ADDENDUM

Public Building Commission of Chicago | Richard J. Daley Center | 50 West Washington Street, Room 200 | Chicago, Illinois 60602 | (312) 744-3090 | pbcchicago.com

ADDENDUM NO.: **05**

PROJECT NAME: **Salt Dome Replacement Facility (Grand Avenue)**

PROJECT NO.: **04021**

CONTRACT NO.: **C1598**

DATE OF ISSUE: **January 29, 2021**

NOTICE OF CHANGES, MODIFICATIONS, OR CLARIFICATIONS TO CONTRACT DOCUMENTS

The following changes, modifications, or clarifications are hereby incorporated and made an integral part of the Contract Documents. Unless clearly expressed otherwise by this Addendum, all terms and conditions defined in the original Contract Documents shall continue in full force and effect and shall have the same meaning in this Addendum. Issued Addenda represent responses/clarifications to various inquiries. Contractors shall be responsible for including all associated labor/material costs in its bid. Drawings/specifications corresponding to inquiry responses will be issued with the Issue for Construction Documents, upon issuance of building permit.

ITEM NO. 1: **CHANGE TO KEY DATES**

Change 1 **Bid Due Date and Time** has been **RESCHEDULED** to Wednesday, February 3, 2021 at 11:00a.m.

ITEM NO. 2: **REVISIONS TO BOOK 1 – PBC INSTRUCTIONS TO BIDDERS**

None.

ITEM NO. 3: **REVISIONS TO BOOK 2 – PBC STANDARD TERMS AND CONDITIONS**

None.

ITEM NO. 4: **REVISIONS TO BOOK 3 – TECHNICAL SPECIFICATIONS**

Change 2 **Book 3 – Volume 1 – REVISED –** Specification Section 00 01 02 – Table of Contents: Updated to reflect revised specifications.

Change 3 **Book 3 – Volume 1 – REVISED** – Specification Section 13 70 00 – Inflated-Form Thin-Shell Concrete Dome: Removed lines 1.2B and 2.1A. Added section 1.5 to detail contractor qualifications. Revised line 1.6D with additional detail. Added line C.1.a. with additional requirements.

Change 4 **Book 3 – Volume 1 – REVISED** – Specification Section 31 20 00 – Earth Moving: Removed section 3.18 (Drainage Course Requirements). Adjusted format of section 3.19.

Change 5 **Book 3 – Volume 1 – REVISED** – Specification Section 32 13 13 – Concrete Paving: Removed references to colored concrete in lines 2.2.F and 3.8 A.

ITEM NO. 5: **REVISIONS TO DRAWINGS**

None.

ITEM NO. 6: **REQUESTS FOR INFORMATION**

RFI-1.

Question: **Drawing sheet AS1.1, keynote N005 indicates stainless steel bollards. There is no specification provided for the stainless steel bollards. Please provide specification.**

Response: Please refer to Drawing Sheet C1.14 for the proposed steel bollard details.

RFI-2.

Question: **Please provide some type of specification for Keynote N004 "Ventilator Duct" on sheet A2.1. Sheet S2.1 also indicates this as a ventilator, however, there are no specifications or notes identifying type of ventilator.**

Response: Contractor shall anticipate installation of four (4) 18-inch, galvanized steel Roof Turbine Ventilators with 1,200 CFM flow @ 4 MPH wind on the dome roof.

RFI-3.

Question: **Per schedule discussions with (subcontractor), they have indicated that they anticipate mobilizing on jobsite on April 12th 2021 and acceptance of ring beam connections/foundation and beginning dome construction on April 26th 2021. 20 weeks of dome construction, demobilizing on September 11, 2021. If the successful general contractor is not allowed to mobilize on site until April 1, 2021, we do not see a way of performing the required earthwork and dome foundation work required prior to dome construction, in a 3 week period, prior to (subcontractor) beginning dome construction. Can the successful general contractor mobilize any sooner than April 1, 2021 or can any additional time be allowed for substantial completion and Milestone #1?**

Response: All Work must be completed in accordance with the Time of Completion requirements.

RFI-4.

Question: **Per drawing C-1.6, site sections cut resulted to 3486 CY of dirt while 12,030 CY of imported clean fill for areas to be raised to the required site elevations. Is the excavation for footing and dome slab installation to be done prior to cut and fill of the site?**

Response: Contractor should determine the order of construction operations that will be required to complete the work in accordance with the Contract Documents.

RFI-5.

Question: **Details 102 & 103/S3.1 shows 5 layers of #5 transverse bars at 18" O.C and #9 x 60'-0" bars within the 24" deep concrete footing under opening. The notes call out these to be 3 layers. How do you want us to approach this?**

Response: Details 102 and 103 correctly show 5 layers of reinforcement. Two (2) of the reinforcing layers at these locations are detailed in detail 101 as well. The intent of the referenced notes is to show that 102 and 103 details include an additional three (3) layers of reinforcement at these locations.

RFI-6.

Question: **What is the thickness/section of the concrete pad for the staff trailer?**

Response: Please refer to Drawing Sheet C1.14 detail "P.C.C. CONCRETE PAVEMENT SECTION", the concrete pad section should consist of 9" PCC surface with a 6" CA-6 subbase.

RFI-7.

Question: **Sections on sheet C1.14 contradict section from detail 105 of sheet S3.1. Please clarify what is the thickness of PCC and sub base required on the inside floor of the dome.**

Response: Please refer to Addendum No. 4, revised Drawing Sheet S3.1 detail 105 for the thickness of PCC slab inside of the dome. Drawing Sheet C1.14 details do not apply for the slab inside of the dome.

RFI-8.

Question: **Is the general contractor responsible of procuring any permits?**

Response: Please refer to Book 2, Article 6. Permits and Licenses.

RFI-9.

Question: **Specification 015005 Temporary Facilities seems like a general specification that does not apply to this project. Please confirm the contractor will be require to procure all items listed on this specification.**

Response: It is the Contractor's responsibility to determine the temporary facilities that will be required for the project.

RFI-10.

Question: **In our site visit we saw there is several equipment attachments around the jobsite. Who is responsible for moving all equipment, material, etc. that is on the job site right now?**

Response: Equipment shall be relocated by others prior to the April 1, 2021 construction start date. Any remaining equipment will be relocated by others to not interfere with any construction activity.

RFI-11.

Question: **According to sheet C1.2 the entire jobsite with the exception of the dome, roads and parking lot will be 6" of CA-6. However, per sheet SM-2 the area requiring engineered barrier could be 18" of CA-6. Will the 6" from C1.2 be part of the 18" from SM-2 or the site on this area would be a total of 24" of CA-6.**

Response: Please refer to Addendum No. 4, regarding the placement of CA-6 on the site. Undisturbed asphalt millings may remain in place and may be considered as the final proposed surface, where it complies with the soil management plan. 6" of CA-6 will be accepted as part of the engineered barrier as long as it meets the requirements of sheets SM-1 (revised in Addendum No. 4), SM-2, and relevant specifications.

RFI-12.

Question: **Reference sheet SM-2. What is the difference from the gray area around the dome that is labeled "ASPHALT GRINDINGS/3' CLEAN FILL/18" CLEAN FILL W/GEOTEXTILE" that is inside the dotted line for "ENGINEERED BARRIER AREA" to the same label (gray area) that is outside the engineered barrier dotted line.**

Response: Please refer to SM-2 Legend, the area within the enclosed dashed line labeled "Engineered Barrier Area" is the area requiring an engineered barrier. The area outside of the enclosed dashed line does not require an engineered barrier.

RFI-13.

Question: **Would the engineered allow 3" rock/aggregate capped with CA-6 as an approved engineered barrier?**

Response: Please refer to Drawing Sheet SM-2 Note #2, for the engineered barrier requirements.

RFI-14.

Question: **We are under the impression that there is no 3-Phase power on site presently, as all the existing gear and distribution is all 1-Phase. Please confirm and or clarify, as 3 -Phase power will be needed for the Dome concrete equipment.**

Response: Existing electrical service at site is 120/240V, single phase, 3 wire. There is no 3-phase power on-site presently.

RFI-15.

Question: **Please clarify what is the greyed area between the dome and grand ave on sheets C1.4 and C1.8 with the legend "18 SPREADERS"**

Response: Please refer to Drawing Sheet C1.2, revised in Addendum No. 4, for the scope of work at this location. The grey shaded area referred to as "18 Spreaders" noted on C1.4 and C1.8 is included for information only. This is intended to illustrate future equipment storage area as it relates to the facility operation. The Contractor shall assume no additional work related to this grey area, per the Contract Documents.

RFI-16.

Question: **Existing surface elevation in soil borings is different from the one stated in the plans by the existing contour lines. Please clarify which on is correct.**

Response: Please refer to Drawing Sheet V0.1, revised in Addendum No. 4, for the contour line to be used for this project. Surface elevations in the soil borings report are only relevant to the geotechnical report.

This Addendum includes the following attached Specifications and/or Documents:

1. Specification Section 00 01 02 – Table of Contents
2. Specification Section 13 17 00 – Inflated Form Thin-Shell Concrete Dome
3. Specification Section 31 20 00 – Earth Moving
4. Specification Section 32 13 13 – Concrete Paving

This Addendum includes the following attached Drawings:

1. None

END OF ADDENDUM NO. 05

SECTION 00 01 02

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APPENDIX A: OWNER-PROVIDED DOCUMENTS – FOR REFERENCE ONLY

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SECTION 13 17 00
INFLATED-FORM THIN-SHELL CONCRETE DOME

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 03 30 00 Cast In Place Concrete Ring Beam for ring beam.

1.2 SUMMARY

A. This section includes all labor, materials and equipment required to construct the custom, insulated, clear-span, reinforced concrete dome as defined in the concrete documents.

~~B. General contractor to provide all general condition site services such as temporary power, water supply, site security, garbage, restroom facilities along with survey and staking, excavation and backfill, and all other items as noted on dome contractor's proposal.~~

1.3 DEFINITIONS

A. Shotcrete: Mixed mortar or cement, sand, 3/8-inch minus aggregate and water projected at high velocity onto a surface. The force of the jet impacting on the surface compacts the material. A relatively dry mixture is used so that the material supports itself minimizing sagging or sloughing, including when used on vertical and overhead applications.

B. Rebound: Rebound is defined as aggregate mixed with some cement which ricochets off the surface during the application of shotcrete because of collision with the hard surface, reinforcement, or with the aggregate particles themselves, which amount varies with the position of the work, air pressure, cement content, maximum size and grading of aggregate, amount of reinforcing and thickness of layer.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site directly after dome mobilization.
   1. Attendees shall include General Contractor, Dome Contractor, Owner, Architect, and Owners Independent Testing (OIT) Lab.

1.5 QUALIFICATIONS

A. The following qualifications shall be submitted for review at the pre-award meeting (date and time to be determined by the commission)

1. Documentation that the dome contractor has been in business and has constructed at least 5 concrete domes designed to store granular bulk dry materials, which domes are generally similar in scope and size as the dome structure to be constructed under this specification.
2. Documentation confirming that over the last 10 years none of the dome structures constructed by the dome contractor or any related or affiliated company(s) having the same ownership or management, have experienced any structural failures. Structural failures defined here as the collapse of a dome structure; or a serious deformation or collapse of any significant portion of already placed structural reinforced concrete, either during the building's construction, or after the dome was completed.
3. Documentation of at least 2 of the contractor's shotcrete nozzlemen indicating experience shotcreting significant portions of at least 3 domes or other large structures that required shotcreting both vertical walls and overhead. (ACI/ASA nozzleman certification alone is insufficient.) Nozzleman documentation can consist of either of the following:
   a. Have a current ACI/ASA Shotcrete Nozzleman Certification; AND documented records (project name, location, yards sprayed vertically and overhead, etc.) of **at least 100 additional hours** of shotcreting against air supported membranes in this type of structures.
   b. Have documented records (project name, location, yards sprayed vertically and overhead, etc.) of **at least 600 hours** of shotcreting against air supported membranes in this type of structures; AND pass a mock-up test panel as is typically required for ACI/ASA Nozzleman Certification.
4. Samples of 3D imagery reports produced based on 3D laser scanners (for example, a GEO SLAM ZEB Horizon scanner or equal) for at least 3 previous domes or large fabric structures; documented training from the scanner manufacturer certifying the scanner operator's qualifications for operating the scanner.
5. Proposed workflow including means, methods, and testing and inspection plans for review and approval by the engineer. This documentation will be submitted to the Chicago DOB in order to obtain final approval for the building permit. The Contractor will be required to provide any supplemental information or make revisions as requested.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product including reinforcement and forming materials and accessories, stabilizing foam, shotcrete materials, admixtures, and curing compounds.

B. Design Mixtures: For each shotcrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop drawings: Submit complete dome shop drawings and structural calculations showing plan view, transverse cross sections, concrete cross section, and reinforcing steel placement to clearly indicate proper assembly of the dome.

D. Samples: For air form fabric, with accompanying data sheets or specifications.

1.7 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials.
4. Reinforcing

B. Field quality-control reports.

C. As-Built Drawings: Provide drawings at the completion of the Project, showing all as built conditions and drawing changes.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel trained and qualified to test and inspect shotcrete by either the American Concrete Institute or the American Shotcrete Association.

B. Shotcrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design shotcrete mixtures.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service:

1. Testing scope of work provided by Owner:
   a. Owner will engage a qualified independent testing agency to perform preconstruction testing and inspections

   b. From each test panel, testing agency will obtain six test specimens: one set of three specimens unreinforced and one set of three specimens reinforced. Agency will perform the following:
      1) Strength Testing: Test each set of unreinforced specimens for compressive strength according to ASTM C 42/C 42M.
      2) Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2

2. Testing scope of work provided by Dome Contractor:
   a. Dome Contractor will produce shotcrete test panels before shotcrete placement according to requirements in ACI 506.2 and ASTM C 1140 for each design mixture. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 3-1/2 inches (90 mm).

1.10 WARRANTY

A. The Dome Contractor shall provide a written warranty in accordance with the manufacturer's standard coverage. From the date of final acceptance any defects in materials and/or workmanship shall be promptly repaired or replaced at no cost to the owner for the following minimum periods:
   1. Structural warranty: 10 - years
   2. Air form membrane: 10 - year Manufacturer Warranty

PART 2 - PRODUCTS

2.1 CONCRETE DOME

A. REMOVED

B. The dome shall have a storage capacity of a nominal 60,000 tons of de-icing road salt. The net capacity shall be calculated based upon the following:

   1. The material pile will be horizontal 45 above interior grade.
   2. Product will be compacted with a bulk density of up to 85 lbs. per cubic foot, and with a 32°-degree angle of repose
   3. Dome diameter will be 236' from outside wall to outside wall.

C. Tolerances: The outside diameter at the base of the dome shall not vary more than plus or minus 2 inches from the design diameter. The vertical height of the dome shall not vary more than plus or minus 18 inches from the design height (typically less than 12"). At any given point, the outside profile of the dome will not vary more than plus or minus 18 inches from the design. The actual shape and height of the dome are available only after the air form is inflated to its designed pressure.

2.2 FORMS

A. General: Form shall be single-ply architectural fabric membrane and shall form the finished roof surface in the finished dome condition.

B. Form Material: Flame-resistant Coated PVC Architectural Fabric meeting the following requirements:
   1. Flame Spread of 0-25 when tested in accordance with ASTM E 84.
   2. Smoke Developed of 0-450 when tested in accordance with ASTM E 84
   3. Certified as Flame-resistant by California Fire Marshal
   4. Meets NFPA 701 and UL 214 requirements
   5. FTMS 191 method 5903: 2 second flameout.
   6. Base Fabric Weight: 7.5 oz/yd^2
   7. Coated Fabric Weight: 28 oz/yd^2

C. Basis of Design: Seaman Corporation, Shelter-Rite High Performance 8028 FRLTC Architectural Fabric

D. Form and Roof membrane Warranty: 10 years minimum, including guarantee for water-tightness.

2.3 INSULATION

A. General: Sprayed polyurethane foam in the thickness indicated, installed on the interior side of the inflated air-form, meeting the following requirements:
   1. Thickness: 1.5 inches
   2. Core Density: 2 lbs/ cubic foot
   3. K-Factor: 0.12
   4. Permeability: 3.0 perms
   5. Compressive Strength: 30 psi, 90% closed cells
   6. Flame Spread: 0-25 when tested in accordance with ASTM E 84
   7. Smoke Developed of 0-450 when tested in accordance with ASTM E 84

B. Basis of Design: NCFI Polyurethanes, Spray Foam System 11-025 Shelter-Rite High Performance 8028 FRLTC Architectural Fabric

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, A616 or A617, Grade 60 deformed.

B. Plain-Steel Wire: ASTM A 82, as drawn

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

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

E. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice" and as follows:

2.5 SHOTCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I, II, III, IV or V as specified by the Portland Cement Association. Use only one brand and type of cement for Project.

B. Aggregates: ASTM C 33, from a single source, and as follows:

   1. Combined Aggregate Size: 3/8-inch minus
   2. Deleterious Substances: Coarse-aggregate Class 3S according to ASTM C 33.

C. Sand: Clean, well-graded, with a fineness modulus between 2.70 and 3.00 and meeting the following gradations:

SIEVE SIZE	% PASSING BY WEIGHT
No.4	95-100
No.8	80-90
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

D. Water: Potable, complying with ASTM C 94/C 94M, free from deleterious materials that may affect color stability, setting, or strength of shotcrete.

2.6 ADMIXTURES

A. General: ASTM C 1141. Provide admixtures for shotcrete that do not contain chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.

1. All admixtures must be approved by the Structural Engineer prior to their use.

2.7 SHOTCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.

B. Provide mixture free of chloride ions.

C. Admixtures: When included in shotcrete design mixtures, use admixtures according to manufacturer's written instructions.

D. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.8 SHOTCRETE MIXTURES

A. Shotcrete Mixture Proportion mixture to provide shotcrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi

2. Proportioning: The mix shall not be leaner than 846 lbs of Portland cement to each cubic yard of concrete.

3. Admixtures: Admixtures may be used, provided they do not impair the density of the shotcrete or are corrosive to steel and concrete. All admixtures must be approved by the Structural Engineer prior to their use.

2.9 SHOTCRETE EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.

B. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.10 BATCHING AND MIXING

A. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C 94 and furnish batch ticket information.

PART 3 - EXECUTION

3.1 GENERAL

A. The required proportions shall be assembled, well mixed, placed, finished and cured as hereinafter specified. It shall be uniformly dense and sound.

3.2 PREPARATION

A. Foam: Ensure foam is cured and depth gauges are in place along with all pre-mat rebar supports. Ensure foam is free from all debris and any trapped moisture.

B. Concrete: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces to saturated, surface-dry condition before shotcreting.

C. Earth: Compact and trim to line and grade before placing shotcrete. Do not place shotcrete on frozen surfaces. Dampen surfaces to saturated, surface-dry condition before shotcreting.

3.3 FORMS

A. General: Install and maintain forms to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.

1. Construct forms to required sizes, shapes, lines, and dimensions using depth gages to obtain accurate alignment, location, and grades in finished structures.

2. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.

B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. All reinforcing steel shall meet ACI building code requirements for temperature and shrinkage steel

C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

D. Securely embed reinforcing anchors into existing substrates, located as required.

E. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports, bolsters, chairs, spacers, and other devices as required to maintain minimum concrete cover. Accurately place reinforcing as shown on final approved drawings

F. Maximum spacing between the bars shall not exceed 18" or five time the shell thickness, whichever is less.

G. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.

H. Install welded wire reinforcement in longest practical lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by shotcrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.6 APPLICATION

A. General: Shotcrete shall be applied in a steady uninterrupted flow. Should the flow become intermittent, the nozzleman shall direct it away from the work until it again becomes constant or shall shut off the flow of materials.

B. Position of Pneumatic Nozzles: Except as otherwise indicated, the nozzle shall, as much as possible, be held at approximately right angles to the surface and shall be kept at the working distance from the surface.

1. When encasing reinforcing steel, the procedure of shooting under right angles may be modified in order to better direct the material around the bars.

2. Shooting through two curtains of steel will not permitted except when shooting on a solid base where all steel will be properly embedded. The steel for the second curtain shall not be placed until the first curtain has been embedded in shotcrete.

C. Shotcreting More Than One Layer: Sufficient time shall be allowed for each layer of shotcrete to set to allow for the next layer to penetrate and bond to the previous layer to ensure pockets, cold joints, and staging do not take place.

D. Base Construction: Every precaution shall be taken to remove rebound from the bottom areas and corners of the dome as quickly as it develops. The material shall be applied so that a proper flow of shotcrete into the corners is achieved.

3.7 Rebound: Rebound is defined as aggregate mixed with some cement which ricochets off the surface during the application of shotcrete because of collision with the hard surface, reinforcement, or with the aggregate particles themselves, which amount varies with the position of the work, air pressure, cement content, maximum size and grading of aggregate, amount of reinforcing and thickness of layer.

3.8 Dome contractor shall adhere to depth gauges installed in a grid pattern spaced from 6 ft. to 10 ft. Finished shotcreting must cover the depth gauges.

A. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1 and as follows. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Discontinue shotcreting when interior temperature would seriously impair quality and strength of shotcrete.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
4. Do not use calcium chloride, salt, or other materials containing antifreeze agents.

B. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to recommendations of ACI 305R when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete.

3.9 SURFACE FINISHES

A. General: Finish shotcrete according to descriptions in ACI 506R.

B. Natural Finishes:

1. Gun Finish: Natural undisturbed finish as sprayed.

3.10 CURING

A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.

B. Shotcrete will be placed inside of a weather tight form, optimizing curing conditions which will shade the shotcrete from direct sunlight and maintain high relative humidity.

3.11 FIELD QUALITY CONTROL

A. Testing scope of work provided by Owner:
1. Owner will engage a qualified independent testing agency to sample materials, visually grade cores, perform tests, and submit reports during shotcreting.

a. Shotcrete Test Cylinders
   1) Independent testing agency will test daily one test from the first 50 Cy and every 100 cy thereafter.
   2) Agency will perform the following:
      a) Slump Test: 4" – 7"
      b) Compressive Strength Test: Each set of unreinforced specimens for compressive strength according to ASTM C 42/C 42M
      c) Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.
   3) Strength of shotcrete will be considered satisfactory according to the following:
      a) Specimen Cores: Mean compressive strength of each set of three unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
      b) Specimen Cubes: Mean compressive strength of each set of three unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

B. Inspection scope to be provided by Owner's Testing Agency:
   1. Pressurization: Confirm that the pressurization of the inflated-form is maintained at 2" of water column pressure (0.072 psi).
      a. Frequency: Twice daily during entire duration of inflation.
   2. Verification of air-form and Dome profile: Obtain periodic measurements to confirm that the dome profile is within the specified tolerances of the dome profile as approved by the City of Chicago in the Permitted drawings.
      a. Measurements shall be confirmed at the following stages of construction:
         1) Immediately after air-for inflation and before application of spray foam insulation layer.
         2) After the spray foam is cured and before the application of reinforcing or shotcrete
         3) After the initial application of shotcrete.
      b. Measurements shall be taken at ten-foot intervals along two perpendicular axes.
         1) Take measurements at the same points at each stage of construction so as to be able to compare results.
      c. Notify Engineer of Record of any discrepancies
   3. Placement of reinforcement to verify required cover per contract documents.
   4. Concrete placement, including conveying and depositing.
      a. Confirm space around reinforcement is completely filled with shotcrete without void and stiffens sufficiently to support subsequent layers.
   5. Visual inspection during shotcrete placement to identify any areas of sagging resulting from the following:
      a. Concrete sloughing or sagging as a result of delamination between construction layers:
         1) Delamination of foam from air form
         2) Delamination of concrete from foam
         3) Delamination of concrete from previous concrete layer
      b. Concrete sloughing or sagging resulting from localized depression of inflated air form.

C. Quality Control scope of work provided by Dome Contractor
1. Dome Contractor will perform the following quality control measures:
a. The Contractor shall confirm the dome's profile and dimensions by submitting to the Engineer a report with images produced from data generated by a GEO SLAM ZEB Horizon 3D scanner (or equal) at the following stages of construction:
1) Immediately after air-form inflation and before application of spray foam insulation layer.
2) After the spray foam is cured and before the application of reinforcing or shotcrete.
3) After the initial application of shotcrete.
b. Air Form:
1) Receive certificate of compliance
a) Verify size, shape, color, welded seams, etc
2) Inflate
a) Check and approve profile
b) As-built measurements verified with engineer for compliance
c. Embedments:
1) Identify all embeds
a) Identify location, number, orientation, etc.
d. Urethane Foam:
1) Identify spec compliance
2) Identify expiration date
3) Application depth verification
a) Utilize DTI Foam Check sheets
e. Reinforcement Stickers:
1) Verify spacing
f. Premat & Wire
1) Verify spacing and structural spacing requirements
g. Depth Gages:
1) Verify spacing and depth length per engineered drawings per bench layer
h. Reinforcement:
1) Per structural drawings
a) Verify lap and tie off with painted end lap dimensions
b) Verify with photos as needed
i. Shotcrete:
1) Check Material properties of each truck
2) Ensure delivery meets spec
3) Identify location of each load on dome profile
4) Conformance with drawings
5) Full coverage of depth gauges
j. Final:
1) Install and complete all shotcrete, embeds, blockouts, etc. to drawing compliance

3.12 REPAIRS

A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.

1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs.
2. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders.
3. Dampen surfaces and apply new shotcrete.
4. Once repairs have been completed, perform measurements to confirm dome profile is within specified tolerances. Notify Engineer of Record of any discrepancies.

B. Repair core holes from in-place testing according to repair provisions in ACI 301, except do not use shotcrete.

3.13 CLEANING

A. Remove rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.
   1. Remove rebound from project site.
      a. In lieu of removing rebound, rebound may be uniformly spread over compacted earth dome floor.

END OF SECTION 13 17 00

SECTION 31 20 00
EARTH MOVING

PART 1 – GENERAL

1. 1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

B. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches for utilities and pits for buried utility structures.
7. Excavating well hole to accommodate elevator-cylinder assembly.

C. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
2. Division 01 Section “Project Procedures for Indoor Air Quality (IAQ)”.
3. Division 01 Section “Waste Materials Management and Recycling”.
4. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
5. Division 14 Section 142400 "Hydraulic Elevators" for excavating well hole to accommodate elevator-cylinder assembly.
6. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
7. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
8. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.

9. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
10. Division 31 Section "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
11. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
12. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
13. Division 33 Section "Subdrainage" for drainage of foundations.

1.3 DEFINITIONS

Retain definition(s) remaining after this Section has been edited. Revise to suit office or local earth moving practices.

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

Consider revising the term "drainage course" in first paragraph below and throughout this Section to suit Project or office standard. See Evaluations.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

Retain one of first two paragraphs below for classified excavation. See Evaluations.
Retain first paragraph below if performance of Contractor's equipment is used to define the term "rock."

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

Retain first subparagraph below for confined excavation. Revise size and performance ratings of equipment to suit Project; ratings are based on Caterpillar's "Model No. 320CL."

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

Retain subparagraph below for mass or bulk excavation. Revise size and performance ratings of equipment to suit Project; ratings are based on Caterpillar's "Model No. 973C."

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

Retain first paragraph below if standard penetration values are used to define the term "rock." Revise number of blows or penetration resistance to suit office practice. No correlation is intended between equipment- and geotechnical-based definitions of "rock"; both are arbitrary values chosen to standardize criteria for defining "rock."

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Controlled low-strength material, including design mixture.
   3. Geofoam.
   4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. Geotextile: 12 by 12 inches.
   2. Warning Tape: 12 inches long; of each color.

1.5 INFORMATIONAL SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. Geotextile: 12 by 12 inches.
   2. Warning Tape: 12 inches long; of each color.

C. Qualification Data: For qualified testing agency.
D. Minimum 4 lbs sample of sub-base, base and bedding aggregate materials.
E. Sieve Analysis per ASTM C136 for sub-base, base and bedding aggregate materials.

F. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

G. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins

1.6 QUALITY ASSURANCE

H. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

I. Preexcavation Conference: Conduct conference at [Project site] <Insert location>.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

B. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section 015000 "Temporary Facilities and Controls," and Division 31 Section 311000 "Site Clearing," are in place.

C. Do not commence earth moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

D. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
J. Sand: ASTM C 33; fine aggregate.
K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Drainage Geotextile: Nonwoven needle-punched geotextile, complying with the following, measured per test methods referenced:
   1. Grab Tensile Strength: 160 lbs (0.72 kN); ASTM D 4632.
   2. Grab Tensile Elongation: 50%; ASTM D 4632.
   3. Trapezoid Tear Strength: 60 lbs (0.27 kN); ASTM D 4533.
   4. Mullen Burst Strength: 305 psi (2101 kPa); ASTM D 3786.
   5. Puncture Strength: 95 lbs (0.43 kN); ASTM D 4833.
   6. CBR Puncture Stength: 400 lbs (1.79 kN); ASTM D 6241.
   7. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
   8. Permittivity: 1.4 per second, minimum; ASTM D 4491.
   9. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface as specified in Division 31 Section 311100 “Site Clearing”.

C. Protect and maintain erosion and sedimentation controls during earth moving operations.

D. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Dewatering shall consist of sump pits/wells/surface pumping and any other dewatering methods required to keep subgrades dry and convey ground water away from excavations.

B. Dewatering systems shall be constructed, maintained and operated in accordance with the City of Chicago guidelines.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. General: Excavation shall be in accordance with the regulations set forth by the City of Chicago.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs-on-grade.
f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit or as indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
   3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
   4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Trenches in Tree- and Plant-Protection Zones:
   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
   3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Subgrade below ring beam foundation should be visually inspected for salt. If Architect determines that salt is visible in the soils, continue excavation and replace with compacted backfill or fill material as directed.

D. Proof-roll subgrade below the building slabs and pavements with a heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

E. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
1. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Revise depth of layers in first paragraph below to suit Project.

B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

D. Retain one option in paragraph below based on ASTM laboratory-test method required. Replace the term "unit weight" with "density" if preferred.
E. Compact soil materials to percentages of maximum dry unit weight according to ASTM D 698 and as recommended by the Geotechnical Report.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
B. Provide a smooth transition between adjacent existing grades and new grades.
C. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
D. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
E. Revise subparagraphs below to suit Project.
F. Turf or Unpaved Areas: Plus or minus 1 inch.
G. Walks: Plus or minus 1 inch.
H. Pavements: Plus or minus 1/2 inch.
I. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Revise this article to suit Project and for installations of "subbase and base courses" other than under pavements and walks.
B. General: Install in accordance with the City of Chicago regulations.
C. Revise this article to suit Project and for installations of "subbase and base courses" other than under pavements and walks.
D. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
E. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
F. Retain first two subparagraphs below if applicable.
G. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
H. Place base course material over subbase course under hot-mix asphalt pavement.
I. Retain option in four subparagraphs below if retaining "and base course" option in paragraphs above.
J. Shape subbase course and base course to required crown elevations and cross-slope grades.
K. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
L. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

M. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

~~3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE~~

~~A. Revise this article to suit Project and for installations of "drainage courses" other than under pavements and walks.~~
~~B. Place drainage course on subgrades free of mud, frost, snow, or ice.~~
~~C. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:~~
~~D. Retain applicable subparagraphs below.~~
~~E. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.~~
~~F. Place drainage course 6 inches or less in compacted thickness in a single layer.~~
~~G. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.~~
~~H. Revise percentage of compaction in subparagraph below and change compaction test from ASTM D 698 to ASTM D 4254 or ASTM D 1557 if required. Replace the term "unit weight" with "density" if preferred. See Evaluations.~~
~~I. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.~~

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
B. Testing Agency shall inspect and verify all proofrolling operations.
C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
F. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
G. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.

H. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
I. When testing agency reports that subgrades, subbases, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
C. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
E. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. City of Chicago Construction Standards, most current edition.
C. Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, January 1, 2012.

1.2 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Curbs and gutters.
4. Walks.
5. Unit Pavers

B. Related Sections:

1. Division 01 Section “Project Procedures for Indoor Air Quality (IAQ)”.
2. Division 01 Section “Waste Materials Management and Recycling”.
3. Division 03 Section "Cast-in-Place Concrete” for general building applications of concrete.
4. Division 31 Section 312000 "Earth Moving" for subgrade preparation, grading, and subbase course.
5. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection. Submit 12”x12” samples for each concrete paving system required.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of

materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

C. Material Test Reports: For each of the following:
   1. Aggregates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
   1. Samples Panel:
      a. General Contractor: Before installing any exterior concrete paving, provide a sample paving panel for a typical concrete walk inclusive of a handicapped curb ramp.

b. Paving is to show the proposed color, surface finish of both the walk and textured ramp surface, reinforcement, control and expansion joints, sealant and workmanship.
c. Panel size shall be a minimum of 6'-0" wide x 15'-0" long in the presence of the Architect prior to the installation of these materials on the site.
d. Erect the panel in a location acceptable to the Architect and in the presence of the Architect prior to the installation of these materials on the site.
e. Do not start concrete site work until the Architect has given written approval of all components of the sample panel.
f. This sample panel will be used as a standard of comparison for all site concrete constructed of same materials.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Comply with IDOT approved lists for manufacturers and products and IDOT Standard Specifications.

2.2 FORMS

A. Form Materials: Comply with Section 1103.05 and all other related sections of the IDOT Standard Specifications.
B. Form-Release Agent: Comply with IDOT Standard Specifications.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.

B. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.2 CONCRETE MATERIALS

A. Cementitious Material: Comply with Section 1001 and all other related sections of the IDOT Standard Specifications.
   1. Portland Cement: ASTM C 150, Type I.

B. Normal-Weight Aggregates: Comply with Section 1004 and all other related sections of the IDOT Standard Specifications.
   1. Coarse Aggregate Quality: Class B or better.
   2. Maximum Coarse-Aggregate Size: 1-1/2 inches
   3. Coarse Aggregate Gradation: IDOT gradation CA-1, CA-7 or CA-16.
   4. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Comply with Section 1002 and all other related sections of the IDOT Standard Specifications.

D. Air-Entraining Admixture: Comply with Section 1020.04, 1021.02 and all other related sections of the IDOT Standard Specifications.

E. Chemical Admixtures: Other chemical admixtures may only be used with specific approval of the admixture by the Architect and must comply with Section 1021 and all other related sections of the IDOT Standard Specifications.

~~F. Color Admixture: Shall be a single-component, pigmented, water reducing concrete admixture that is factory formulated and packaged in cubic yard increment; not multiple additives and pigments to be dosed separately into the mix. It shall comply with U.B.C. Standard No. 26-9; ASTM C494 Standard Specification for Chemical Admixtures and ASTM C979 Standard Specification for pigments for Integrally Colored Concrete. Color to be Charcoal / Dark Gray with SRI above 29.~~

2.3 CURING MATERIALS

A. Moisture-Retaining Cover: Comply with Section 1020.13 and all other related sections of the IDOT Standard Specifications.

B. Water: Potable.

C. Membrane-Forming Curing Compound: Comply with Section 1022 and all other related sections of the IDOT Standard Specifications.

2.4 RELATED MATERIALS

A. Hot-Poured Joint Sealant: Comply with Section 1050 and all other related sections of the IDOT Standard Specifications:
   1. Hot-Poured Joint Sealant: Type II.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned in compliance with Section 1020 Table 1 and all other related sections of the IDOT Standard Specifications.
   1. Pavement for Driveways: Use IDOT Class PV.
   2. Pavement for Curbs and Sidewalks: Use IDOT Class SI.

B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content in compliance with Section 1020 Table 1 for the specified IDOT concrete class and all other related sections of the IDOT Standard Specifications.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.6 CONCRETE MIXING

A. Concrete Mixing: Comply with Sections 420, 1020, 1103 and all other related sections of the IDOT Standard Specifications.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with Section 420 and all other related sections of the IDOT Standard Specifications.
B. If concrete walks or similar lightly loaded paving does not require proof-rolling to the degree described in first paragraph below, revise requirements in paragraph to suit Project.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Form Materials: Comply with Section 1103.05 and all other related sections of the IDOT Standard Specifications.
B. Form-Release Agent: Comply with IDOT Standard Specifications.

3.4 STEEL REINFORCEMENT

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.

D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

3.5 JOINTS

A. General: Comply with Section 420 and all other related sections of the IDOT Standard Specifications.
B. Coordinate joint types, descriptions, and locations with Drawings. Three types of joints and tool edgings have been consolidated in this Article for consistency rather than for strict sequence of installation.
C. Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
    1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

D. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
    1. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-

half of dowel length to prevent concrete bonding to one side of joint.

E. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

F. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least 2 inches:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

G. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. General: Comply with Section 420 and all other related sections of the IDOT Standard Specifications.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
2. Trowel Edging: Provide a 4-inch wide smooth trowel edge finish after texturing.

3.8 CONCRETE PROTECTION AND CURING

A. General: Comply with Sections 420, 1020 and all other related sections of the IDOT Standard Specifications.

B. Curing and protection shall be as outlined in IDOT Section 1020.13. ~~Color lithochrome color wax matching the colored concrete as manufactured by L.M.Schofield Company or approved equal, and applied in accordance with the manufacturer's written instructions' or white pigmented curing compound as outlined in IDOT Section 718.04.a are the preferred curing methods. White-opaque polyethylene film shall not be accepted as a curing method.~~

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

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 at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, 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/C 143M; 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; 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 and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Testing Agency shall inspect and record all curing procedures.
D. Testing Agency shall inspect and verify all steel reinforcement placement.
E. Strength of each concrete mix will be satisfactory if average of any 3 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.
F. 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 mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
G. 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.
H. 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.
I. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
J. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION