DIVISION 3 – CONCRETE

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:

1. Rigid Pavement (PCC).
2. Curb and Gutter.
3. Driveway Aprons.
4. Sidewalk and Sidewalk Ramps.
5. Cross-Pans.

B. Related Sections:

1. Section 02060 – Aggregate Materials.
2. Section 02315 – Excavation.
3. Section 02721 – Aggregate Base Course.
4. Section 02740 – Rigid Pavement.

1.2 REFERENCES

A. Colorado Department of Transportation:

1. 2017 CDOT Standard Specifications for Road and Bridge Construction.
2. 2012 CDOT M&S Standard Plans

B. Concrete Reinforcing Steel Institute:

1. CRSI – Manual of Standard Practice.
2. CRSI – Placing Reinforcing Bars.

C. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 304 – Measuring, Mixing, Transporting, and Placing Concrete.

3. ACI 305 - Hot Weather Concreting.

4. ACI 306 - Standard Specification for Cold Weather Concreting.

5. ACI 318 - Building Code Requirements for Structural Concrete.

D. American Society for Testing and Materials:

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C67 - Standard Test Methods for Sampling & Testing Brick and Structural Clay Tile.

3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.

5. ASTM C150 - Standard Specification for Portland Cement.

6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

8. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

9. ASTM C902 - Standard Specification for Pedestrian and Light Traffic Paving Brick.

10. ASTM C936 - Standard Specification for Solid Concrete Interlocking Paving Units.

11. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

E. 2010 Americans with Disabilities Act Accessibility Guidelines (ADAAG).

F. 2011 Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)

1.3 SUBMITTALS

A. Product Data: Submit data on joint filler, admixtures, accessories and curing compounds.

B. Concrete Mix Design: Submit current mix design with aggregate gradation, cylinder compression test results, and mix proportioning prior to beginning work. Design shall not be dated prior to three years before start date, which is indicated on the Notice to Proceed.

C. Delivery Tickets: Submit concrete delivery tickets indicating mix I.D. number, time water was added, elapsed time from when water was added and concrete placed, and amounts of additional water added.

D. Work Schedule: Submit schedule to allow at least 24 hours notice of work to be performed or concrete poured to allow for appropriate schedules for testing and inspection.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from one source for Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F unless approved by Engineer, or surface is wet or frozen.

B. Concrete placed in cold weather conditions shall be done in accordance with ACI 306.

C. Conform to ACI 305 when concreting during hot weather.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II – Moderate, low alkali, maximum tricalcium aluminate content of 8%.

B. Aggregates: ASTM C33; 2 percent maximum soft particles.

C. Water: Clean; not detrimental to concrete; free of oils, acids, alkalis, salts, or organic materials.

2.2 ADMIXTURES

A. Furnish materials in accordance with 2017 CDOT Standard Specifications for Road and Bridge Construction.

B. Air Entrainment: ASTM C260.

C. Fly Ash: Substitution of 20 percent of cement material shall be allowed.

2.3 ACCESSORIES

A. Bonding Agent: Two component, moisture insensitive epoxy.

B. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 in 48 hours and 7,000 psi in 28 days.

C. Curing Compound: membrane forming, ASTM C309.

D. Detectable Warning Paver: ASTM C67, C902, C936; ADA compliant; compressive strength of 8000 psi or greater, water absorption maximum of 5%; Pavestone ADA Compliant Paver (Product No. 200), providing a minimum visual contrast of 70 percent in light reflectance between the paver and adjoining surface, i.e. Red for grey sidewalks, Pewter for red sidewalks.

E. Paver Bedding and Joint Sand: ASTM C33 for Bedding Sand; ASTM C144 for Joint Sand; clean, non-plastic, free of deleterious or foreign material.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Expansion Joint Devices: resilient filler strip with hardness to permit plus or minus 25 percent joint movement with full recovery.

2.5 FORM MATERIALS

A. Forms shall be straight, uniform width and thickness, waterproof, free from knots, offsets, holes, dents, and other surface defects.

2.6 REINFORCEMENT

A. Reinforcing Joint Steel (Cross Pans): ASTM A615; 40 ksi yield grade, as specified; #5 as specified; deformed billet steel bars; chairs and spacers sized and shaped for strength and support reinforcement.

B. Reinforcing Joint Steel (Driveway Aprons): ASTM A615; 40 ksi yield grade, as specified; #5 as specified; deformed billet steel bars; chairs and spacers sized and shaped for strength and support reinforcement.

C. Reinforcing Joint Steel (Pavement or Cross Pan Repair): ASTM A615; 60 ksi yield grade, as specified; #5 as specified; smooth billet steel bars; 12-inches long.

D. Tie Wire: 16 gage minimum; annealed type.

E. Rigid Pavement (PCC):
1. See Section 02750.

2.7 CONCRETE MIX

A. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C94.

B. Provide concrete to the following criteria: Conform to Class B or BZ of Section 601.02 and 601.03 of the 2017 CDOT Standard Specifications for Road and Bridge Construction.

C. Rigid Pavement (PCC): Conform to Class P, with No. 67 or 57 coarse aggregate, of Section 601.02 and 601.03 of the 2017 CDOT Standard Specifications for Road and Bridge Construction. See Section 02750.

D. Final mix shall contain a minimum of 565 pounds of cement per cubic yard of concrete, with a water-cement ratio not to exceed 0.45.

E. Slump shall be 4 inches $\pm$ 1 inch.

F. Admixtures: Include admixture types and quantities indicated in concrete mix designs approved through submittal process.

1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.

2. Use calcium chloride only when directed by Engineer.

3. Use set retarding admixtures during hot weather.

4. Add air-entraining agent to normal weight concrete mix for work exposed to exterior.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

C. The Engineer prior to concrete placement shall approve final form grades.

3.2 PREPARATION

A. Excavate and prepare base course according to Section 2315 and Section 2721.

B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.

C. In locations where new concrete is doweled to existing work, i.e. pavement or cross pan repair, drill holes, 3/4-inch diameter, 12-inches o.c. in existing concrete, clear out holes using compressed air, fill holes with epoxy, and insert steel dowels. Coat exposed portion of dowels with grease.

D. Place expansion material and reinforcement in required locations. Locate reinforcing splices, not indicated on drawings, at point of minimum stress. Splice according to ACI 318, Class B tension splice.

E. Place any conduit and repair any cables or pipelines.

F. Place forms to straight-line grade at specified elevations. Maintain or facilitate storm water drainage with driveway, sidewalk, curb and gutter, and cross-pan grading.

G. Forms shall be placed around all concrete work. Pouring concrete directly against asphalt edge will not be allowed. Horizontal lines shall be smooth and straight. Curved forms shall be placed at uniform distance from radius point. Standard curb face shall be formed and not hand shaped.

H. Remove all loose dirt, mud, debris, and other loose materials from inside forms.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.

B. Notify Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. All curb and gutter shall be formed and placed by machine when physically possible.

G. Do not interrupt successive placement; do not permit cold joints to occur.

H. Saw cut joints within 12 hours after placing, using 3/16 inch thick blade or hand tool; cut into 1/4 depth of slab thickness; straight and perpendicular to edges; match existing joint patterns per Engineer where applicable. Locate joints at changes in grade or line, corners, or other points of stress.

I. Screed slabs on grade to drain; sidewalks shall not have a cross slope of more than 2 percent.

3.4 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with a broomed, uniformed finish free of visual cavities or defects. Finish edges with edging trowel.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Apply curing compound to unformed surfaces after finishing, not to exceed 300 SF per gallon.

D. Remove forms only after concrete has attained sufficient strength to support all dead and live loads.

E. Contractor shall provide barricading or personnel as necessary to protect freshly finished concrete from vandalism or other damage.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301.

B. Provide free access to Work and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

D. When tests indicate Work does not meet specified requirements, remove Work and replace.

E. Concrete Testing:

1. Contractor is required to hire an independent, licensed engineer experienced in concrete analysis and evaluation to perform required tests in accordance with ACI. Copies of test results showing exact location of sample collection and test

sites must be furnished to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.

2. Engineer may request additional cylinder compressions, slump, aggregate sieve designation, thickness, and deleterious substance tests to be performed by a qualified designee.

3. Tests of concrete may be performed at random to ensure conformance with specified requirements.

F. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.7 PATCHING AND REPAIR

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed by Engineer using specified grout and epoxy.

D. For repair of internal sections of pavement or cross pans, entire panels must be removed joint to joint by carefully saw-cutting and hammering out discarded concrete so as not to chip, crack, or otherwise damage adjacent concrete. Removal of no more than one half of or less than one third of concrete pavement panel will be allowed as long as transverse saw-cuts are continued completely to both outside edges of the pavement. If the saw-cut for the partial panel removal is longitudinal to the pavement than upon completion of curing operations but prior to opening of pavement to traffic, the pavement shall be cored with a 6-inch diameter core at the terminus of the longitudinal saw-cut to include the entire “T” joint intersection. The core shall then be removed and the remaining hole filled and repaired with non-shrink grout.

E. Pavement panels broken into three or more pieces shall be removed and replaced.

F. Pavement panels containing random and wandering cracks shall be removed and replaced.

G. Pavement panels containing a single longitudinal or transverse crack not having vertical separation and is no closer than 1 foot to but generally parallel, for the width or length of the panel, to any tooled or sawed joint, shall be routed or “vee’d” out with appropriate tools and sealed in the same manner as the pavement.

H. Concrete pavement shall be cut back a minimum of 1 foot from the trench wall. Contractor shall repair any damage due to settlement of the pavement subgrade due to operations in the trench. Voids under pavement shall be repaired by pavement removal and replacement or by drilling and injecting an approved non-shrink hydraulic cement grout into the empty spaces.

I. Concrete pavement shall be resealed in accordance with Section 02750 after repair. Old sealant must be removed by methods approved by Engineer prior to resealing.

3.8 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Engineer will determine repair or replacement of defective concrete.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.9 PEDESTRIAN ACCESS RAMPS

A. Pedestrian Access Ramps (Curb Ramps) shall be constructed win accordance with 2011 PROWAG and other standards incorporated by reference.

B. Detectable Warning and Well

1. Detectable warnings shall be located and constructed in accordance with section R305, 2011 PROWAG.

2. Weep holes shall be cast or drilled into the well for proper drainage of the structure. Weep holes shall be ¾" (0.75 inch) diameter and fully penetrate the concrete floor of the well. Weep holes shall be spaced evenly across the lowest edge of the well with one weep hole placed in the lowest corner. The number of weep holes shall be equal to the width of the sidewalk (i.e. 4 foot wide sidewalk will have 4 weep holes).

3. Spread sand evenly in the well area defined and screed the sand to an appropriate embedment depth as directed by Engineer.

4. Screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers.

5. Pavers shall be placed in a running bond pattern. Domes shall be aligned to create a square grid in the predominant direction of travel. Pavers shall be installed such that the base of the truncated dome is approximately 1/8 inch above the adjoining surface, allowing for settlement with a smooth transition between the sidewalk and detectable warning.

6. A vibrating plate compactor shall be used to embed the pavers into the sand. The size and type of compactor shall be in accordance with the paver manufacturer's recommendations, or as directed by the Engineer. Replace any pavers damaged during the compaction operations.

7. Joint spacing between paver units shall be in accordance with the manufacturer's recommendations, or as approved by the Engineer. Joints shall be filled completely with joint sand. Excess sand shall be removed by sweeping.

8. Bedding sand may be used for joint sand, requiring more effort in compaction and sweeping to fill the joints. Joint sand shall never be used for bedding sand.

3.10 SITE WORK

A. Backfill suitable topsoil around all new concrete adjacent to existing earth or sodded areas to conform to new elevations. Topsoil shall conform to 2017 CDOT Standard Specifications for Road and Bridge Construction, Section 207.02. Generally, install lightly compacted topsoil to within 1 inch of top of concrete, grade and rake out clumps to leave smooth.

B. Backfill with approved aggregate material and asphalt patch.

C. Remove all roots, wood chips, excess concrete, trash or other debris, or excess materials generated from work from the site, leaving site clean and basically complete.

3.11 SCHEDULE

A. Sidewalk:

1. Concrete 4 inches thick minimum, over base course.

2. Concrete 6 inches thick minimum, over base course: through driveways and alleys and sidewalk adjacent to mountable curb and gutter.

3. Minimum width:

a. 4 feet for repair of existing facilities of lengths equal to or less than the width of a single parcel of land;

b. 5 feet for new construction and repairs of existing facilities longer than the width of a single parcel of land;

c. 6 feet for high use and commercial areas.

d. Areas with sidewalk widths less than 5 feet shall have 60 inch X 60 inch passing spaces spaced at a maximum of 200 feet installed at the time of repair or construction.

B. PCC Pavement:

1. Concrete 6 inches thick minimum, over base course: a professional licensed engineer shall design final installed thickness.

C. Cross pan:

1. Concrete 8 inches thick minimum, over base course.

2. Minimum width: 8 feet

END OF SECTION