PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install Project concrete work as described in Contract Documents.
   2. Quality of concrete used on Project but furnished under other Sections.

B. Products Installed But Not Supplied Under This Section:
   1. Inserts, bolts, boxes, templates, and fastening devices for other work, including those for bases
      only for Mechanical and Electrical.
   2. Concrete accessories.

C. Related Sections:
   1. Sections Under 04 8000 Heading: Bond bond beams confined in hollow masonry units.
   2. Divisions 22, 23, And 26: Mechanical and electrical devices including boxes, conduits, pipes,
      hangers, inserts, and other work to be embedded in concrete work before placing.
   3. Section 31 2324: Granular base course under slabs.
   4. Section 32 1313: Concrete paving.
   5. Section 32 3213: Cast-in-place retaining walls.
   6. Furnishing of items to be embedded in concrete specified in Section involved.
   7. Owner will provide concrete leveling compounds and patching compounds required for carpet
      installation.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM C 33-03, 'Standard Specification for Concrete Aggregates.'
   2. ASTM C 94-03, 'Standard Specification for Ready-Mixed Concrete.'
   5. ASTM C 494-04, 'Standard Specification for Chemical Admixtures for Concrete.'
   6. ASTM C 618-03, 'Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan
      for Use in Concrete.'
      Levelness Numbers.'

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Conform to requirements of ASTM C 94 unless specified otherwise.
   2. For testing purposes, following concrete strengths are required:
      a. At 7 days: 60 percent minimum of 28 day strengths.

1.4 SUBMITTALS

A. Shop Drawings: Show dimensioned locations of anchor bolts for hold-down anchors and columns.

B. Quality Assurance / Control:
   1. Concrete mix design.
2. Delivery Tickets: Require mix plant to furnish delivery ticket for each batch of concrete. Keep delivery tickets at job-site for use of Owner or his representatives. Tickets shall show following:
   a. Name of ready-mix batch plant.
   b. Serial number of ticket.
   c. Date and truck number.
   d. Name of Contractor.
   e. Name and location of Project.
   f. Specific class or designation of concrete conforming to that used in Contract Documents.
   g. Amount of concrete.
   h. Time loaded.
   i. Type, name, manufacturer, and amount of admixtures used.
   j. Amount and type of cement.
   k. Total water content.
   l. Sizes and weights of sand and aggregate.

1.5 QUALITY ASSURANCE

A. Pre-Installation Conference:
   1. Schedule pre-installation conference after placing of footings, installation of foundation forms and reinforcing steel, and installation of anchors, dowels, inserts, and block outs in foundation walls and slabs, but before placing of concrete.
   2. In addition to agenda items specified in Section 01 3000, review following:
      a. Approved mix design and use of admixtures.
      b. Installation scheduling, coordination, and placement of items installed in and under floor slab.
      c. Placement, finishing, and curing of concrete including cold and hot weather requirements.

1.6 PROJECT CONDITIONS

A. Project Environmental Requirements:
   1. Cold Weather Concreting Procedures:
      a. General Requirements:
         1) Materials and equipment required for heating and protection of concrete shall be approved and available at Project site before beginning cold weather concreting.
         2) Forms, reinforcement, metallic embedments, and fillers shall be free from snow, ice, and frost. Surfaces that will be in contact with newly placed concrete, including sub-grade materials, shall be 35 deg F 2 deg C minimum at time of concrete placement.
         3) Thaw sub-grade 6 inches 150 mm deep minimum before beginning concrete placement. If necessary, re-compact thawed material.
         4) Use no frozen materials or materials containing ice.
      b. Requirements When Average 24 Hour Temperature, midnight to midnight, Is Below 40 deg F 4 deg C:
         1) Temperature of concrete as placed and maintained shall be 55 deg F 13 deg C minimum and 75 deg F 27 deg C maximum.
         2) Heat concrete for 72 hours minimum after placing if regular cement is used; for 48 hours if high early strength cement is used; or longer if determined necessary by Architect. During this period, maintain concrete surface temperature between 55 and 75 deg F 13 and 27 deg C.
         3) Vent flue gases from combustion heating units to outside of enclosure to prevent carbonation of the concrete surface.
         4) Prevent concrete from drying during heating period. Maintain housing, insulation, covering, and other protection 24 hours after heat is discontinued.
         5) After heating period, if temperature falls below 32 deg F 0 deg C, protect concrete from freezing until strength of 2000 psi 14 MPa minimum is achieved. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi 24 Mpa minimum is achieved.
c. Requirements When Average 24 Hour Temperature, midnight to midnight, is Above 40 deg F 4 deg C, but when temperature falls below 32 deg F 0 deg C:
   1) Protect concrete from freezing for 72 hours after placing, or until a strength of 2000 psi 14 Mpa is achieved, whichever is longer. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi 24 Mpa minimum is achieved.

d. Protect soil supporting concrete footings from freezing under any circumstances.

2. Hot Weather Concreting Procedures:
   a. Maximum concrete temperature allowed is 90 deg F 32 deg C in hot weather.
   b. Cool aggregate and subgrades by sprinkling.
   c. Avoid cement over 140 deg F 60 deg C.
   d. Use cold mixing water or ice.
   e. Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

1.7 SEQUENCING

A. Font piping cannot be installed if Font pit is completely formed. Leave enough space in appropriate Font pit wall to allow connection of piping. Then fill in access space and dampproof.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: Meet requirements of ASTM C 150, Type <Insert Type>.

B. Aggregates:
   1. Coarse:
      a. Meet requirements of ASTM C 33 or nonconforming aggregate that by test or actual service produces concrete of required strength and conforms to local governing codes.
      b. Aggregate shall be uniformly graded by weight as follows:
         1) Flat Work, Size No. 67.
            
            | Sieve  | Percent Passing | Sieve  | Percent Passing |
            |--------|-----------------|--------|-----------------|
            | One Inch | 100             | 25 mm  | 100             |
            | 3/4 Inch | 90 - 100        | 19 mm  | 90 - 100        |
            | 3/8 Inch | 20 - 55         | 9 mm   | 20 - 55         |
            | No. 4   | 0 - 10          | 4.75 mm| 0 - 10          |
            | No. 8   | 0 - 5           | 2.36 mm| 0 - 5           |

         2) All Other, Size No. 57.
            
            | Sieve   | Percent Passing | Sieve   | Percent Passing |
            |---------|-----------------|---------|-----------------|
            | 1-1/2 Inch | 100            | 38 mm  | 100             |
            | One Inch | 95 - 100       | 25 mm  | 95 - 100        |
            | 1/2 Inch | 25 - 60        | 12 mm  | 25 - 60         |
            | No. 4   | 0 - 10         | 4.75 mm| 0 - 10          |
            | No. 8   | 0 - 5          | 2.36 mm| 0 - 5           |

   2. Fine:
      a. Meet requirements of ASTM C 33.
      b. Aggregate shall be uniformly graded by weight as follows:
         
         | Sieve    | Percent Passing | Sieve    | Percent Passing |
         |----------|-----------------|----------|-----------------|
         | 3/8 Inch | 100             | 9 mm     | 100             |
         | No. 4    | 95 - 100        | 4.75 mm  | 95 - 100        |
         | No. 8    | 80 - 100        | 2.36 mm  | 80 - 100        |
         | No. 16   | 50 - 85         | 1.18 mm  | 50 - 85         |
         | No. 30   | 25 - 60         | 0.60 mm  | 25 - 60         |
         | No. 50   | 10 - 30         | 0.30 mm  | 10 - 30         |
         | No. 100  | 2 - 10          | 0.15 mm  | 2 - 10          |
C. Water: Clear, apparently clean, and potable.

D. Admixtures And Miscellaneous:
   1. Mineral:
      a. Fly Ash Pozzolan: Meet requirements of ASTM C 618, Class F or C and with loss on ignition (LOI) of 3 percent maximum.
   2. Chemical:
      a. No admixture shall contain calcium chloride nor shall calcium chloride be used as an admixture. All chemical admixtures used shall be from same manufacturer and compatible with each other.
      b. Air Entraining Admixture:
         1) Meet requirements of ASTM C 260 or CSA CAN3-A23.1-M94.
         2) Type Two Acceptable Products:
            a) Air Mix 200 or AEA-92 by Euclid.
            b) Air plus or Super Air Plus by Fritz-Pak.
            c) MB-VR, MB-AE or Micro Air by Master Builders.
            d) Sika Air by Sika.
            e) Daravair or Darex II AEA by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6000.
      c. Water Reducing Admixture:
         1) Meet requirements of C 494, Type A and containing not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon WR 75 or Eucon 91 by Euclid.
            b) FR-2 or FR-3 by Fritz-Pak.
            c) Pozzolith Series by Master Builders.
            d) Plastocrete 160 by Sika.
            e) Daracem 50/55, WRDA-64, or WRDA-82 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6000.
      d. Water Reducing, Retarding Admixture:
         1) Meet requirements of ASTM C 494, Type D and contain not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon Retarder 75 by Euclid.
            b) FR-1 or Modified FR-1 by Fritz-Pak.
            c) Pozzolith Series by Master Builders.
            d) Plastiment by Sika.
            e) Daratard-17 or Daratard-40 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6000.
      e. High Range Water Reducing Admixture (Superplasticizer):
         1) Meet requirements of ASTM C 494, Type F or G and containing not more than 0.05 percent chloride ions.
         2) Type Two Acceptable Products:
            a) Eucon 37 or Eucon 537 by Euclid.
            b) Supercizer 1 through 7 by Fritz-Pak.
            c) Rheobuild 1000 or Glenium Series by Master Builders.
            d) Sikament 300 by Sika.
            e) Darachem-100 or WRDA-19 by W R Grace.
            f) Equal as approved by Architect before use. See Section 01 6000.
      f. Non-Chloride, Non-Corrosive Accelerating Admixture:
         1) Meet requirements of ASTM C 494, Type C or E and not contain more chloride ions than are present in municipal drinking water.
         2) Type Two Acceptable Products:
            a) Accelguard 80 by Euclid.
            b) Pozzolith NC 534 or 122HE or Pozzutec 20+
            c) Daraset or Polarset by W R Grace.
            d) Equal as approved by Architect before use. See Section 01 6000.
   3. Evaporation Retardant:
      a. Type Two Acceptable Products:
         1) Sure Film J-74 by Dayton Superior.
2) Euco-Bar By Euclid Chemical Co.
3) E-Con by L & M Construction Chemicals.
4) Confilm by Master Builders.
5) U S Spec Monofilm ER by U S Mix Products.
6) Equal as approved by Architect before use. See Section 01 6000.

4. Bonding Agents:
a. Type Two Acceptable Products:
   1) Day Chem Ad Bond (J-40) by Dayton Superior.
   2) Flex-Con by Euclid Chemical Co.
   3) Larsen Weldcrete by Larsen Products Corp.
   4) Everbond by L & M Construction Chemicals.
   5) Acryl Set by Master Builders.
   6) Sonocrete by Sonneborn.
   7) Tamms Bond by TAMMS Industries.
   8) U S Spec Multicoat by U S Mix Products.
   9) Acrylic Additive by W R Bonsal.
   10) Intralok by W R Meadows.
   11) Equal as approved by Architect before use. See Section 01 6000.

2.2 MANUFACTURERS

A. Contact Information:
   8. Master Builders / deGussa Admixtures, Cleveland, OH  www.masterbuilders.com

2.3 MIXES

A. Submit mix designs to meet following requirements:
   1. Proportions:
      a. Mix Type 1:
         1) Minimum weight cement per cu yd concrete: 517 lbs 235 kg.
         2) Water / Cement Ratio: 0.50 maximum by weight.
      b. Mix Type 2:
         1) Minimum weight cement per cu yd concrete: 564 lbs 256 kg.
         2) Water / Cement Ratio: 0.45 maximum by weight.
      c. Air Entrainment:
         1) Exterior Concrete: 6 percent, plus or minus 1-1/2 percent.
      d. Do not add water any time during mixing cycle above amount required to meet specified water / cement ratio. No reduction in the amount of cementitious material is allowed.
   2. Admixtures:
      a. Mix design shall show proposed admixture, amount, usage instructions, and justification for proposed use. Do not use any admixture without Architect's written approval.
      b. Mineral: An amount of specified fly ash not to exceed 20 percent of weight of cement may be substituted for cement. If substituted, consider fly ash with cement in determining amount of water necessary to provide specified water / cement ratio.
      c. Chemical:
1) 4 inch 100 mm slump maximum before addition of high range water reducer.
2) 8 inch 200 mm slump maximum with use of high range water reducer.
3) Specified accelerator or retarder may be used if necessary to meet environmental conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inserts, bolts, boxes, templates, pipes, conduits, and other accessories required by Divisions 22, 23, and 26 shall be installed and inspected before placing concrete.

B. Install inserts, bolts, boxes, templates, pipes, conduits, and other accessories furnished under other Sections to be installed as part of work of this Section. Tie anchor bolts for hold-down anchors and columns securely to reinforcing steel.

C. Remove water and debris from space to be placed.

3.2 INSTALLATION

A. Site Tolerances:
   1. Tolerances shall conform to requirements of ACI 117, except where specified differently.
   2. Local Flatness / Levelness of Interior Slabs:
      a. Specified Overall Value of $F_{28}$ / $F_{20}$ and Minimum Local Value of $F_{15}$ when tested in accordance with ASTM E 1155.
      b. Table Four: Maximum Variation Tolerances.

<table>
<thead>
<tr>
<th>Thickness, standard</th>
<th>plus 3/8 inch, minus 1/4 inch</th>
<th>plus 9 mm, 3 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, footings</td>
<td>minus 0 inch</td>
<td>minus 0 mm</td>
</tr>
<tr>
<td>Plan, 0 - 20 feet</td>
<td>1/2 inch</td>
<td>12 mm</td>
</tr>
<tr>
<td>Plan, 40 feet or greater</td>
<td>3/4 inch</td>
<td>19 mm</td>
</tr>
<tr>
<td>Plan, footings</td>
<td>plus 1/2 inch</td>
<td>plus 12 mm</td>
</tr>
<tr>
<td>Eccentricity, footings</td>
<td>2 inch max standard,</td>
<td>50 mm max standard,</td>
</tr>
<tr>
<td></td>
<td>1/2 inch at masonry</td>
<td>12 mm at masonry</td>
</tr>
<tr>
<td>Openings, size</td>
<td>minus 1/4 inch, plus One inch</td>
<td>minus 6 mm, plus 25 mm</td>
</tr>
<tr>
<td>Openings, location</td>
<td>plus / minus 1/2 inch at center</td>
<td>plus / minus 12 mm at center</td>
</tr>
<tr>
<td>Plumb</td>
<td>1/2 inch max</td>
<td>6 mm max</td>
</tr>
<tr>
<td>Consecutive Steps, treads</td>
<td>1/4 inch</td>
<td>6 mm</td>
</tr>
<tr>
<td>Consecutive Steps, risers</td>
<td>1/8 inch</td>
<td>13 mm</td>
</tr>
<tr>
<td>Flight of Stairs, treads</td>
<td>1/4 inch in total run</td>
<td>6 mm in total run</td>
</tr>
<tr>
<td>Flight of Stairs, risers</td>
<td>1/8 inch in total height</td>
<td>3 mm in total height</td>
</tr>
</tbody>
</table>

B. Placing:
   1. Place as soon after mixing as possible. Deposit as nearly as possible in final position. Placing of concrete shall be continuous until a panel or section is complete.
   2. In order to avoid overloading of forms and ties, observe following rate of filling for various air temperatures:
      a. Table Five: Placing Rate.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Rate of Fill per Hour</th>
<th>Temperature</th>
<th>Rate of Fill per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 deg F</td>
<td>2 feet</td>
<td>4 deg C</td>
<td>600 mm</td>
</tr>
<tr>
<td>50 deg F</td>
<td>3 feet</td>
<td>10 deg C</td>
<td>900 mm</td>
</tr>
<tr>
<td>60 deg F</td>
<td>4 feet</td>
<td>16 deg C</td>
<td>1 200 mm</td>
</tr>
<tr>
<td>70 deg F</td>
<td>5 feet</td>
<td>21 deg C</td>
<td>1 500 mm</td>
</tr>
</tbody>
</table>

3. Compact concrete in forms by vibrating and other means where required. Thoroughly work in concrete around reinforcing bars.
4. Do not embed aluminum in concrete.
5. Do not use contaminated, deteriorated, or re-tempered concrete.
6. Avoid accumulation of hardened concrete.
7. Joints:
   a. Where possible, locate joints under partitions or where joints will cause least disruption to floor coverings.
   b. Construction Joints: Locate where shown on Drawings to least impair strength of completed structure. Construction joints in foundation walls shall not occur within 6 feet 1 800 mm of corner and be keyed.

C. Bonding Fresh And Hardened Concrete:
   1. Re-tighten forms.
   2. Roughen surfaces.
   3. Clean off foreign matter and laitance.
   4. Wet but do not saturate.
   5. Slush with neat cement grout or apply bonding agent.
   6. Proceed with placing new concrete.

D. Special Requirements:
   1. Footings:
      a. Bear 12 inches 300 mm minimum into undisturbed earth or on mechanically compacted engineered fill. Step footings at ratio of 1-1/2 horizontal to One vertical unless detailed otherwise. Exterior wall footing shall bear <Insert Dimension> minimum below finish grades.
      b. Level top of finish footing and leave rough.
      c. Where joints are required, bulkhead, key horizontally, and dowel with two No. 5 reinforcing bars, 48 inches 1 200 mm long.
   2. Foundations And Walls: Leave steel projecting where required for floor tie.
   3. Exterior Slabs:
      a. Dusting with cement not permitted.
      b. For continuous placing and where shown on Drawings, saw cut one inch deep control joints before shrinkage occurs.
   4. Equipment Bases: Coordinate with appropriate Sections for locations and dimensions.
   5. Anchor Bolts: Place anchor bolts not tied to reinforcing steel immediately following leveling of concrete. Reconsolidate concrete around bolt immediately after placing bolt. Do not disturb bolts during finishing process.
   6. Substrate For Geocomposite Foundation Drainage System:
      a. Concrete surfaces shall be of sound structural grade and have smooth finish free of fins, ridges, protrusions, rough spalled areas, loose aggregate, exposed course aggregate, voids or entrained air holes. Rough surfaces shall receive well-adhered parge coat.
      b. Repair voids, rock pockets, and excessively rough surfaces with approved non-shrink grout or grind to match unrepaired areas.
      c. Surfaces at cold joints shall be on the same plane.

E. Finishing:
   1. Rubbed Finish, Exposed Vertical Surfaces:
      a. Immediately after removing forms, remove joints, marks, bellies, projections, loose materials, and cut back metal ties from surfaces to be exposed.
      b. Point up voids with cement mortar, 1:2 mix, and rub exposed surface with carborundum to smooth, even surface.
   2. Steel Trowel Finishes, Interior Flatwork:
      a. Float and steel trowel interior slabs after concrete has set enough to avoid bringing water and fines to surface.
      b. If power troweling is used, get approval of finish from Architect.
   3. Broom Finishes, Exterior Flatwork Not Specified in Section 03 3053:
      a. Broom finish exterior slabs.
      b. Round edges including edges formed by expansion joints.
      c. Remove edger marks.
   4. Rough: Top of slabs and stairs to receive setting bed for ceramic or paver tile.
F. Curing:
   1. Interior Slabs:
      a. Water cure as specified in Section 03 3913, unless Cold Weather Concreting Procedures are necessary.
      b. Membrane cure as specified in Section 03 3923, if Cold Weather Concreting Procedures are necessary.
   2. Concrete Paving: Membrane cure as specified in Section 03 3923.
   3. All Other Concrete Flatwork And Curbs: Membrane cure as specified in Section 03 3923

3.3 FIELD QUALITY CONTROL

A. Inspection: Notify Architect three days minimum before placing concrete for footings, foundation walls, and building slabs.

3.4 ADJUSTING

A. Remedy For Out-of-Tolerance Building Slabs:
   1. Sections of slabs to be covered by carpet, which do not meet specified tolerances but are within 10 percent of specified tolerances, may be corrected by grinding or filling, at Owner’s option. Remove and replace sections of slabs measuring outside specified correctable tolerances.
   2. If floor leveling compounds or concrete patching compounds are required to bring floor into specified tolerances in carpeted areas, they will be provided by Owner in conjunction with carpet installation and back-charged to Contractor.

3.5 PROTECTION

A. Protect concrete that has not received its initial set from precipitation to avoid excess water in mix and unsatisfactory surface finish.

B. Do not allow materials resulting from construction activities, which will affect concrete or application of finish floor systems adversely, to come in contact with interior concrete slabs.

END OF SECTION