KOMPONENT
By CTS Cement Manufacturing Corp.

CSI SECTION 03 31 00 – CAST-IN-PLACE CONCRETE
03 31 19 – SHRINKAGE-COMPENSATING STRUCTURAL CONCRETE
03 33 00 – ARCHITECTURAL CONCRETE- CAST-IN-PLACE CONCRETE
03 47 19 – SITE CAST CONCRETE
03 53 00 – CONCRETE OVERLAYMENT
03 70 00 – MASS CONCRETE
03 61 00 – CEMENTITIOUS GROUTING

Type K Shrinkage-Compensating Cement Concrete for Concreting or Grouting Applications, including: Cast-in-Place Concrete, Pre-Stressed Concrete, Post-Tensioned Concrete, Mass Concrete, Architectural Concrete

SPECIFIER NOTE: *The following guideline specification has been prepared to assist Architect or Engineers and design professionals in the preparation of project master specifications. It is intended for use by qualified design professionals and is not intended to be used verbatim. Appropriate modifications to meet specific project requirements are required. Make appropriate [selections] where options are provided and delete items that are not applicable to the project. Contact CTS Cement Technical Support for additional information or project specification assistance.*

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply and installation of cast-in-place shrinkage-compensating cement concrete, including formwork, concrete materials, mixture design, placement procedures and finishes.

1.2 RELATED SECTIONS

[A. Section 03 30 00 - Cast-in-Place Concrete
[B. Section 03 31 00 - Structural Concrete
[C. Section 03 33 00 - Architectural Concrete
[D. Section 03 38 00 - Post-Tensioned Concrete
[E. Section 03 40 00 - Precast Concrete
[F. Section 03 41 00 - Precast Structural Concrete
[G. Section 03 45 00 - Precast Architectural Concrete
[H. Section 03 47 00 - Site-Cast Concrete
[I. Section 03 50 00 - Cast Decks and Underlayment
[J. Section 03 70 00 - Mass Concrete

1.3 REFERENCES

[A.	ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
[B.	ASTM C33	Standard Specification for Concrete Aggregates
[C.	ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
[D.	ASTM C94	Standard Specification for Ready-Mixed Concrete
[E.	ASTM C150	Standard Specification for Portland Cement
[F.	ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
[G.	ASTM C289	Standard Test Method for Potential Alkali-Silica Reactivity for Aggregates (Chemical Method)
[H.	ASTM C494	Standard Specification for Chemical Admixtures for Concrete

[I.	ASTM C779	Standard Test Method for Abrasion of Horizontal Concrete Surfaces
[J.	ASTM C805	Standard Test Method for Rebound Number of Hardened Concrete
[K.	ASTM C806	Standard Test Method for Restrained Expansion of Expansive Cement Mortar
[L.	ASTM C845	Standard Specification for Expansive Hydraulic Cement
[M.	ASTM C878	Standard Test Method for Restrained Expansion of Shrinkage-Compensating Concrete
[N.	ASTM C979	Pigments for Colored Concrete
[O.	ASTM C1028	Static Co-Efficient of Friction Values (SCOF)
[P.	ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
[Q.	ASTM C1293	Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
[R.	ASTM E1155	Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
[S.	ACI 117	Specification for Tolerances of Concrete
[T.	ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
[U.	ACI 223	Guide for the Use of Shrinkage-Compensating Concrete
[V.	ACI 301	Specifications for Structural Concrete
[W.	ACI 302.1R	Guide for Concrete Floor and Slab Construction
[X.	ACI 305.1	Guide to Hot Weather Concreting
[Y.	ACI 306.1	Guide to Cold Weather Concreting
[Z.	ACI 308	Guide to Curing Concrete
[AA.	ACI 318	Building Code Requirements for Structural Concrete
[BB.	ACI 347	Guide to Formwork for Concrete
[CC.	ACI 350	Code Requirements for Environmental Engineering Concrete Structures

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, apply to this section.

1.5 SUBMITTALS

A. General: Submit samples and manufacturer's product data sheets, installation instructions, reference guidelines, Safety Data Sheets (SDS), etc. in accordance with Division 01 General Requirements Submittal Section.

SPECIFIER NOTE: *Modify to suit sustainability requirements for the project.*

[A. General: Submit samples and manufacturer's product data sheets, installation instructions, reference guidelines, Safety Data Sheets (SDS), etc. in accordance with Division 01 General Requirements Submittal Section. Submit LEED™ point potential and EPD Transparency Briefs.

B. Design Mixtures: Submit preliminary mix designs to the project Engineer and CTS Cement Manufacturing Corp. for review [six (6)] [eight (8)] weeks prior to initial concrete placement. For each concrete mixture, submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Maintain mix designs approved by the project Engineer for the project with Project Contract Documents.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Location of construction joints is subject to approval of the Architect or Engineer.

E. Test Data: Submit qualified testing data that confirms compliance with specified performance requirements.

SPECIFIER NOTE: *Modify below to suit project scope and requirements.*

F. Material Certificates for each of the following, signed by respective manufacturers:

[1. Cementitious materials.

[2. Admixtures.

[3. Form materials and form-release agents.

[4. Steel reinforcement and accessories.

[5. Fiber reinforcement.

[6. Waterstops.

[7. Curing compounds.

[8. Floor and slab treatments.

[9. Bonding agents.

[10. Adhesives.

[11. Vapor retarders.

[12. Semirigid joint filler.

[13. Joint-filler strips.

[14. Repair materials.

[15. Evaporation Retardant

[16. Integral Color.

[17. Colorants/Stains.

SPECIFIER NOTE: *Additional information on items [18. and [19. below can be found at PNA Construction Technologies, www.pna-inc.com. See Diamond Dowel® System and Armor-Edge® Joint Assembly.*

[18. Dowels/Tapered Plate Dowels

[19. Precision, Steel Bar Joint Assemblies

G. Material Test Reports for the following from a qualified testing agency:

[1. Aggregates: [Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.]

H. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

[I. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

J. Field quality-control reports.

K. Minutes of pre-installation conference.

1.6 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at the Project Site located at [enter site address] at least three (3) weeks prior to initial concrete placement.

B. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

[1. Owner, Owner's Representative or Developer.

[2. Architect.

[3. Contractor's superintendent/supervisor.

[4. Independent testing agency responsible for concrete testing.

[5. Concrete producer.

[6. Concrete Subcontractor, including Finishers and Supervisor.

[7. Polished Concrete Subcontractor, including Supervisor.

[8. Shrinkage-compensating cement manufacturer.

[9. Admixture manufacturer(s).

[10. Complementary hardeners, sealers, colorants manufacturer(s).

[11. Walkway Auditor.

[12. Building Inspector/QC Inspector.

[13. Engineer or Architect of Record.

C. Before submitting design mixtures, review concrete design mixtures, procedures for ensuring consistent quality of concrete materials, [special inspection and testing and inspecting agency procedures for field quality control,] [concrete finishes and finishing,] [cold- and hot-weather concreting procedures,] [curing procedures,] [construction contraction and isolation joints, and joint-filler strips,] [semi-rigid joint fillers,] [forms and form removal limitations,] [shoring and reshoring procedures,] [vapor-retarder installation,] [anchor rod and anchorage device installation tolerances,] [steel reinforcement installation,] [methods for achieving specified floor and slab flatness and levelness] [floor and slab flatness and levelness measurement,] [concrete repair procedures,] and concrete protection.

1.7 QUALITY ASSURANCE

A. Manufacturer:

1. Must have marketed shrinkage-compensating cement materials in the United States for at least fifteen (15) years and must have completed projects of the same general scope and complexity.

2. Shrinkage-compensating cement and complementary admixture materials must be manufactured by or approved for use by CTS Cement Manufacturing Corp. and distributed by the same or an authorized CTS Cement dealer. (Contact Susan Foster at e. sfoster@ctscement.com, c. (714) 614-7392, o. (800) 929-3030, www.CTScement.com)

B. Concrete Applicator:

1. Must be experienced and competent in installation of shrinkage-compensating concrete and who employs on the Project personnel qualified as [ACI Certified Concrete Flatwork Finisher and Technician] [, Specialist: _____] and a qualified supervisor who is ACI Certified as [Concrete Flatwork Finisher and Technician] [, Specialist: _____]] [Concrete Quality Technical Manager] [_____].

2. Must be a currently listed Komponent® Shrinkage-Compensating Concrete Qualified Contractor holding a valid Certificate of Completion for the CTS Qualified Contractor Program.

3. Applicator must provide evidence of a minimum of five years of experience in work similar in size and scope to that required by this section.

C. Concrete Producer:

1. Must be experienced in manufacturing ready-mixed concrete products and comply with ASTM C 94/C 94M requirements for production facilities and equipment.

2. Manufacturer compliant with [NRMCA's Ready Mixed Concrete Production Facilities].

D. Testing Agency:

1. An independent testing agency qualified according to ASTM C1107 and ASTM E329 for testing indicated.

a. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program and be familiar with Type K Shrinkage-Compensating Cement Concrete.

b. Personnel performing laboratory tests must be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing Agency Laboratory Supervisor must be an ACI-certified Concrete Laboratory Testing Technician, Grade II and be familiar with Type K Shrinkage-Compensating Cement Concrete and associated ASTM shrinkage-compensating cement testing methods.

[E. Walkway Auditor:

1. Certified by CPAA or NFSI to test polished concrete floors for dynamic and static coefficient of friction according to ANSI B101.1 and B101.3.

[F. Coefficient of Friction:

1. Achieve following coefficient of friction by field quality control testing in accordance to the following standards:

a) ANSI B101.1 Static Coefficient of Friction - Achieve a minimum of [.5] for level floor surfaces.

b) ANSI B101.3 Dynamic Coefficient of Friction - Achieve a minimum of [.35] for level floor surfaces.

G. Mockups:

1. Cast concrete panels to represent work to be expected, including typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

2. Placement and finishing work must be performed by same personnel as will place and finish concrete for Project.

3. Mock-ups must be accepted/rejected by owner/architect/representative prior to construction.

4. Maintain and make approved samples available at the job site throughout the construction process and until final acceptance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Cement: Deliver cementitious materials to the concrete producer in bulk or pre-packaged units. Deliver products in original, unopened, undamaged packaging with manufacturer's identification (i.e., brand logo, product name, weight of packaged unit, lot number). Use appropriate measures to protect from damage and deterioration during transit.

2. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage to steel reinforcement and applied coatings.

[3. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

[4. Complementary Products: Deliver, store, and handle all densifiers, sealers, coatings, etc. according to manufacturer's instructions. Deliver products in original, unopened, undamaged packaging with manufacturer's identification (i.e., brand logo, product name, weight of packaged unit, lot number). Use appropriate measures to protect from damage and deterioration during transit.

B. Storage: Store all materials according to manufacturer's instructions and prevent damage or deterioration.

1. Store bulk cement material in clean silos.

2. Store bagged cement products in a dry location, covered, out of direct sunlight, off the ground, and protected from moisture. Maintain storage temperature required by the manufacturer. Keep materials dry until used.

3. Store bulk sand in a well-drained area on a clean, solid surface. Protect from inclement weather and prevent contamination.

4. Store all complementary products in accordance with manufacturer's written instructions for temperatures, moisture, ventilation, and other conditions affecting product integrity.

1.9 SITE / ENVIRONMENTAL CONDITIONS

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

1. When average high and low temperature is expected to fall below 40°F (4.4°C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 90°F (32°C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 FIELD CONDITIONS

A. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.

1. Prohibit use of markers, spray paint, and soapstone.

2. Prohibit vehicle traffic over concrete surfaces.

3. Prohibit pipe-cutting operations over concrete surfaces.

4. Prohibit storage of any items over concrete surfaces for not less than 14 days after concrete placement.

5. Prohibit ferrous metals storage over concrete surfaces.

6. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces.

7. Protect from acids and acidic detergents contacting concrete surfaces.

8. Protect from painting activities over concrete surfaces.

PART 2 PRODUCTS

2.1 CONCRETE

A. Comply with current International Building Codes and ACI 301, ACI 319, ACI 350[, enter other as appropriate for the project].

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

2.3 REINFORCEMENT

A. As specified in Section 03 20 00.

SPECIFIER NOTES: *Modify to suit sustainability requirements for the project. Type K Shrinkage-Compensating Concrete can be used with all types of reinforcement, giving designers maximum flexibility in optimizing design, performance, sustainability and value.*

When using Type K Shrinkage-Compensating Concrete, the following considerations apply to reinforcement requirements for the concrete element. Review the current ACI 223 publication for additional information.

- *Rebar, welded wire fabric, or steel fibers provide sufficient restraint for Type K concrete.*
- *For non-structural concrete, steel reinforcing must have a minimum p = 0.15%.*
- *For structural concrete, normal structural reinforcement is sufficient to provide required restraint for Type K concrete.*

When using Synthetic Microfiber Reinforced Shrinkage-Compensating Concrete:

- *For non-structural concrete, such as topping slabs or slabs on grade, only minor reinforcement (two #4 bars, 6 in. from edge) is required around the perimeter of the slab, and double diagonal #4 bars, 4 feet long at re-entrant corners and at penetrations. No additional steel reinforcement is required. Contact the Type K cement manufacturer for additional information.*

2.4 TYPE K CEMENT

SPECIFIER NOTE: *Modify below to suit project scope and requirements.*

[A. Komponent®: Expansive cement additive that is combined with local ASTM C150 Type I, II, IV or V portland cement at a ratio of approximately 15% Komponent® and 85% portland cement at the batch plant or on site to create ASTM C845 Type K Cement. The exact percentages are determined during mix design review and testing per ASTM C878. Site mixed Type K Cement is used in conjunction with traditional reinforcement.

[B. Type K Cement: Pre-blended units of Komponent® expansive cement additive combined with ASTM C150 Type II portland cement at 15% Komponent® and 85% portland cement. Pre-blended Type K Cement is used in conjunction with traditional reinforcement.

D. Material must meet ASTM C845 (modified) as a Type K Cement.

E. Material must provide expansion from 0.04% to 0.10% at 7 days when tested in accordance with ASTM C878 (modified) by CTS Cement Manufacturing Corp. or a qualified laboratory approved by CTS Cement.

F. Concrete trial batches must be performed per CTS Cement's recommended mix designs and approved by the Structural Engineer.

G. Mix Design – Type K Cement Concrete

SPECIFIER NOTE: *Refer to CTS Cement's Mix Design Guidelines for additional information.*

1. Refer to drawings for required properties of all mix designs including 28-day strength, expansion, maximum water/cement ratio, maximum aggregate size, slump range, and air entrainment requirements.

2. Mix design to be developed per the shrinkage-compensating cement manufacturer's guidelines, and the most current ACI 223 and ACI 211.1 recommendations.

3. Designed expansion must be verified per ASTM C878.

2.5 SUPPLEMENTARY CEMENTITIOUS MATERIALS

SPECIFIER NOTE: *When using supplementary cementitious materials in a Type K shrinkage-compensating concrete or grout mix design, CTS will recommend percentages to optimize performance, workability, and sustainability. Contact CTS Cement Technical Support for additional information or mix design assistance.*

A. Fly Ash: Comply with ASTM C618, Class [F] [C]. Report the chemical analysis of the fly ash in accordance with ASTM C311. Evaluate and classify fly ash in accordance with ASTM D5759.

B. Slag Cement: Comply with ASTM C989, Grade [___].

C. Silica Fume: Comply with ASTM C1240.

SPECIFIER NOTE: *Silica fume can be used with Type K cement, though its use is not commonly incorporated into the mix design. The benefits of silica fume can be achieved by the use of Type K cement alone without the negative impacts on workability and constructability often experienced when silica fume is used.*

2.6 AGGREGATES

D. Fine and coarse aggregates must conform to ASTM C33/C33M.

E. Lightweight aggregates must conform to ASTM C330/C330M.

F. Provide aggregates from a single source with a documented satisfactory service record for at least 10 years in similar applications and service conditions using similar aggregates and cementitious materials.

2.7 ADMIXTURES

A. Must be approved by the shrinkage-compensating cement manufacturer to be compatible with other admixtures and suitable for use with Type K Cement. Admixtures must be submitted during mix design review for appropriate evaluation and testing.

B. Admixtures must conform to ASTM C494.

C. Air entraining admixture must conform to ASTM C260/C260M.

[2.8 COLOR PIGMENTS

A. Must comply with ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures and be color stable,[free of carbon black,] nonfading, and resistant to lime and other alkalis.

2.9 WATER

A. Clean, potable water compliant with ASTM C94/C94M.

2.10 SLIP SHEET MATERIAL

SPECIFIER NOTES:
(1) Shrinkage-compensating concrete slabs-on-grade require the use of a slip sheet to reduce subgrade friction and allow for the necessary movement during expansion. It is also used to retain moisture in the slab during the initial cure period. Slab-on-grade base materials should be proof rolled and show no more than 1/2-inch (13mm) rutting. A smooth, well compacted base without ruts will provide the best substrate and produce the best long-term results.

(2) The slip sheet is not intended to function as a vapor barrier. If subgrade conditions warrant the use of a vapor barrier, it should be specified in conjunction with one layer of 6 to 8 mil (0.15 to 0.20mm) polyethylene sheeting that will act as the slip sheet.

[A. Slab-on-Grade: Minimum single-layer of 6-8 mil (0.15 to 0.20mm) polyethylene sheet designed to perform as a slip-sheet to minimize friction and restraint exerted by the base and used to retain moisture in the slab during the initial cure period. For use with smooth, well compacted subgrade without ruts. Minimum two layers of 6 mil (0.155mm) polyethylene sheet (total 12 mils (0.31mm)) is required for coarser subgrade with rutting where the integrity of the first slip sheet may be compromised during construction.

[A. Slab-on-Grade: Minimum single-layer of 6-8 mil (0.15 to 0.20mm) polyethylene sheet, used in conjunction with an on-grade vapor barrier, designed to perform as a slip-sheet to minimize friction and restraint exerted by the base and used to retain moisture in the slab during the initial cure period.

2.11 CURING MATERIALS

SPECIFIER NOTE: *Topically applied curing compounds are not recommended for use with shrinkage-compensating concrete. They impede the formation of ettringite crystals necessary to achieve designed expansion during cement hydration and concrete cure.*

A. Absorptive Cover: Burlap or burlene compliant with AASHTO M182, Class 3 or Class 4 or two (2) layers of Class 1 or Class 2.

B. Moisture-Retaining Cover: UltraCure or similar compliant with ASTM C171 for white opaque polyethylene film or white burlap-polyethylene sheets. Clear or black polyethylene film may be used for cold weather protection.

C. Water: Clean, potable water compliant with ASTM C94/C94M.

[2.12 LIQUID APPLIED PRODUCTS

[A. Liquid Densifier: An Aqueous solution of Silicon Dioxide dissolved in one of the following Hydroxides that penetrates into the concrete surface and reacts with the Calcium Hydroxide to provide a permanent chemical reaction that hardens and densifies the wear surface of the cementitious portion of the concrete. All of the following have the same chemistry varying only by the alkali used for solubility of the Silicon Dioxide.

1. Sodium Silicate
2. Potassium Silicate
3. Lithium Silicate
4. Alkalis solution of Colloidal Silicates or Silica

SPECIFIER NOTE: *Modify below to suit project scope and requirements. Retain one of the following two paragraphs when specifying colored finish.*

[B. Dye: Non-film forming soluble colorant dissolved in a carrier designed to penetrate and alter coloration and appearance of a concrete floor surface without a chemical reaction. Color: [_____]

[B. Pigmented Micro Stains: Fine pigment particles (<3.9 x 10-4 inches) suspended in water-based silicate solution that penetrates concrete and reacts with calcium hydroxide to lock in color particles. Color: [_____]

2.13 RELATED MATERIALS

SPECIFIER NOTE: *Modify to suit project scope and requirements. Include, as appropriate: reglets, dovetail anchors, joint treatment materials, bonding agents, etc.*

A. Evaporation Retardant: Water-based, VOC-compliant, and designed to form a thin, monomolecular film to reduce rapid moisture loss from the concrete surfaces prior to curing.

B. Repair Material: A product that is designed to repair cracks and surface imperfections. The specified material must have sufficient bonding capabilities to adhere after the polishing to the concrete surface and provide abrasion resistance equal to or greater than the surrounding concrete substrate.

C. Grout Material: A thin mortar used for filling spaces. Acceptable products shall be:

1. Epoxy, urethane, polyurea, or polyaspartic resins.
2. Latex or acrylic binders mixed with cement dust from previous grinding steps.
3. Silicate binders mixed with cement dust from previous grinding steps.

D. Protective Cover: Non-woven, puncture and tear resistant, polypropylene fibers laminated with a multi-ply, textured membrane, not less than 18 mils (0.46mm) in thickness.

2.14 PERFORMANCE REQUIREMENTS, CONCRETE MIX DESIGN

SPECIFIER NOTE: *Modify to suit project scope and requirements.*

A. Compressive Strength, Minimum: [Enter Number] at 28 Days

B. Water/Cement Ratio, Maximum: [Enter Number]

C. Slump Limit: At point of placement, 6 inches +/- 1.5 inches (152mm +/-38mm)

D. Air Content: [Enter Number] percent, +/- 1.5 percent at point of delivery for [Enter Number] nominal maximum aggregate size.

PART 3 EXECUTION

3.1 FORMWORK INSTALLATION

A. As specified in Section 03 10 00.

3.2 STEEL REINFORCEMENT INSTALLATION

A. As specified in Section 03 20 00.

[3.3 SLIP SHEET INSTALLATION

SPECIFIER NOTE:
A slip sheet is required for slab-on-grade and unbonded topping slab applications using Shrinkage-Compensating Concrete. Review the current Komponent® Shrinkage-Compensating Concrete Reference Guide for additional information.

A. Ensure installation of formwork, reinforcement, and embedded items is complete and required inspections are completed prior to installation.

B. Slip sheet and all reinforcement must be in place prior to the day of the pour.

C. Position slip sheet installation directly [on-grade] [on top of the sub-base slab] [other].

D. Ensure complete and secure coverage of the slip sheet layers. Overlap edges of each sheet at least 8 inches (203mm). Stagger overlaps in a shingle fashion and ensure top side overlapping. Avoid alignment of ends sheet to sheet. Extend sheets up onto vertical formwork at least 3 inches (76.2mm). Prevent direct bond to vertical surfaces.

E. Avoid damage to the slip sheet during construction. If damage occurs, repair or replace the damaged section of slip sheet prior to placement of concrete. Ensure the integrity of the slip sheet is fully restored.

3.4 JOINTS

A. Coordinate joint types, description, and location with Drawings.

B. Construct joints in accordance with ACI 222.3R, ACI 224.3R, ACI 302.1R using industry best practices to ensure joints are true to line with faces perpendicular to surface plane of concrete.

SPECIFIER NOTES: *(1) Type K Shrinkage-Compensating Concrete allows extended joint spacing up to 150ft x 150ft (45.7m x 45.7m) based on project designs. Modifications to joint spacing can be made up to 3:1 L/W in accordance with current ACI 223 guidelines. Joint spacing guidelines are provided in accordance with current ACI 223 and in conjunction with panel thicknesses. Modify as required to meet specific project requirements, concrete element designs, and site conditions. (2) Consult the Structural Engineer and Project Designer for evaluation and appropriate modifications for project specific concrete elements. (3) Minimum thickness for Type K or System-K™ Shrinkage-Compensating Concrete topping slabs is 2 inches (50.8mm).*

C. Contraction Joints: When necessary, install as soon as possible after finishing using a triangular arbor configuration saw blade to reduce edge raveling or dislodging aggregates at the spacing indicated on and in coordination with Drawings and in compliance with guidelines for the use of shrinkage-compensating concrete.

D. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect or Engineer and in agreement with reduced construction joint requirements for Type K Shrinkage-Compensating Concrete.

   a. Use a bonding agent at locations where fresh concrete is placed against hardened and partially hardened concrete surfaces.

E. Isolation/Expansion Joints: Install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.5 CONCRETE MIXING

A. Concrete production must comply with ASTM C94/C94M except where stated herein.

B. For bulk introduction, standard batching and mixing procedures and industry best practices should be used.

C. If bags are used, one of the following methods should be used in compliance with manufacturer's published procedures for batching and mixing.

a. Use pre-blended Type K expansive cement.

b. Use of the Komponent expansive additive added via a pre-mixed slurry or slurry pump at the plant, or by slurry pump at the jobsite.

c. Do not dry feed material into the mixer after batching portland cement concrete components.

d. Do not use damaged or broken bags/units, or partially used bags/units from previous projects.

D. To increase the slump or workability at the job site, use water reducers, hydration stabilizers, or plasticizers per manufacturer's dosage rates and recommendations. Trim water can be added successfully not to exceed the designed w/c ratio. Suitability of adding water at the job site is determined by the project engineer. Do not add water to concrete during delivery.

SPECIFIER NOTE: *Adding water after initial mixing can inhibit designed expansion of the shrinkage-compensated concrete. Mix design adjustments should be made at the batch plant during initial production and within the designed w/c ratio.*

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Concrete temperature at placement must not exceed 90°F (32°C). No concrete shall be placed that is 90 minutes or older measured from the time of initial production.

C. Concrete temperature at placement must not be less than 55°F (13°C). Protect concrete from freezing temperatures for 7 days after placement.

D. Subgrade temperature shall not be less than 40°F at time of placement. Ambient conditions must be 40°F (4°C) and rising at time of placement.

E. Placement techniques must comply with the ACI Manual of Concrete Practice.

[F. Slab-on-Grade Floor Flatness and levelness requirements are:

1. FF = [_____], Specified Overall Value in [_____ areas as detailed on drawings]
2. FF = [_____], Minimum Local Value in [_____ areas as detailed on drawings]
3. FL = [_____], Specified Overall Value in [_____ areas as detailed on drawings]
4. FL = [_____], Minimum Local Value in [_____ areas as detailed on drawings]

[G. Initial flatness and levelness should be tested within 8 hours after completion of the final troweling operation according to ASTM E1155 *Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers* by an independent testing agency experienced with the testing procedure and possessing the necessary equipment. Additional testing to be conducted at [6 months] [9 months] [12 months] [24 months] to ensure long-term performance requirements achieved.

H. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

I. Deposit and consolidate concrete in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

J. Submit delivery ticket from plant for each concrete load.

K. Use evaporation retardants to protect the concrete surface from sudden loss of water when concrete is exposed to sun and wind.

L. Maximum length of chutes is 50 feet (15.24m). Do not allow concrete to be dropped freely more than five (5) feet (1.5m).

3.7 CONCRETE FINISHING

A. Finishing techniques must comply with the ACI Manual of Concrete Practice. Floors and slabs must comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces.

B. Type K Shrinkage-Compensating Cement Concrete produces little bleed water, so the start of finishing must be when the concrete has started to set. One-quarter (1/4) inch (6.35mm) depression method may be used to determine the time to commence finishing operations.

C. Finish Level: [Smooth-Formed] [Rough-Formed] [Rubbed] [Scratch] [Float] [Trowel] [Fine Broom] [Other]

3.8 CONCRETE PROTECTION & CURING

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

B. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days using one of the following methods:

1. Continuous water-fog spray.

2. Water Cure: Water cure for seven (7) days by absorptive or moisture-retaining cover. Start water curing as soon as it can be done without marring the surface.

   Continuous inspection to ensure 100% absorptive or moisture-retaining cover contact with surface to be cured is required. Use appropriate restraints to keep the material in place where wind or other hindrance to full contact and wet cure could be an issue. Periodic monitoring of moisture retention in the curing blanket is required and additional water applied as required.

   Ensure material is rolled out flat and evenly. Avoid wrinkles and bubbles. Uneven or raised material will result in irregular aesthetics and must be avoided.

   a) Absorptive Cover: Wet burlap or burlene, water saturated, and keep continuously wet. Cover concrete surfaces and edges ensuring a 12 inch (300mm) lap over adjacent absorptive covers.

   b) Moisture-Retaining: Flood the surface of the concrete with water and immediately cover with polyethylene film or white burlap-polyethylene sheets. Keep the surface continuously wet. Cover concrete surfaces and edges ensuring a 12 inch (300mm) lap over adjacent moisture-retaining covers.

[3. For Vertical Elements and Elevated Slabs: Break forms the day following the pour. Immediately follow with a 7-day wet cure of all exposed surfaces. If forms cannot be removed the day following placement, contact CTS Cement for additional curing information.

C. Start water cure as soon as it can be done without marring the surface.

D. Surface must be kept continuously wet. Drying of the surface is not allowed.

3.9 CONCRETE ACCEPTANCE OF SURFACE AND CONDITIONS

A. Examine substrates for compliance with requirements and other conditions affecting performance.

[1. Concrete Finished Floor Flatness and Floor Levelness according to applicable Division 03 Section on cast-in-place concrete.

2. Concrete curing methods according to applicable Division 03 Section on cast-in-place concrete.

3. Concrete Compression strength per according to applicable Division 03 Section on cast-in-place concrete.

B. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.

C. Starting work within a particular area will be construed as acceptance of surface conditions.

SPECIFIER NOTE: *Modify below to suit project scope and requirements.*

3.10 PREPARATION

A. Cleaning New Concrete Surfaces:

1. Prepare and clean concrete surfaces.

2. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, bond breakers, and other contaminants incompatible with liquid applied products and polishing.

3. Use mechanical removal methods as needed to ensure a neutralized and clean substrate completely free of bond breakers or other contaminants that would inhibit performance or aesthetic results.

[3.11 COLORING CONCRETE FLOORS

A. Dye or Pigmented Micro Stain Application:

1. Apply solution by methods and techniques required by manufacturer to produce finish matching approved field mock-ups.

2. Maintain wet edge, working newly applied solution into edges of adjacent wet edges of previously treated surfaces.

3. Maintain consistent saturation throughout application.

4. Avoid splashing, dripping, or puddling of solution on adjacent substrates.

5. When color matches approved mock-ups, neutralize as required by manufacturer.

3.12 FIELD QUALITY CONTROL

A. Field Testing: Engage a qualified walkway auditor to perform field testing to determine if concrete floor finish complies with specified coefficient of friction:

1. ANSI B101.1 for static coefficient of friction.
2. ANSI B101.3 for dynamic coefficient of friction.

3.13 PROTECTION

A. Covering: After completion of polishing, protect polished floors from subsequent construction activities with protective covering.

END OF SECTION

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This sample guideline specification is intended for use by a qualified design professional. The sample guideline specification is not intended to be used verbatim as an actual specification without appropriate modifications for the specific project requirements.