design batter.

C. Horizontal alignment: ± 1.5" (40 mm) over any 10' (1 m) distance. Corners, bends & curves: ± 1 ft (300 mm) to theoretical location.

D. Maximum horizontal gap between erected units shall be ≤ ½ inch (13 mm).

3.8 FIELD QUALITY CONTROL

A. Quality Assurance – The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.

B. Quality assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications. (*Quality assurance is usually best performed by the site geotechnical engineer).*

C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.

D. Quality control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Cast-in-Place Concrete required to complete the work indicated on all the project construction drawings except for related sections.

B. Related Sections
1. Section 02513: Portland Cement Concrete Paving.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans.

1.3 SUBMITTALS

A. Product Data: Submit preprinted data for each type of manufactured material and product demonstrating compliance requested by the Architect.

B. Design Mixes: Submit design mix for each concrete mix. Include field test data used to establish the required average strength in accordance with ACI 301. Review of design mixes and field test data will be for general information only. Production of concrete to comply with specified requirements is the responsibility of the contractor. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until each mix has been reviewed by the Architect.
1. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Shop Drawings:
1. Steel Reinforcement Shop Drawings: Submit details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. LEED Submittals:

1. LEED Credit MR 4.1 and Credit MR 4.2: Submit product data for products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
a. Include statement indicating costs for each product having recycled content.

2. LEED Credit MR 5.1 and Credit MR 5.2: Submit product data for products that have extracted, harvested, or recovered, as well as manufactured within 500 miles of the Project site.
   a. Include a statement indicating the percentage by weight which is extracted, harvested, or recovered within 500 miles of the Project site.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

E. Publications: Comply with the latest edition of the following, except as modified by the Contract Documents. Maintain a copy of the latest edition of ACI 301, 117, 318, and 347 at the project site at all times. Where provisions of the above codes and standards are in conflict with the building code in force for the Project, the building code shall govern.
   1. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
   2. ACI 301, "Standard Specification for Structural Concrete."
   3. ACI 302, "Guide for Concrete Floor and Slab Construction."
   4. ACI 305, "Hot Weather Concreting"
   5. ACI 306 , "Cold Weather Concreting"
   6. ACI 308, " Standard Practice for Curing Concrete"
   7. ACI 318 " Building Code Requirements for Structural Concrete"
   8. ACI 347 " Recommended Practice for Concrete Formwork"
   9. ASTM C494 Standard Specification for Chemical Admixtures for Concrete
   10. CRSI "Manual of Standard Practice."

F. Concrete Testing Service: The Owner will employ a testing laboratory to perform initial field quality control testing.
   1. Materials and installed Work may require testing and retesting, at anytime during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed Work, shall be done at the Contractor's expense.

G. Pre-Concrete Conference

1. Conduct a meeting to review the detailed requirements for preparing the concrete design mixes and to review the drawings, specifications, and the project.
2. Require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
   a. Contractor's superintendent
   b. Laboratory responsible for the concrete design mix
   c. Laboratory responsible for the field quality control
   d. Concrete subcontractor
   e. Architect
   f. Boards Authorized Representative
3. Type and print minutes from the meeting and distributed to all parties within 5 days of the meeting.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and dam age.
   1. Avoid damaging coatings on steel reinforcement.

1.6 PROJECT CONDITIONS

A. Before commencing work, examine all adjoining work on which this work is in any way dependent for proper installation and workmanship and report to the Contractor any condition which prevents performing first class work.

B. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

C. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Formed Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Rust-free metal.
   2. Exterior-grade undamaged, unpatched plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
      b. Structural 1, B-B, or better, mill oiled and edge sealed.
      c. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 90 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

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

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
   2. Do not use wood, masonry, concrete or other similar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I. Type III cement may be used in lieu of Type I at Contractor's option, when acceptable to the Architect.
   1. Use only one brand of cement throughout project, except as otherwise indicated.

B. Fly Ash: ASTM C618, Class C or F

C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
   1. Class: Severe weathering region, but not less than 3S.
   2. Nominal Maximum Aggregate Size: 3/4 inch (19 mm) unless otherwise indicated.

D. Lightweight Aggregate: ASTM C 330.
   1. Nominal Maximum Aggregate Size: 3/4 inch (19 mm).
   2. Provide water cooled expanded blast furnish slag such as True-Lite by LaFarge manufactured within 500 miles of the Project.

E. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Drinkable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
   1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
   2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Provide a minimum 28 day compressive strength of 4000 psi (27.7 MPa) and a maximum water-cementitious material ratio of 0.44, unless otherwise indicated.

D. Footings: Proportion normal-weight concrete mix as follows unless otherwise indicated:
   1. Compressive Strength (28 Days): 4000 psi (27.6 MPa) with a maximum water cementitious material ratio of 0.44 (non air-entrained).

2. Maximum Slump at point of placement: 4 inches (100 mm).
3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 2- to 4-inch (50- to 100-mm) slump.

E. Slab-on-Grade: Proportion normal-weight concrete mix as follows unless otherwise indicated:
1. Exterior Exposed Concrete - Compressive Strength (28 Days): 5000 psi (34.5 MPa) with a maximum water-cementitious material ratio of 0.4 (air-entrained).

F. Cementitious Materials:
1. For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.
2. For all other concrete, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
a. Fly Ash: 25 percent by weight.

G. Air Content: Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
1. Air Content: 6 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

H. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

I. Prepare design mixes for each type and strength of concrete by either laboratory trial batch of field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs.

2.9 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." In the case of fabrication errors, do not rebend or straighten reinforcement.

B. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the Work:
1. Bar lengths, depths or bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on the Drawings or final Shop Drawings
3. Bars with reduced cross section due to excessive corrosion or other cause.
4. Bars with damaged corrosion resistive coating (if specified).

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads within acceptable deflection limits.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, ind inserts, and other features required.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3 mm), for surfaces predominantly exposed to public view.
   2. Class B, 1/4 inch (6 mm), for course-textured concrete formed surfaces intended to receive plaster, stucco, or wainscoting.
   3. Class C, 1/2 inch (13 mm). for all other surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
   1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Coat contact surfaces of forms with non-staining, rust preventative form-release agent, according to manufacturer's written instructions, before placing reinforcement. Rust stained steel formwork is not acceptable.

I. Elevate formwork as required for anticipated deflections due to weight and pressures of fresh concrete, shortening of formwork system, and construction loads.

J. Carefully inspect falsework and formwork during and after concrete placement to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.

K. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.

L. Forms for exposed Concrete:
1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes.
2. Do not use metal cover plates for patching holes or defects in forms.
3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersection.
4. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance of concrete. Do not use narrow strips of form material that will produce bow.
5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

3.2 REMOVING AND REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. At a spacing not to exceed 4'-0" on center in either direction. For slabs on grade, use supports not to exceed 4'-0" o.c. with sand plates or horizontal runners where base material will not support chair legs.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two mesh spacings. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
   2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls at not more than 60 feet in any horizontal direction. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into 15-foot maximum perpendicular strips, and areas not exceeding 225 square feet. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete within 24-hours after initial floating, when cutting action will not tear, abrade, or otherwise damage surface, and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: Install joint-filler strips at all slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one si de of joint.

3.5 CONCRETE PLACEMENT

A. Pre-Placement Inspection:
   1. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.
   2. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their Work; cooperate with other trades in setting such Work, as required.
   3. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.
   4. Soil at bottom of foundation systems are subject to testing for soil bearing value by the testing laboratory, as directed by the Architect. Place concrete immediately after approval of foundation excavations.
   5. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
   6. Remove soil, debris, standing water, ice, snow, loose mill scale or coating and other foreign matter from formwork and metal deck.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless indicated on trip ticket.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete. Place concrete in accordance with the practices and recommendations of ACI 304, and as herein specified.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete plac ement.
   3. Screed slab surfaces with a straightedge and strik e off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing f rozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 FINISHING SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
1. F(F) defines the maximum floor curvature allowed over 24 in. Computed on the basis of successive 12 in. elevation differentials, F(F) is commonly referred to as the "Flatness F-Number".
2. F(L) defines the relative conformity of the floor surface to a horizontal plane as measured over a 10 ft. distance, commonly referred to as the "Levelness F-Number".
3. All floors shall be measured in accordance with ASTM E-1155 "Standard Test Method for Determining Floor Flatness and Levelness Using the "F Number" System.

4. All slabs shall achieve the specified overall tolerance. The minimum local tolerance (1/2 bay) shall be 2/3 of the specified tolerances.

B. Trowel Finish: Apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
1. All other slab on grade overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15 other.

3.8 MISCELLANEOUS CONCRETE ITEMS

A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301, ACI 306.1 for cold-weather protection, and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive resilient sheet floor coverings. Cure concrete surfaces to receive other floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Comply with ACI 301.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent slab elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39
   a. Test two specimens at 7 days, two at 28 days and one at 56 days if 28-day compressive strength has not yet been obtained.
   b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

8. Floor Flatness and Levelness: ASTM E 1155
   a. Test one sample area for each slab area required to have a floor flatness, F(F) or floor levelness F(L) greater than 25.
   b. Perform tests elevated slabs within 72 hours of concrete placement.

C. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

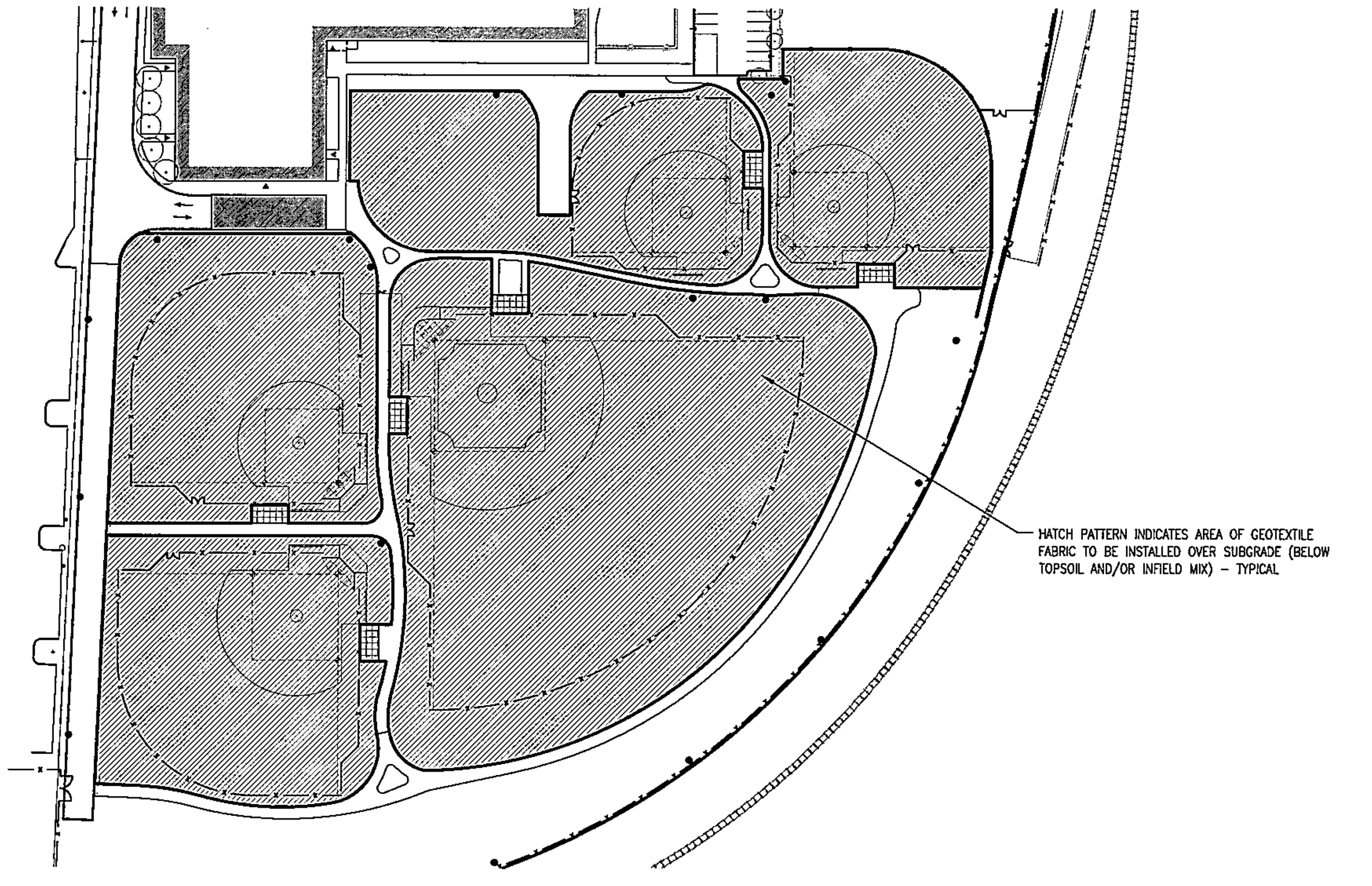
E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

G. Defective Work: Concrete work which does not conform to the specified requirements, including strength , tolerances, and finishes, shall be corrected at the Contractor's expense without extension of time . The contractor shall also be

responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

END OF SECTION



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AS.1
GEOTEXTILE FABRIC LAYOUT
1" = 80'-0"

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