during the construction completion operations.
The Contractor shall provide for an independent testing laboratory to analyze the sample of asphalt material to verify that it conforms to the requirements of HFMS-2P, ASTM D2027 Asphalt Material. The cost for testing of the asphalt material will be considered incidental to the bid price for the various items of work involved.

B. Aggregates: The Contractor shall provide for an independent testing laboratory to perform testing of the material to be used as a cover aggregate to evaluate its compliance with the requirements contained in these specifications. The Contractor shall provide test results for one sample prior to the beginning of operations and for two (2) samples obtained by the Engineer during the construction operations.
   1. The cost for the testing of aggregate samples shall be considered incidental to the bid price for various items involved in the completion of the seal coat work.

3.6 TRIAL APPLICATION

A. At the onset of operations to apply the seal coat, a test section at least 100 foot long by 20 foot wide shall be placed by the Contractor using the approved job material. The material shall be placed in accordance with the specified requirements. The application rates of the bituminous material and the aggregate shall be evaluated to insure conformance with the specification requirements. Placement of additional seal coat on other project areas shall not commence until the Engineer approves the application rates of the bituminous and aggregate material.

3.7 TRAFFIC CONTROL

A. Contractor shall provide flaggers, signs, and barriers to warn, direct, and prevent traffic from traveling on freshly applied asphalt until it has penetrated, and does not track or pickup on the tires of vehicles.

END OF SECTION

# SECTION 32 16 13 - CURB AND GUTTER

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Included in this section is all work related to placement of curb and gutter, fillet and valley gutter. This includes the furnishing and placement of Portland Concrete Cement (PCC) for constructing curb and gutter, including applicable reinforcing steel, expansion material, jointing, joint sealing and finishing.

### 1.2 RELATED SECTIONS

A. Section 31 23 13 - Subgrade Preparation

B. Section 32 11 23 - Aggregate Base Courses

C. Section 32 16 23 - Sidewalks

D. Section 32 17 26 - Tactile Warning Surfacing

### 1.3 REFERENCES

A. The following Sections of the “GreenBook” Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNi Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:

1. Section 201-1 - Portland Cement Concrete
2. Section 301-1 - Subgrade Preparation
3. Section 303-5 - Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps and Driveways

### 1.4 SUBMITTALS

A. Submit complete mix design and test reports.

B. Submit Material Certificates for

1. Steel reinforcement and reinforcement accessories.
2. Admixtures
3. Curing compounds
4. Applied finish materials
5. Bonding agent or epoxy adhesive

6. Joint fillers

1.5 QUALITY ASSURANCE

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

B. 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 (American Concrete Institute) ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Shall comply with Division 3, Cast-In-Place Concrete. Proportioning of ingredients shall be in accord with an Engineer approved mix design. Minimum compressive strength shall be 4000 psi at 28 days.

B. Cementitious Material: Use cementitious materials, of same type, brand, and source throughout Project:

C. The cementitious materials shall be in accordance with the approved mix designs

D. Normal-Weight Aggregates: Aggregates shall be in accordance with Local and State Standard Specifications.

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

F. Air-Entraining Admixture: ASTM C 260.

G. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM C 494, Type A.

2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

## 2.2 CURING MATERIALS

A. Absorptive Cover: (American Association of State Highway and Transportation Officials) AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

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

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. Provide evaporation retarders by:
   a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
   b. BASF Construction Chemicals, LLC; Confilm.
   c. ChemMasters; Spray-Film.
   d. Conspec by Dayton Superior; Aquafilm.
   e. Dayton Superior Corporation; Sure Film (J-74).
   f. Edoco by Dayton Superior; BurkeFilm.
   g. Euclid Chemical Company (The), an RPM company; Eucobar.
   h. Kaufman Products, Inc.; VaporAid.
   i. iLambert Corporation; LAMBCO Skin.
   j. L&M Construction Chemicals, Inc.; E-CON.
   k. Meadows, W. R., Inc.; EVAPRE.
   l. Metalcrete Industries; Waterhold.
   m. Nox-Crete Products Group; MONOFILM.
   n. Sika Corporation, Inc.; SikaFilm.
   o. SpecChem, LLC; Spec Film.
   p. Symons by Dayton Superior; Finishing Aid.
   q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
   r. Unitex; PRO-FILM.
   s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Provide curing compounds by:

a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; D.O.T. Resin Cure.
d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
e. Edoco by Dayton Superior; DSSCC Clear Resin Cure.
f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; AQUA KURE - CLEAR.
i. L&M Construction Chemicals, Inc.; L&M CURE R.
j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
k. Nox-Crete Products Group; Resin Cure E.
l. I. SpecChem, LLC; PaveCure Rez.
m. Symons by Dayton Superior; Resi-Chem Clear.
n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
o. TK Products, Division of Sierra Corporation; TK-2519 WB.
p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.
1. Provide curing compounds by:
a. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
b. ChemMasters; Safe-Cure 2000.
c. Conspec by Dayton Superior; D.O.T. Resin Cure White.
d. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).
f. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; AQUA KURE - WHITE.
i. L&M Construction Chemicals, Inc.; L&M CURE R-2.
j. Meadows, W. R., Inc.; 1100-WHITE SERIES.
k. SpecChem, LLC; PaveCure Rez White.
l. Symons by Dayton Superior; Resi-Chem White.
m. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

## 2.3 RELATED MATERIALS

A. Joint Fillers: [ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

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

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
   1. Types I and II, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
   1. Provide surface retarders by:
      a. ChemMasters; Exposee.
      b. Conspec by Dayton Superior; Delay S.
      c. Dayton Superior Corporation; Sure Etch (J-73).
      d. Edoco by Dayton Superior; True Etch Surface Retarder.
      e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
      f. Kaufman Products, Inc.; Expose.
      g. Meadows, W. R., Inc.; TOP-STOP.
      h. Metalcrete Industries; Surftard.
      i. iNox-Crete Products Group; CRETE-NOX TA.
      j. jScofield, L. M. Company; LITHOTEX Top Surface Retarder.
      k. Sika Corporation, Inc.; Rugasol-S.
      l. SpecChem, LLC; Spec Etch.
      m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
      n. Unitex; TOP-ETCH Surface Retarder.
      o. Vexcon Chemicals Inc.; Certi-Vex Envioset.

## 2.4 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience. Mix designs must be a State approved mix.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 3,500 psi for cast in place concrete and 4,500 psi for precast concrete unless stated otherwise on the plans.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.32 to 0.42 based on State Standard Specifications.
3. Slump Limit: 2inches to 4 inches plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 5 percent to 8 percent for ¾ inch and 1-inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture high-range, water-reducing admixture high-range, water-reducing and retarding admixture, and plasticizing and retarding admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Do not exceed 95 degrees F concrete temperature at time of placement.

E. Cementitious Materials: Use fly ash or ground granulated blast-furnace slag to reduce the total amount of portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 15 percent for Class F Fly Ash and 20 percent for Class C Fly Ash.
2. Ground Granulated Blast-Furnace Slag: 25 percent.

## 2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
2. When the anticipated temperature of the concrete is 95 degrees or higher, the materials shall be cooled at the batch plant using ice or cold water. Adjustments must be made for water/cement ratio to keep the slump within specifications.

## 2.6 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

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

2.7 STEEL REINFORCEMENT

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

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

C. Reinforcing Bars: ASTM A 615, Grade 60; deformed.

D. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934; with ASTM A 615, Grade 60 deformed bars.

E. Joint Dowel Bars: ASTM A 615, Grade 60 plain-steel bars [; zinc coated (galvanized) after fabrication according to ASTM A 767, Class I coating]. Cut bars true to length with ends square and free of burrs.

F. Epoxy-Coated, Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60, plain-steel bars.

G. Tie Bars: ASTM A 615, Grade 60, deformed.

H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to (Concrete Reinforcing Steel Institute) CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

J. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

K. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

L. J. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

M. Zinc Repair Material: ASTM A 780.

2.8 EXPANSION JOINTS

A. Shall be premolded expansion joint filler complying with ASTM Specification D1751 for resilient bituminous types and ASTM Specification D1752 for resilient non-bituminous types.

PART 3 - EXECUTION

3.1 FIELD CONDITIONS

A. Seasonal Restrictions:
   1. Concrete pavements may not be placed after November 1 or before April 1 without special permission of Engineer.

B. Weather Limitations:
   1. Temperature must be at least 40 degrees F., but less than 95 degrees F. during placement.

3.2 SUBGRADE

A. Provide compacted subgrade and specified gravel under all curb and gutter and other specified concrete per typical sections or plan notes on drawings. Notify Engineer 24 hours prior to concrete placement to allow inspection of subgrade. If required, adjust subgrade elevations by removing excess material.

3.3 FORM WORK

A. Curb and gutter forms shall provide an identical match with adjacent existing curb and gutter. Forms for other concrete shall meet the approval of the Engineer.

B. Forms shall be firmly staked and braced in a manner that will not deflect if walked upon nor during concrete placement. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

D. Deflections shall be limited as specified by Section 203.1 of ACI 347. Reuse of wood forms will be permitted, but warped, deflected, or kinked forms shall not be used.

E. Power driven slip forming equipment is permitted for this work subject to compliance with other requirements of these specifications.

3.4 PLACING

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site unless the required slump and workability cannot be met. If water must be added, the Material Tester II shall immediately call the batch plant and adjust the mix to resolve the problem. Do not add water to fresh concrete after testing. If water is added the test must be repeated.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.5 FINISHING

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

B. Placing shall proceed at such a rate that fresh concrete is integrated with concrete which is still plastic.

C. All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked into corners of forms, eliminating all air pockets, or stone pockets which may cause honeycombing, pitting or places of weakness.

D. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

E. A medium broom finish shall be provided with consistent texture with lines running perpendicular to the length of the curb and gutter section.

F. Floating shall be performed prior to texturing and shall be done in accordance with Division 3.

## 3.6 JOINTS

A. Tooled contraction joints shall normally be spaced 10 feet center to center unless otherwise instructed by the Engineer. Curb and gutter and sidewalk shall be separated by one inch (1") preformed expansion joints when they abut each other.

B. Expansion Joints:
   1. Extend to full depth of concrete.
   2. Place doweled connection as per the details on the drawings.
   3. Locate expansion joints at all construction joints, at beginning and end of curves, at 300-foot intervals, and at other locations as required by the Engineer.

C. Longitudinal Joints at Slabs: Provide keyed construction joints with rebar at longitudinal joints between the gutter section and concrete pavements.

D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of Insert dimension 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. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
   7. Curb & Gutter and sidewalk Expansion joints shall be sealed in accordance with the plan details.

## 3.7 CURING AND PROTECTION

A. The surface shall be protected against mechanical injury.

B. The concrete shall be cured and protected against premature drying and excessively low or varying temperatures in accordance with Division 3. Membrane curing compound (colorless) must be applied to all exposed surfaces and to formed surfaces immediately after forms are removed.

C. Comply with ACI 306.1 for cold-weather protection.

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

E. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

F. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing, curing compound or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water using misters or soaker hoses.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive.
      Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period. If forms are stripped within the curing period, spray the exposed surfaces.

## 3.8 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor shall engage a qualified testing agency to perform Quality Control tests and inspections. The owner will engage a qualified testing agency to perform Quality Assurance tests and inspections.

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 one composite sample for each 100 cu. yd. or 5000 sq. ft. or fraction thereof of each concrete mixture 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; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. 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 mixture. Air meters shall be calibrated at least yearly.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
    b. If the Contractor wishes to make extra test specimens to be broken at less than 28 days he may. If the test specimens indicate that design strength has been achieved the Contractor may proceed with the work.

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

D. Test results shall be reported in writing to Engineer, 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.

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

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. If compressive strength tests fail, the Contractor shall have representative core samples taken and delivered to the laboratory. These samples shall be tested independently. If these samples fail then the work must be replaced.

## 3.9 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 Owner.

B. Drill test cores, where directed by Owner, 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.

## 3.10 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

A. A specified Concrete Cleanout Area shall be maintained by the Contractor as described in the SWPPP and Erosion Control Plan. Concrete waste shall be removed whenever the cleanout area is full. Spillage shall be reported in accordance with the NPDES Permit.

## 3.11 BACKFILL

A. After the curing period (min. 72 hrs.), the area behind the curb and gutter shall be filled to the required elevations with embankment material salvaged from excavation work.

B. Compact material to required density and place topsoil to required thickness where applicable.

Backfilling of curb and gutter must precede paving operations.

END OF SECTION

# SECTION 32 16 23 - SIDEWALKS

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. This includes the furnishing and placement of Portland Concrete Cement (PCC) for constructing sidewalk, including applicable reinforcing steel, expansion material, jointing, joint sealing and finishing.

### 1.2 RELATED SECTIONS

A. Section 32 11 23 - Aggregate Base Courses

B. Section 32 16 13 - Curb and Gutter

### 1.3 REFERENCES

A. The following Sections of the "GreenBook" Standard Specifications for Public Works Construction, 2018 Edition, written and promulgated by Public Works Standards, Inc. and published by BNi Building News, 990 Park Center Drive, Suite E, Vista, CA 92081 shall be included in this specification as if fully written:
   1. Section 201-1 - Portland Cement Concrete
   2. Section 301-1 - Subgrade Preparation
   3. Section 303-5 - Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps and Driveways

### 1.4 SUBMITTALS

A. Submit complete mix design and test reports.

B. Submit Material Certificates for
   1. Steel reinforcement and reinforcement accessories.
   2. Admixtures
   3. Curing compounds
   4. Applied finish materials
   5. Bonding agent or epoxy adhesive
   6. Joint fillers

1.5 QUALITY ASSURANCE

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

B. 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 (American Concrete Institute) ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Shall comply with Division 3, Cast-In-Place Concrete. Proportioning of ingredients shall be in accord with an Engineer approved mix design. Minimum compressive strength shall be 4000 psi at 28 days.

B. Cementitious Material: Use cementitious materials, of same type, brand, and source throughout Project:
   1. The cementitious materials shall be in accordance with the approved mix designs

C. Normal-Weight Aggregates: Aggregates shall be in accordance with Local and State Standard Specifications.

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

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Retarding Admixture: ASTM C 494, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

## 2.2 CURING MATERIALS

A. Absorptive Cover: (American Association of State Highway and Transportation Officials) AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

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

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
   1. Provide evaporation retarders by:
      a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
      b. BASF Construction Chemicals, LLC; Confilm.
      c. ChemMasters; Spray-Film.
      d. Conspec by Dayton Superior; Aquafilm.
      e. Dayton Superior Corporation; Sure Film (J-74).
      f. Edoco by Dayton Superior; BurkeFilm.
      g. Euclid Chemical Company (The), an RPM company; Eucobar.
      h. Kaufman Products, Inc.; VaporAid.
      i. Lambert Corporation; LAMBCO Skin.
      j. L&M Construction Chemicals, Inc.; E-CON.
      k. Meadows, W. R., Inc.; EVAPRE.
      l. Metalcrete Industries; Waterhold.
      m. Nox-Crete Products Group; MONOFILM.
      n. Sika Corporation, Inc.; SikaFilm.
      o. SpecChem, LLC; Spec Film.
      p. Symons by Dayton Superior; Finishing Aid.
      q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
      r. Unitex; PRO-FILM.
      s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
   1. Provide curing compounds by:
      a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
      b. ChemMasters; Safe-Cure Clear.
      c. Conspec by Dayton Superior; D.O.T. Resin Cure.
      d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
      e. Edoco by Dayton Superior; DSSCC Clear Resin Cure.

f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; AQUA KURE - CLEAR.
i. L&M Construction Chemicals, Inc.; L&M CURE R.
j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
k. Nox-Crete Products Group; Resin Cure E.
l. SpecChem, LLC; PaveCure Rez.
m. Symons by Dayton Superior; Resi-Chem Clear.
n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
o. TK Products, Division of Sierra Corporation; TK-2519 WB.
p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.
1. Provide curing compounds by:
a. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
b. ChemMasters; Safe-Cure 2000.
c. Conspec by Dayton Superior; D.O.T. Resin Cure White.
d. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).
f. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; AQUA KURE - WHITE.
i. L&M Construction Chemicals, Inc.; L&M CURE R-2.
j. Meadows, W. R., Inc.; 1100-WHITE SERIES.
k. SpecChem, LLC; PaveCure Rez White.
l. Symons by Dayton Superior; Resi-Chem White.
m. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

## 2.3 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

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

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
1. Types I and II, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
   1. Provide surface retarders by:
      a. ChemMasters; Exposee.
      b. Conspec by Dayton Superior; Delay S.
      c. Dayton Superior Corporation; Sure Etch (J-73).
      d. Edoco by Dayton Superior; True Etch Surface Retarder.
      e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
      f. Kaufman Products, Inc.; Expose.
      g. Meadows, W. R., Inc.; TOP-STOP.
      h. Metalcrete Industries; Surftard.
      i. Nox-Crete Products Group; CRETE-NOX TA.
      j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
      k. Sika Corporation, Inc.; Rugasol-S.
      l. SpecChem, LLC; Spec Etch.
      m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
      n. Unitex; TOP-ETCH Surface Retarder.
      o. Vexcon Chemicals Inc.; Certi-Vex Envioset.

## 2.4 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience. Mix designs must be State approved mix.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 3,500 psi for cast in place concrete and 4,500 psi for precast concrete unless stated otherwise on the plans.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.32 to 0.42 based on State Standard Specifications.
   3. Slump Limit: 2inches to 4 inches plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 5 percent to 8 percent for ¾ inch and 1-inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture high-range, water-reducing admixture high-range, water-reducing and retarding admixture, and plasticizing and retarding admixture in concrete as required for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Do not exceed 95 degrees F concrete temperature at time of placement.

E. Cementitious Materials: Use fly ash or ground granulated blast-furnace slag to reduce the total amount of portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 15 percent for Class F Fly Ash and 20 percent for Class C Fly Ash.
   2. Ground Granulated Blast-Furnace Slag: 25 percent.

## 2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
   2. When the anticipated temperature of the concrete is 95 degrees or higher, the materials shall be cooled at the batch plant using ice or cold water. Adjustments must be made for water/cement ratio to keep the slump within specifications.

## 2.6 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

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

## 2.7 STEEL REINFORCEMENT

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

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

C. Reinforcing Bars: ASTM A 615, Grade 60; deformed.

D. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934; with ASTM A 615, Grade 60 deformed bars.

E. Joint Dowel Bars: ASTM A 615, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767, Class I coating. Cut bars true to length with ends square and free of burrs.

F. Epoxy-Coated, Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60, plain-steel bars.

G. Tie Bars: ASTM A 615, Grade 60, deformed.

H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to (Concrete Reinforcing Steel Institute) CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
   2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

J. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

K. Zinc Repair Material: ASTM A 780.

## 2.8 EXPANSION JOINTS

A. Shall be premolded expansion joint filler complying with ASTM Specification D1751 for resilient bituminous types and ASTM Specification D1752 for resilient non-bituminous types.

# PART 3 - EXECUTION

## 3.1 FIELD CONDITIONS

A. Seasonal Restrictions:

1. Concrete pavements may not be placed after November 1 or before April 1 without special permission of Engineer.

B. Weather Limitations:
1. Temperature must be at least 40 degrees F., but less than 95 degrees F. during placement.

3.2 SUBGRADE

A. Provide compacted subgrade and specified gravel under all sidewalk and other specified concrete per typical sections or plan notes on drawings. Notify Engineer 24 hours prior to concrete placement to allow inspection of subgrade. If required, adjust subgrade elevations by removing excess material.

3.3 FORM WORK

A. Forms shall meet the approval of the Engineer.

B. Forms shall be firmly staked and braced in a manner that will not deflect if walked upon nor during concrete placement. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

D. Deflections shall be limited as specified by Section 203.1 of ACI 347. Reuse of wood forms will be permitted, but warped, deflected or kinked forms shall not be used.

E. Slope walks as indicated on the plans.

F. Sidewalk thickness shall be three inches (3") unless otherwise noted on the plans.

3.4 PLACING

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site unless the required slump and workability cannot be met. If water must be added, the Material Tester II shall immediately call the batch plant and adjust the mix to resolve the problem. Do not add water to fresh concrete after testing. If water is added the test must be repeated.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## 3.5 FINISHING

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

B. Placing shall proceed at such a rate that fresh concrete is integrated with concrete which is still plastic.

C. All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked into corners of forms, eliminating all air pockets, or stone pockets which may cause honeycombing, pitting or places of weakness.

D. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

E. A medium broom finish shall be provided with consistent texture with lines running perpendicular to the length of the curb and gutter section.

F. Floating shall be performed prior to texturing and shall be done in accordance with Division 3

## 3.6 JOINTS

A. After floating, and prior to texturing, the sidewalk shall be edge tooled and control joints shall be placed across the concrete sidewalk surface at intervals to match the width of the sidewalk, or as designated by the engineer. The control joints shall be Zip Strip (12”), or Engineer approved equal, or tooled joints matching the existing sidewalk.

B. Edges shall be retooled after texturing to provide uniform tool marks with smooth surfaces which are relatively free of defects.

C. Sidewalk Expansion joints shall be sealed in accordance with the plan details.

## 3.7 CURING AND PROTECTION

A. The surface shall be protected against mechanical injury.

B. The concrete shall be cured and protected against premature drying and excessively low or varying temperatures in accordance with Division 3. Membrane curing compound (colorless) must be applied to all exposed surfaces and to formed surfaces immediately after forms are removed.

C. Comply with ACI 306.1 for cold-weather protection.

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

E. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

F. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing, curing compound or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water using misters or soaker hoses.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period. If forms are stripped within the curing period, spray the exposed surfaces.

## 3.8 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor shall engage a qualified testing agency to perform Quality Control tests and inspections. The owner will engage a qualified testing agency to perform Quality Assurance tests and inspections.

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 one composite sample for each 100 cu. yd. or 5000 sq. ft. or fraction thereof of each concrete mixture 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; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. 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 mixture. Air meters shall be calibrated at least yearly.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
   b. If the Contractor wishes to make extra test specimens to be broken at less than 28 days he may. If the test specimens indicate that design strength has been achieved the Contractor may proceed with the work.

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

D. Test results shall be reported in writing to Engineer, 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.

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

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. If compressive strength tests fail, the Contractor shall have representative core samples taken and delivered to the laboratory. These samples shall be tested independently. If these samples fail then the work must be replaced.

## 3.9 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 Owner.

B. Drill test cores, where directed by Owner, 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.

3.10 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

A. A specified Concrete Cleanout Area shall be maintained by the Contractor as described in the SWPPP and Erosion Control Plan. Concrete waste shall be removed whenever the cleanout area is full. Spillage shall be reported in accordance with the NPDES Permit.

3.11 BACKFILL

A. After the curing period (min. 72 hrs.), the area behind the curb and gutter shall be filled to the required elevations with embankment material salvaged from excavation work.

B. Compact material to required density and place topsoil to required thickness where applicable.

C. Backfilling of curb and gutter must precede paving operations.

END OF SECTION

# SECTION 32 17 23 - PAVEMENT MARKINGS

## PART 1 - GENERAL

### 1.1 Section Includes

A. Traffic Paint.

B. Thermoplastic Reflectorized Pavement Markings.

C. Permanent Marking Tape.

D. Preformed Polymer Marking Material

### 1.2 Related requirements

A. Section 32 12 16 - Asphalt Paving

B. Section 32 16 13 - Curb and Gutter

### 1.3 Description of Work

A. Traffic Paint - Work involves the furnishing and installing of permanent traffic paint in accordance with the Contract Documents.

B. Thermoplastic Reflectorized Pavement Markings - Work involves the furnishing and installing of thermoplastic reflectorized pavement markings in accordance with the Contract Documents.

C. Permanent Marking Tape - Work involves the furnishing and installing of permanent marking tape in accordance with the Contract Documents.

D. Preformed Polymer Marking Material - Work involves the furnishing and installing of preformed polymer marking material in accordance with the Contract Documents.

### 1.4 Submittals

A. Submit detailed catalog cuts, manufacturer's specifications and test data of products proposed for use demonstrating conformance to requirements of this Section in accordance with the requirements of the Contract General Conditions.

1.5 Special Requirements

A. The completed thermoplastic reflectorized pavement marking installation shall be warranted to the Owner, from the date of final payment, against peeling, chipping, flaking, delamination, and shoving for a period of one year or until the markings are normally worn away by traffic.

B. Thermoplastic material shall be accepted on the basis of sampling and inspection at the place of manufacture or in warehouse lots as determined by the Engineer. In addition, all samples shall be accompanied with the manufacturer's certified identification of the binder formulation (e.g. "formulated as a hydrocarbon resin"). Any unauthorized tampering, opening, or breaking of seals on the containers between the time of sampling and delivery to the construction site shall be cause for rejection of the material.

C. The minimum batch size of thermoplastic material when tested shall not be less than 3000 lbs. unless the total order is less than that amount.

D. Reflective glass spheres may be approved at the construction site on the basis of the manufacturer's certification.

E. Type III primers will be subject to approval by the Engineer prior to use. Requests for approval shall be accompanied with technical data including brand name, instructions for use, hazard warnings, and 1-quart sample of the primer material.

F. Upon prior approval by the Engineer of the Type III primer, the product may then be accepted at the construction site on the basis of the brand name labeled on the container.

G. Any materials found to not meet these requirements shall be immediately replaced with materials meeting requirements of this Section.

PART 2 - PRODUCTS

2.1 Traffic Paint

A. Traffic paint shall meet the requirements STATE OF CALIFORNIA Department of Transportation Specification PTWB-01R2 For Paint, Rapid Dry Waterborne Traffic Line, White, Yellow and Black, only waterborne paint shall be used.

2.2 Thermoplastic Reflectorized Pavement Markings

A. White and Yellow Reflectorized Thermoplastic

1. Composition Requirements
   a. The thermoplastic material composition shall be specifically formulated for application at temperatures greater than 400 degrees F true*; and shall show no significant breakdown, or deterioration at a true temperature of 475 degrees Fahrenheit. (*True temperature as referenced above is measured with high precision laboratory grade equipment.)
      1) The binder component shall be formulated as hydrocarbon resin or formulated as alkaloid base product as shown on the Contract Drawings. The pigment, beads, and filler shall be uniformly dispersed in the binder resin.
      2) The thermoplastic material shall be free from all skins, dirt and foreign objects and shall comply with the following requirements:

| | % by Weight | |
|---|---|---|
| Component | White | Yellow |
| Binder | 17.0 Min. | 17.0 Min |
| Titanium Dioxide | 10.0 Min. | --- |
| Glass Beads | 20.0 Min. | 20.0 Min |
| Calcium Carbonate & Inert Fillers | 49.0 Min. | ** |
| Yellow Pigments | --- | ** |

** Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2. Physical Properties of Composition.
   a. Colors: White thermoplastic composition, as placed, shall be white, free from dirt or tint. Yellow thermoplastic composition, as placed, shall be yellow, free from dirt or tint, and shall be a reasonable visual match to Munsell book notation 10YR8/14 in accordance with ASTM D 1535.
   b. Drying Time: When installed on pavement at air temperature of 70 degrees F, and in thickness between 1/8 inch and 3/16 inch, the thermoplastic material shall be completely solid and shall show no damaging effect from traffic after 10 minutes.
   c. Color Retention: The thermoplastic material shall not change color during the warranty period.
   d. Yellowness Index: White thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with AASHTO Designation T 250.
   e. Softening Point: The thermoplastic material shall have a softening point of not less than 194 degrees Fahrenheit true when tested in accordance with ASTM E 28.

f. Specific Gravity: The specific gravity of the thermoplastic material as determined by a water displacement method at 25 degrees Celsius shall be between 1.8 and
g. 2.2 (referred to water at 25 degrees Celsius true).
h. Fumes: The thermoplastic material shall not exude fumes, which are toxic or obnoxious or injurious to persons or property when it is heated during applications.

2.3 Thermoplastic Reflectorized Pavement Markings Equipment

A. Thermoplastic application equipment shall be subject to approval by the Engineer prior to the start of Work.
1. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.
2. Unless otherwise approved by the Engineer, all longitudinal pavement-marking lines shall be striped using only mobile applicator equipment. Longitudinal pavement marking lines include broken lines (skipline), edge lines, barrier lines, and solid lines as defined by the FHWA Manual on Uniform Traffic Control Devices.
a. Portable applicator equipment will be acceptable for placing all other markings; and for longitudinal marking where use of mobile applicator equipment is impractical, as approved by the Engineer.
3. Thermoplastic material shall be applied to the primed pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for maintaining the temperature and controlling the flow of the material.
4. Applicators shall be equipped and constructed in such a manner as to satisfy the requirements of the National Board of Fire Underwriters.
5. For heating the thermoplastic material, the applicator equipment shall include melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate “supply” vehicle or included as part of the application equipment. The kettle(s) shall be capable of automatically heating the thermoplastic material to, and maintaining it at an indicated gauge temperature of 420 degrees Fahrenheit to 430 degrees Fahrenheit. The heating mechanism shall be by means of thermostatically controlled indirect heat transfer medium. Direct heating of the melting kettle by flame will not be allowed.
6. Thermoplastic material temperature gauges accurate to plus or minus 15 degrees Fahrenheit shall be provided at both ends of each kettle and reservoir, and in each extrusion shoe, in such a manner as to be visible and capable of monitoring the thermoplastic material temperature throughout the marking operation.
7. Applicator equipment including separate “supply” kettles shall be constructed to provide continuous mixing and agitation of the thermoplastic material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts

of the equipment that come into contact with material shall be so constructed as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that mixing and conveying parts, up to and including the extrusion shoe(s), maintain the material at the required application temperature.

8. The applicator equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe; shall provide a means for cleanly cutting off stripe ends squarely; shall provide a method of applying "skip" lines; and shall be capable of applying various widths of traffic markings from 3 to 12 inches wide.
9. The applicator equipment shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow up to 10 pounds per 100 square feet of thermoplastic material.
   The bead dispenser shall be automatically operated in such a manner that it will only dispense beads while the thermoplastic material is being applied.
10. Applicator equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

B. Mobile Applicator Equipment
   1. The mobile applicator shall be defined as a truck mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by the extrusion method. The unit shall be equipped to maintain and apply the thermoplastic material at an indicated gauge temperature of 420 degrees Fahrenheit, and at the widths and thicknesses specified herein. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 linear feet of longitudinal markings in an 8-hour day.
   2. The mobile applicator shall be equipped with melting kettle(s) or materials storage reservoir(s) and glass bead hopper of such capacity as to allow for continuous marking operations. The kettle(s) or reservoir(s) shall be capable of heating and/or holding the thermoplastic material at an indicated gauge temperature of 420 degrees Fahrenheit.
   3. The mobile applicator shall be equipped with an extrusion shoe(s), and shall be capable of marking edge-line and centerline stripes. The extrusion shoe(s) shall be closed, heat jacketed, or suitably insulated units; shall apply the molten thermoplastic at an indicated gauge temperature greater than 415 degrees Fahrenheit; shall be capable of extruding a uniform line pre-set at 3 to 12 inches wide at a thickness of not more than 1/8 inch nor more than 3/16 inch.
   4. The mobile applicator shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

C. Portable Applicator Equipment
   1. The portable applicator shall be defined as hand operated equipment, specifically designed for placing hot extruded thermoplastic installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge, and centerlines. It is

intended that the portable applicator reservoir will be loaded with hot thermoplastic material from the supply vehicle melting kettle(s).

2. The portable applicator shall be equipped with all the necessary components, including the material storage reservoir, glass bead hopper, temperature gauges, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding and applying the molten thermoplastic at indicated gauge temperatures greater than 415 degrees F; of extruding a line of generally uniform cross-section, pre-set at 3 to 12 inches in width at a thickness of not less than 1/8 inch nor more than 3/16 inch.

## 2.4 Reflective Glass Spheres (Pre-Mix and Drop-On)

A. Reflective glass spheres for use in the composition and for drop-on shall conform to the following requirements:

1. The glass spheres shall be colorless, clean, and transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching. They shall be spherical in shape and at least 70% of the glass beads shall be true spheres when tested in accordance with ASTM D 1155.
2. The refractive index of the spheres shall be a minimum of 1.50 as determined by the liquid immersion method at 25 degrees Celsius true.
3. The silica content of the glass spheres shall not be less than 60%.
4. The crushing resistance of the spheres shall be as follows: A 40-lb dead weight, for 20 to 30 mesh spheres, shall be the average resistance when tested in accordance with ASTM D 1213.
5. The glass spheres shall have the following grading when tested in accordance with ASTM D 1214.

| U.S. Standard Sieve Mass | % Passing |
|---|---|
| No. 20 | 100 |
| No. 30 | 79-95 |
| No. 50 | 15-60 |
| No. 80 | 0-15 |

B. Glass spheres for drop-on shall be treated with a moisture-proof coating meeting the flow requirements of AASHTO M 247 Section 4.4.2, shall not absorb moisture during storage, shall remain free from clusters, and shall flow freely from dispensing equipment.

## 2.5 Permanent Marking Tape

A. Permanent marking tape shall have a nominal width of 4 inches and shall consist of a yellow or white, weather and traffic resistant film on a conformable, metallic foil backing precoated with a pressure sensitive adhesive. The tape shall be flexible and

formable, and following application, shall remain conformed to the texture of the pavement surfaces.

1. Thickness
   a. The average thickness of the film, including glass spheres, shall be not less than 15 mils or more than 50 mils.
2. Retroreflectance
   a. The white or yellow tapes shall have the following initial minimum retroreflectance values at 1.05-degree observation angle and 88.76-degree entrance angle, measured by a Retrolux Model 1500 retroreflectometer:

| | White | Yellow |
|---|---|---|
| Specific luminance, med/sq.ft./ft.-cdl. | 550 | 325 |

B. Permanent marking tape materials shall conform to Iowa Department of Transportation (IDOT) IM 483.06.

2.6 Preformed Polymer Marking Material

A. The preformed polymer marking material shall consist of glass beads imbedded in a white or yellow, polymer film precoated with a pressure sensitive adhesive. The Contract Documents will specify precut symbols and legends or tape to be made of preformed polymer marking material. The preformed polymer marking tape shall be a nominal width of 4 inches.

1. Color
   a. The color shall be white or yellow, conforming to standard highway markings.
2. Thickness
   a. The thickness of the marking film shall be from 60 mils to 90 mils, as measured to include adhesive and glass beads.
3. Retroreflectance
   a. The white or yellow tapes shall have the following initial minimum retroreflectance values at 1.0 degree observation angle and 88.76-degree entrance angle, measured by a Retrolux Model 1500 retroreflectometer.

| | White | Yellow |
|---|---|---|
| Specific luminance, med/sq.ft./ft.-cdl. | 325 | 150 |

B. Preformed polymer marking material shall conform to IDOT IM 483.06.

2.7 Primer

A. Type III primer for use on both bituminous and Portland cement concretes shall be of the type recommended by the manufacturer of the thermoplastic material and shall be designed to dry track free in under 5 minutes.

2.8 Packaging and Shipment

A. The thermoplastic material shall be manufactured in block form and packaged in suitable corrugated containers to which it will not adhere during shipment or storage. Each container shall weigh approximately 50 pounds and shall consist of blocks approximately 14 inches x 28 inches x 2¼ inches in size.

Each container shall be sealed at the point of manufacture and plainly marked with the color, basic resin type (either hydrocarbon or alkaloid), manufacturer's name, batch number and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall not be heated in excess of 440 degrees Fahrenheit gauge.

B. The reflective glass spheres for drop-on application shall be shipped in strong moisture resistant bags containing approximately 50 pounds. Each bag shall be marked with the name and address of the manufacturer, and the name and weight of the material, date of manufacture and batch number.

C. Type III primer shall be shipped in pails, drums or other strong substantial containers. Each container shall be plainly marked with the brand name of the product, the name and address of the manufacturer, the date of manufacture, the quantity of material, the date of expiration or shelf life, and appropriate hazard warnings. Type III primers shall be shipped to the construction site with instructions for use affixed to each container.

PART 3 - EXECUTION

3.1 General

A. Pavement Cleaning

1. Prior to executing the Work of this specification section, the pavement surface shall be cleaned by brooming, use of air hoses, or other methods, as necessary. At the time of placing permanent pavement markings, the entire pavement shall be made free of foreign material. The Contractor shall determine the amount of cleaning effort required to achieve desired results.
2. Sufficient time shall elapse after rain, sleet, snow, ice, dew or frost to permit the surface to become thoroughly dry both internally and externally.

B. Pavement markings shall not be applied to any surface until the Engineer has inspected the surface and approved as being satisfactory for the application of striping materials.

C. Pavement markings shall be applied at the locations and in accordance with the patterns and dimensions shown on the Contract Drawings and the FHWA Manual on Uniform Traffic Control Devices.

D. Before any pavement marking work is begun, a schedule of operations shall be submitted to the Engineer for approval.

E. When pavement markings are applied under traffic conditions the Contractor shall provide all necessary qualified personnel, flags, markers, signs, etc. to maintain and protect traffic, and to protect marking operations and the new markings until thoroughly set. Short duration lane and work area closures shall be done in accordance with specification section 01 55 26.

F. The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

G. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled thermoplastic, and thermoplastic applied in unauthorized areas.

H. When necessary, the Contractor shall establish marking alignment points at 25-foot intervals throughout the length of the marking area or as otherwise approved by the Engineer.

I. Unsatisfactory lines, resulting from the presence of dirt, scale, moisture or where pavement striping has been erroneously applied due to mistakes, spillage or drippage, shall be removed by the Contractor at his own expense to the approval of the Engineer.

J. On all sections of a primary road open to traffic, the Contractor shall place temporary or permanent pavement markings on any part where construction operations have obliterated the existing marking.

K. If, due to unavoidable circumstances, the Contractor is not able to complete the temporary or permanent pavement marking or removal specified for that day, the Contractor shall provide or continue to provide traffic control until the pavement marking work is completed.

L. When the installation of preformed polymer pavement marking material is in conjunction with placement of hot mix asphaltic mixtures, the performed polymer shall be inlaid by positioning on the hot mixture prior to the final rolling. Install preformed polymer marking material in accordance with the manufacturer's recommendations.

M. When permanent markings are placed on newly completed Portland cement concrete pavements, the existing curing compound film shall be removed from horizontal surfaces. Curing compound film need not be removed from curbs or other vertical surfaces. Removal shall not damage the underlying Portland cement concrete pavement.

3.2 Traffic Paint

A. Waterborne traffic paint materials shall not be applied when air or surface temperature is below 40°F.

B. Volatile Organic Content (VOC) compliant solvent borne paint shall not be applied when air or surface temperature is below 32°F.

C. The application of the traffic paint, including mixing and thinning of traffic paint, equipment pressures and operating speed of equipment shall be in accordance with the material manufacturer's instructions and recommendations.

D. The Contractor shall apply 4-to-6-inch wide line striping, at the locations and of the color specified on the Contract Drawings or required by the Engineer. Included in this area are letters or traffic arrows and symbols as shown on the Contract Drawings.

E. The traffic paint shall be applied at a coverage rate of not less than 100 square feet, and not more than 110 square feet of surface per gallon of binder, yielding a film thickness of 0.015 inch.

F. The Contractor shall schedule striping operations so as to permit the paint to have set and hardened (generally 1 hour after application) before the roadway is opened to traffic.

G. Striping machines shall be cleaned at the end of each day and more frequently if necessary to insure the application of lines the specified quality and physical requirements.

3.3 Thermoplastic Reflective Pavement Markings

A. All pavement surfaces (new and existing) to be marked shall be primed with Type III primer applied to bituminous concrete and/or Portland Cement concrete pavements at the rates and in accordance with the recommendations of the manufacturer of the thermoplastic material. The primer shall dry tack-free in less than 5 minutes.

B. Thermoplastic pavement markings shall be placed upon dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 55 degrees Fahrenheit and the ambient temperature shall be a minimum of 49 degrees Fahrenheit and rising. The Engineer will determine when atmospheric conditions are such as to produce satisfactory results.

C. The thermoplastic material shall be applied at an indicated gauge temperature no lower than 415 degrees Fahrenheit at the point of deposition. For purposes of these Specifications, the point of deposition shall be defined as within the extrusion shoe.

D. Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 5 lb per 100 square feet of composition.

E. Upon cooling to ambient pavement temperature, the resultant marking shall be an adherent reflectorized strip of the specified thickness and width, capable of resisting deformation by traffic.

3.4 Removal of Pavement Markings

A. Existing pavement markings in the newly marked traffic lanes that are confusing, conflicting, or misleading to traffic shall be removed. The Engineer may designate other pavement markings for removal to maximize the effectiveness of the traffic control plan.

B. Pavement markings remaining after the removal process is completed shall not be visible during daytime or nighttime. Tape markings shall be removed in accordance with manufacturer's recommendations. Removal process shall not cause functional damage to the transverse or longitudinal joint sealant materials.

C. Pavement marking removal operations shall be conducted in a manner so that the finished pavement surface is not damaged or left in a pattern that may mislead or misdirect the motorist. When the operations are completed, the pavement surface shall be power broomed and any marking removal debris shall be removed from the pavement surface before the pavement is open to public traffic. The limits of pavement marking removal shall be not less than the width of the existing or new pavement markings plus 1 inch. When symbols or legends are removed, the area of removal shall cover the entire area of the existing symbol or legend.

D. Removal will not be required prior to being covered by a construction process unless specified in the Contract Documents. Removal of pavement markings may be by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high pressure water blasting. Open abrasive blasting or dry grinding without containment will not be allowed.

E. Pavement marking removal equipment shall provide the following:
   1. Operate without the release of dust.
   2. Recover all removed material.
   3. Include a waste collection and transfer system. For dry wastes, the system shall incorporate High Efficiency Particulate Absolute (HEPA) methods and equipment.

F. Removal operations may be halted if the process and final result is not acceptable to the Engineer.

G. Material collected shall be removed and disposed of in accordance with all applicable Federal and State regulations.

END OF SECTION

# SECTION 32 17 26 - TACTILE WARNING SURFACING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place detectable warning tiles.
   2. Surface-applied detectable warning tiles.
   3. Detectable warning mats.
   4. Cast-in-place detectable warning metal tiles.
   5. Surface-applied detectable warning metal tiles.
   6. Detectable warning unit pavers.

B. RELATED REQUIREMENTS
   1. Section 32 16 23 - Sidewalks
   2. Section 32 13 13 - Concrete Paving

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples for Initial Selection: For each type of exposed finish requiring color selection.

D. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

### 1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Adhesive Application:
   1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:
   1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
      a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering and wear.
      b. Separation or delamination of materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities, CalTrans and ICC-A117.1 for tactile warning surfaces.
   1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

## 2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
   1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass- and carbon-fiber-reinforced polyester per City of Duarte requirements.
   2. Color: As selected by Architect from manufacturer's full line.
   3. Shapes and Sizes:
      a. Rectangular panel, 12 by 12 inches.
      b. Radius panel, nominal 24 inches.
   4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing manufacturer's standard pattern.
   5. Mounting:
      a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
      b. Detectable warning tile set into formed recess in concrete and adhered with adhesive.

B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.
   1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass- and carbon-fiber-reinforced polyester.
   2. Color: As selected by Architect from manufacturer's full line.
   3. Shapes and Sizes:
      a. Rectangular panel, 12 by 12 inches
      b. Radius panel, nominal 24 inches.
   4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing manufacturer's standard pattern.
   5. Mounting: Adhered to existing concrete walkway.

C. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
   1. Material:
      a. Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666.

1) Finish and Color:
   a) Manufacturer's standard powder coat color as selected by Architect from manufacturer's full line.
   b) Mill finish.

b. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.

2. Shapes and Sizes:
   a. Rectangular panel, 12 by 12 inches.
   b. Radius panel, nominal 24 inches.
3. Dome Spacing and Configuration: Manufacturer's standard compliant spacing manufacturer's standard.
4. Mounting:
   a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
   b. Permanently embedded detectable warning tile set into formed recess in concrete and adhered with adhesive.
   c. Replaceable embedded detectable warning tile fastened to permanently installed anchors.

D. Surface-Applied Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles or plates configured for fastening to surface of existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.
   1. Material: Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
   2. Finish and Color:
      a. Manufacturer's standard powder coat, selected by Architect from manufacturer's full line.
      b. Mill finish.
   3. Shapes and Sizes:
      a. Rectangular panel, 24 by 24 inches.
   4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing.
   5. Mounting:
      a. Replaceable surface-applied detectable warning tile fastened with permanently installed anchors to existing concrete walkway.
      b. Permanently fixed detectable warning tile adhered to existing concrete walkway.

## 2.3 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.
   1. Material: Modified rubber compound, UV resistant.

2. Color: As selected by Architect from manufacturer's full range.
3. Shapes and Sizes:
   a. Rectangular panel, 24 by 36 inches.
4. Dome Spacing and Manufacturer's standard compliant spacing.
5. Mounting: Adhered to pavement surface with adhesive.

## 2.4 DETECTABLE WARNING UNIT PAVERS

A. Detectable Warning Concrete Unit Pavers: Solid paving units, made from normal-weight concrete with a compressive strength of not less than 5000 psi, water absorption of not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67, with accessible detectable warning truncated domes on exposed surface of units.
   1. Shapes and Sizes:
      a. Thickness: 2 inches at field of tile.
      b. Face Size: Nominal 12 by 12 inches.
   2. Dome Spacing Manufacturer's standard compliant spacing.
   3. Color: As selected by Architect from manufacturer's full range.

B. Setting Bed: Comply with requirements in Section 321400 "Unit Paving."

C. Aggregate Setting Bed:
   1. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.
   2. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.
   3. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

D. Mortar Setting Bed:
   1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
   2. Sand: ASTM C 33/C 33M.
   3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
   4. Thinset Mortar: Latex-modified portland cement mortar complying with ANSI A118.4.
   5. Water: Potable.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
   1. Furnish Type 304stainless-steel fasteners for exterior use.
   2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles:
   1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
   2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch (3 mm) from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

B. Removable Cast-in-Place Detectable Warning Tiles:
1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

C. Surface-Applied Detectable Warning Tiles:
1. Lay out detectable warning tiles as indicated and mark concrete pavement.
2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
   a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.
3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.
6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

## 3.4 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.

## 3.5 INSTALLATION OF DETECTABLE WARNING UNIT PAVERS

A. Unit Paver Installation, General:
   1. Setting-Bed and Unit Paver Installation: Comply with installation requirements in Section 321400 "Unit Paving."
   2. Mix unit pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
   3. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
   4. Tolerances: Do not exceed 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

B. Aggregate Setting-Bed Applications:
   1. Place aggregate base compact by tamping with plate vibrator, and screed to depth indicated.
   2. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until unit pavers are set and compacted.
   3. Treat leveling course with herbicide to inhibit growth of grass and weeds.
   4. Set unit pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have

spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.

5. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz.
6. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

C. Mortar Setting-Bed Applications:

1. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
2. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch (1.6-mm) thickness for bond coat.
3. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
4. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
5. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each paver with a flat trowel.
6. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
7. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
8. Grouted Joints: Grout paver joints complying with ANSI A108.10. Grout joints as soon as possible after initial set of setting bed.
   a. Force grout into joints, taking care not to smear grout on adjoining surfaces.
   b. Tool exposed joints slightly concave when thumbprint hard.
   c. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.
9. Remove excess grout from exposed paver surfaces, wash and scrub clean.
10. Protect installation from traffic until grout has set.

## 3.6 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

PLAN CHECK COMMENT RESPONSES (Resubmittal #2)
Hospitality Lane
Professional Center, T.I._PHASE 1
RENOVATIONS & ACCESSIBILITY
IMPROVEMENTS
412 W Hospitality Lane, San Bernardino, CA 92415

Application # TI-2024-00041
May 24, 2024
IMEG # 23008184.00

FROM: Ricky Piao, Brian Park, Wenceslao M. Raymundo, Raymond Wang, Gerardo Carranza, Keyner N. Mayer, David Clark
IMEG

This report is to provide response to applicable plan check comments and revisions outside of plan check comments.

PLAN CHECK COMMENT RESPONSES:

BUILDING AND LIFE SAFETY COMMENTS

1. The plan sheets are not in the same order as in the sheet index. In addition, sheets C-4.0 and C-4.1 are not listed in the sheet index. Please provide a plan set that is in the correct order, and a sheet index which lists all sheets included.
   The mechanical and plumbing sheets M0.4, M0.5, M0.6, M0.7, P0.3, P0.4 and P0.5 listed on the sheet index were not included in the plan set. Please include all plan sheets listed or remove those sheets from the sheet index.

   RESPONSE: Sheet index is updated on T1.1.

2. Please note the construction type as per CBC 602.1 in the project information on the cover sheet.
   Please indicate whether the construction type is type IIA or IIB.

   RESPONSE: Type IIB.

ACCESSIBILITY COMMENTS

No further comments noted.

CALGREEN COMMENTS

No further comments noted.

MECHANICAL COMMENTS

1. Please note to install duct smoke detectors in the main supply duct of all RTU's unless the unit is less than 2,000 CFM and serves a dedicated space not connected with spaces served by other units. [CMC 609.1]
   Note #7 says to install the smoke detector in the return riser. Please revise to install smoke detector in the main supply riser or duct.

   RESPONSE: Smoke detector is revised to be on supply duct.

PLUMBING COMMENTS

No further comments noted.

ELECTRICAL COMMENTS

No further comments needed.

ENERGY COMPLIANCE

No further comments needed.

STRUCTURAL COMMENTS

1. Page 3, Comment S1:
   Please provide structural design calculations for the structural alterations proposed for this tenant improvement project. Calculations must be stamped and signed by the design engineer.
   Calculations have not been provided. Structural review of the plans could not be completed without the structural calculations. Comment remains.

   RESPONSE: Structural Calculations is provided for review.

RP/jmt
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PLAN CHECK COMMENT RESPONSES (2nd Submittal)
Hospitality Lane
Professional Center, T.I._PHASE 1
RENOVATIONS & ACCESSIBILITY
IMPROVEMENTS
412 W Hospitality Lane, San Bernardino, CA-92415

Application # TI-2024-00041
Mar 29, 2024

FROM: Ricky Piao (M) - IMEG
Brian Park (P) - IMEG
Wenceslao M. Raymundo (E) - IMEG
Raymond Wang (S) - IMEG
Gerardo Carranza (S) - IMEG
Keyner N. Mayer (C) - IMEG
David Clark - Marks Architects

This report is to provide response to applicable plan check comments and revisions outside of plan check comments.

## PLAN CHECK COMMENT RESPONSES:

### Building and Life Safety Comments

1. Page 2, Comment A1:
   Plans are noted "Preliminary Not for Construction". Please provide plans that are "for construction".
   **Response: The note "Preliminary Not for Construction" was removed.**
2. Page 2, Comment A2:
   Please have the architect- and engineer-of-record stamp and sign each sheet.
   **Response: The DPOR's stamps and signatures are included.**
3. Page 2, Comment A3:
   The plan sheets are not in the same order as in the sheet index. In addition, sheets C-4.0 and C-4.1 are not listed in the sheet index. Please provide a plan set that is in the correct order, and a sheet index which lists all sheets included.
   **Response: Complies.**
4. Page 2, Comment A4:
   Please note the occupancy group in the project information on the cover sheet. [CBC 304.1]
   **Response: Refer to Sheet T1.1, The occupancy group, has been added.**

5. Page 2, Comment A5:
   Please note the construction type as per CBC 602.1 in the project information on the cover sheet.
   **Response: Refer to Sheet T1.1, The construction type, has been added.**

Accessibility Comments

1. Page 3, Comment DA1:
   The parallel curb ramp in front of the accessible parking spaces is less than 72" wide. Please revise to show a 24" wide detectable warning strip along the edge adjacent to the access aisles and parking spaces in accordance with CBC 11B-705.1.2.2.2.1, Exception #1.
   **Response: Truncated domes have decreased in width from 3' (36") to 2' (24") to comply with CBC 11B-705.1.2.2.2.1, Exception #1.**
2. Page 3, Comment DA2:
   Detail 5/C-4.0 is outdated by over a decade and signed by an engineer not associated with this project. Please remove the outdated detail sheet and provide accessible parking details with references that are in accordance with the current 2022 CBC, Chapter 11B Standards.
   **Response: The outdated detail has been updated with a more up-to-date standard detail that complies with 2022 CBC, Chapter 11B standards.**
3. Page 3, Comment DA3:
   The C sheets are noted to see the architectural plans for handrail details; however, the details could not be found. Please coordinate to provide ramp and stair handrail details on the plans for review.
   **Response: See new details added to sheet A1.3.**
4. Page 3, Comment DA4:
   It is not clear why there is a separate lavatory and counter in the restrooms on the second floor. Please identify the use of the separate lavatory and counter space in the second floor restrooms shown on enlarged plans C and D on sheet A2.4. Be advised that baby changing stations shall comply with CBC 11B-226.4.
   **Response: Refer to Sheet A2.4 lavatories and countertop is an existing condition. Lavatories are being replaced.** Page 3, Comment DA5:
   The lavatory in the restrooms is within the 48" required door maneuvering space in front of the accessible toilet compartment. Please provide a minimum 48" door maneuvering clearance on the push side of the toilet compartment door.
   **Response: Refer to Sheet A2.4, 48" min, was added.**

CalGREEN Comments

1. Page 3, Comment CG1:
   Alterations with a valuation of $200,000 or more shall comply with the applicable requirements of the 2022 CGBSC. Please provide a valuation on the plans. If the valuation is at or above $200,000 then provide CGBSC checklists on the plans indicating the applicable CGBSC requirements for this project and where compliance is shown on the plans.
   **Response: 2022 CalGreen Mandatory Measures Checklist sheet T1.2 are attached.**

Mechanical Comments

1. Page 3, Comment M1:
   Please have the mechanical engineer-of-record stamp and sign the mechanical plans.
   **Response: Plans are stamped and signed by MEOR.**
2. Page 3, Comment M2:
   Plans are noted "Preliminary Not for Construction". Please provide plans that are "for construction".
   **Response: "Preliminary Not for Construction" note is removed from the plan.**
3. Page 3, Comment M3:
   Please note to install duct smoke detectors in the main supply duct of all RTU's unless the unit is less than 2,000 CFM and serves a dedicated space not connected with spaces served by other units. [CMC 609.1]
   **Response: Duct smoke detectors are specified on each rooftop packaged unit.**
4. Page 3, Comment M4:
   Please revise General Note #3 on sheet M3.2 to provide "air" balance report at completion of project.
   **Response: Note is revised.**
5. Page 3, Comment M5:
   Please note on plans to permanently identify each RTU with the unit # and the space served in accordance with CMC 303.6.
   **Response: Note is added to sheets M1.1 thru M3.2**

Plumbing Comments

1. Page 3, Comment P1:
   Please have the mechanical engineer-of-record stamp and sign the plumbing plans.
   **Response: Plans are stamped and signed by MEOR.**

2. Page 3, Comment P2:
   Plans are noted "Preliminary Not for Construction". Please provide plans that are "for construction".
   **Response: "Preliminary Not for Construction" note is removed from the plan.**

Electrical Comments

1. Page 4, Comment E1:
   Remove "Preliminary Not For Construction" note on all electrical sheets.
   **Response: "Preliminary Not for Construction" note is removed from the plan.**
2. Page 4, Comment E2:
   Please provide fixture schedule and lighting control cut sheets for new lighting.
   **Response: New lighting is no longer in scope.**
3. Page 4, Comment E3:
   All electrical drawings need to be signed by a licensed California electrical engineer or the installing design-build licensed electrical contractor, per California Business and Professionals Code Section 6735.3.
   **Response: Plans are stamped and signed by EEOR.**
4. Page 4, Comment E4:
   Please clarify whether the following items indicated in Scope of Work are part of this permit:
   a. Electrical Service Entrance, Utility Metering and Electrical Power Distribution System.
   b. Lighting and Lighting Controls.
   **Response: Items a and b have been removed from scope.**

Energy Compliance

1. Page 4, Comment EN1:
   Please provide energy compliance documentation (2022-NRCC-LTI-E) with all required signatures for new indoor lighting.
   **Response: Indoor lighting is no longer in scope.**
2. Page 4, Comment EN2:
   The conditioned area of 19,045 square feet on page 1 of NRCC-MCH-E is significantly less than the total area of 51,410 shown on the cover sheet. Please coordinate the conditioned area shown on the cover sheet and the energy compliance documents.
   **Response: Conditioned area is updated on sheet M 0.3.**

Structural Comments

1. Page 4, Comment S1:
   Please provide structural design calculations for the structural alterations proposed for this tenant improvement project. Calculations must be stamped and signed by the design engineer.
   **Response: Calculations with stamp and signature by SEOR are being provided in this latest submittal.**
2. Page 4, Comment S2:
   Please remove the note "Preliminary Not For Construction" from all structural sheets in the plans and have the engineer stamp and sign all structural sheets.
   **Response: Note has been removed.**

Revisions Outside of Plan Check Comments:

Mechanical

Sheet M0.1

1. TAB pre-demolition notes is added.
2. TAB post-construction notes is added.
3. Mandatory acceptance testing notes is added.
4. Sheets with revisions are clouded on HVAC sheet index.

Sheet M0.2

1. Packaged rooftop unit and exhaust fan schedule is updated.

Sheet M0.3

1. Conditioned area is revised to 51,410 SF.

Sheet M1.1thru Sheet M2.3

1. First – Third floor plan is added. Temperature, occupancy and carbon dioxide sensor is populated on the plan.

Sheet M3.1

1. Duct traverse reading notes is added.
2. TAB pre-demolition notes is added.
3. CMC 303.6 equipment identification note is added.

Sheet M3.2

1. Duct traverse reading notes is added.
2. Relief grill to roof ventilator is added.
3. General Notes 3 "Water Balance" is revised to "Air Balance".
4. CMC 303.6 equipment identification note is added.

Sheet M4.1

1. On detail #5/M4.1 existing wiring is removed since new wiring will be provided for each new unit.

Sheet M5.1

1. Electric heating is added to the equipment diagram.
2. Room sensor location note is added.

Plumbing

Sheet P0.1

1. Revised Plumbing Symbol List to remove unused symbols and add missing symbols.
2. Revised Plumbing Abbreviation Key to remove unused abbreviations.
3. Revised sheet index.

Sheet P0.2

1. Revised Plumbing Material List.
2. Revised Plumbing Rough-In Schedule.
3. Added 2022 CPC Storm Drain Sizing Table.

Sheets P0.3 through P0.5

1. Sheets removed. Project now has book specs.

Sheet P1.3

1. Removed shading in the floor plan.
2. Added existing gas piping and demolition scope below roof.
3. Revised keynote #4 and #5.

Sheet P2.1

1. Added sheet notes.

Sheet P2.2

1. Added sheet notes.

Sheet P2.3

1. Removed shading in the floor plan.
2. Added existing gas piping and demolition scope below roof.
3. Added sheet notes.

Sheet P3.1

1. Added gas pipe demolition on the roof plan.

Sheet P3.2

1. Added VTR with 10 feet radius circle.
2. Tagged new condensate lines.
3. Added roof drain area in tag.
4. Revised keynotes.
5. Added sheet notes.

Sheet P4.1

1. Removed unused details and reorganized detail numbering.

<u>Electrical</u>

Sheet E0.2

1. Added demolition single line diagram.

Sheet E0.3

1. Updated distribution and consolidated to 1 sheet.

Sheet E1.1

1. Removed lighting and lighting control scope.

Sheet E1.2

1. Removed lighting and lighting control scope.

Sheet E1.3

1. Removed lighting and lighting control scope.

Sheet E2.1

1. Removed lighting and lighting control scope.
2. Added DDC Panel connection.
3. Added notes.

Sheet E2.2

1. Removed lighting and lighting control scope.
2. Updated notes.

Sheet E2.3

1. Removed lighting and lighting control scope.
2. Updated notes.

Sheet E5.1

1. Updated notes.

Sheet E5.2

1. Updated RTU connections.
2. Updated notes.

Sheet E6.2

1. Added sheet and schedules.

Sheet E8.1

1. Added sheet and panel schedules and load calcs.

Sheet E8.2

1. Added sheet and panel schedules.

## Structural

Sheet S204

1. Updated multiple equipment weights.
2. Revised roof beam reinforcing information.
3. Updated roof beam information for RTU support.

Sheet S600

1. Updated details #1 and #3.

Sheet S601

1. Updated notes on detail #1.
2. Added new detail #1A (was part of detail #1 + revisions).
3. Added new note to details #2, #5 and #6.

Sheet S602

1. Updated detail #3.

RP/slh

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