SECTION 32 13 13 – CONCRETE PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes
1. Concrete curbs and gutters
2. Concrete sidewalks
3. Concrete ramps
4. Concrete driveways
5. Concrete parking areas

B. Related Sections
1. Section 07 90 00 – Joint Protection: Sealant for joints.
2. Section 32 17 23 – Pavement Markings.
3. Section 31 22 13 – Rough Grading: Preparation of site for paving [and base].
4. Section 31 23 23 – Fill: Compacted subbase for paving.
5. Section 32 12 00 – Flexible Paving.
6. Section 32 17 13 – Parking Bumpers: Precast concrete parking bumpers.
7. Section 32 91 19 – Landscape Grading: Preparation of subsoil at pavement perimeter.
8. Section 32 14 13.19 – Permeable Concrete Pavers

1.02 REFERENCES

A. The "PennDOT Sections" noted herein refer to sections contained in the current Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, as supplemented or revised. The references pertain only to materials, construction, equipment, methods and labor. The payment provisions do not apply to work to be performed under this Contract.

B. Commonwealth of Pennsylvania Department of Transportation Specifications Publication 408, latest edition.

C. Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities, as supplemented or revised.

D. Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 213, Work Zone Traffic Control (PennDOT Chapter 213).

E. American Association of State Highway and Transportation Officials:

1. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

F. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

G. ASTM International:
1. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A185/A185M - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A497/A497M - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
7. ASTM A775/A775M - S Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
8. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
9. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
10. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
11. ASTM C33 - Standard Specification for Concrete Aggregates.
12. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
14. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
15. ASTM C150 - Standard Specification for Portland Cement.
16. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
17. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
18. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
19. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494/C494M - Standard Specification for Chemical Admixtures for

Concrete.

22. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
23. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
24. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
25. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
26. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
27. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
29. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
31. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
32. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Certificates: Furnish certification from concrete and aggregate producer attesting that materials conform to requirements of PennDOT Specifications.

C. Job-Mix Designs: For each job mix proposed for the Work.

D. Material Slips: Furnish certification of the amount of materials utilized from the producer in accordance with PennDOT specifications.

E. Qualification Data: For manufacturer and installer.

1.04 QUALITY ASSURANCE

A. Source Quality Control:
   1. Use materials conforming to PennDOT Publication 408, latest edition and supplementary bulletins thereto.
   2. The quality of the work shall be maintained by using the products of a qualified concrete producer and qualified plant operating workmen, registered with and

approved by PennDOT.

3. The concrete producer shall be a bulk producer regularly engaged in production of concrete conforming to the standards referenced herein.

B. Installer Qualifications:

1. Engage an experienced installer who has completed concrete paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance of not less than five (5) years.
2. Provide at least one person thoroughly trained and experienced in the skills required and is completely familiar with concrete work.
3. For finishing of concrete surfaces and operation of the equipment, use only personnel thoroughly trained and experienced in the skills required.

C. Requirements of Testing Agency:

1. To qualify for acceptance, the testing agency must demonstrate to Engineer's satisfaction, based on evaluation of submitted criteria that it has the experience and capability to conduct required field and laboratory testing listed in Section 03 30 00 without delaying the process of the work.

1.05 SITE CONDITIONS

A. Protection:

1. Protect paved surfaces outside of the pavement removal limits as indicated on the Pavement Restoration Details in the Contract Drawings. Repair pavement outside removal limits damaged by construction operations to PennDOT or local municipalities specifications at no additional expense to Owner.
2. Use all means necessary to protect and maintain pavement materials before, during, and after installation.

B. Environmental Requirements:

1. Do not install aggregate courses when ambient temperature is below or is expected to fall below freezing.
2. Do not use aggregate containing frost nor place aggregate courses on frozen subgrade.
3. Do not place concrete mixtures or courses when surfaces are wet or when the temperature of either air or the surface on which the mixture or course is to be placed is 40°F or lower.

C. Grade Control: Establish and maintain required lines, grades and elevations.

PART 2 – PRODUCTS

2.01 AGGREGATE SUBBASE

A. Aggregate Subbase: Type C or better, No. 2A, Section 703.2, placement per PennDOT Form 408 Section 350.

2.02 CONCRETE PAVING

A. Form Materials:
   1. Form Materials: As specified in Section 03 11 00.
   2. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick.

B. Reinforcement:
   1. Reinforcing Steel and Wire Fabric: Type specified in Section 03 20 00.
   2. Welded Plain or Deformed Wire Fabric: ASTM A 1064; in flat sheets
   3. Dowels: ASTM A615/A615M; 60 ksi yield strength, plain steel bars; cut to length indicated on Drawings, square ends with burrs removed; unfinished.
   4. Tie Wire: Minimum 16 gage annealed type.
   5. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

C. Concrete Materials:
   1. Concrete Materials: As specified in Section 03 30 00.
   2. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength 130 ksi; toughness 15 ksi; ¾ inch long fibers, 34 million/lb fiber count.
   3. Water: ASTM C94/C94M; potable, without deleterious amounts of chloride ions.
   4. Air Entrainment: ASTM C260, compatible with all other admixtures used.
   5. Chemical Admixture: ASTM C494/C494M.
      a. Type A - Water Reducing. Use as required for placement and workability.
      b. Type B - Retarding.
      c. Type C - Accelerating.
      d. Type D - Water Reducing and Retarding.
      e. Type E - Water Reducing and Accelerating. Type E: Use in slabs placed at ambient temperatures below 50 degrees F.
      f. Type F - Water Reducing, High Range. Use in pumped concrete and concrete with water/cement ratios less than 0.5
      g. Type G - Water Reducing, High Range and Retarding. Use in pumped concrete and concrete with water/cement ratios less than 0.5
   6. Color Pigment: ASTM C979; mineral oxides, alkali and fade resistant.
      a. Color: As selected.

2.03 FABRICATION

A. Fabricate reinforcing in accordance with CRSI Manual of Practice and PennDOT Publication 408 and RC standards.

B. Form standard hooks for 180 degree bends and 90 degree bends as indicated on Drawings.

2.04 MIXES

A. Concrete Mix

1. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94/C94M.
2. Provide concrete to the following mix design:

Unit	Measurement
Compressive Strength (7 day)	3,000 psi (Advisory)
Compressive Strength (28 day)	4,000 psi
Cement Content (minimum)	587.5 pounds/cu yd
Water/cement ratio (maximum)	0.47 by weight (mass)
Slump	4 inches ±1 inch Concrete with high range water reducing admixture - Not more than 8 inches. Ramps and sloping surfaces - Not more than 4 inches. Slabs and floors - Not less than 1 inch and not more than 3 inches. Miscellaneous Concrete - Not less than 1 inch and not more than 4 inches.
Air Entrainment	6 percent
Admixture	See 03 33 00
Admixture	

3. Limit the following cementitious materials to maximum percentage by mass of all cementitious materials:
   a. Fly Ash: 0 percent.
   b. Blast Furnace Slag: 0 percent.
   c. Fly Ash and Blast Furnace Slag: 0 percent.
4. Use accelerating admixtures in cold weather when temperatures are below 35 degrees F. Use of admixtures will not relax cold weather placement requirements.
5. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified by ASTM C94 may be required.
6. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 90 to 75 minutes, and when air temperature is above 90°F, reduce mixing

and delivery time to 60 minutes.

7. Contractor is solely responsible for amount of water added and resulting strength of concrete. If concrete strength does not conform to 28 day compressive strength requirements, it shall be removed and replaced at no cost to Owner.

2.05 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler:
   1. ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile, exterior use only.
   2. ASTM D1752; Premolded sponge rubber fully compressible with recovery rate of minimum 95 percent.

B. Expansion and Contraction Joint Devices: ASTM B221; resilient neoprene filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; vinyl cover plate, of longest manufactured length at each location, recess mounted.

C. Sealant: ASTM C309, acrylic copolymer, high solids curing and sealing compound.

2.06 CURING

A. White Polyethylene Sheeting—Burlap-Backed.
   1. White Polyethylene Sheeting—natural burlap backed. AASHTO M 171.
   2. White Polyethylene Sheeting—synthetic burlap backed. AASHTO M 171, except weight of synthetic burlap backed white polyethylene sheeting is 8.0 ounces per square yard.

B. Liquid Membrane-Forming Curing Compound, Clear or White. ASTM C 309, Type 1-D, clear or translucent and containing a red fugitive dye; Type 2, white pigmented.

C. Water: Potable and not detrimental to concrete.

PART 3 – EXECUTION

3.01 GENERAL

A. Restore streets, driveways, parking areas and other areas according to the Pavement Restoration Details shown on the Contract Drawings and the Pavement Restoration Schedule contained at the end of this section.

B. Construct new roadways, streets, driveways, parking areas and other areas according to the Pavement Restoration Details shown on the Contract Drawings and the Pavement Restoration Schedule contained at the end of this section.

3.02 EXAMINATION

A. Verify compacted subgrade or subbase is dry and ready to support paving and imposed loads.
   1. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.
   2. Proof roll subbase in minimum two perpendicular passes to identify soft spots.
   3. For curb installation, the excavation shall be made to the required depth, and the base upon which the curb is to be set shall be compacted to a firm. All soft and unsuitable material shall be removed and replaced with compacted aggregate No.57 or as specified on the Drawings.
   4. Remove soft subbase and replace with compacted fill as specified in Section 31 23 23.

B. Verify gradients and elevations of base are correct.

3.03 INSTALLATION

A. Subbase or Base Course:
   1. Aggregate Subbase or Base Course: Install as specified in PA DOT Publication 408, Section 305.

B. Forms:
   1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
   2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Reinforcement:
   1. Place reinforcing as indicated on Drawings.
   2. Interrupt reinforcing at expansion joints.
   3. Place reinforcing to achieve paving and curb alignment as detailed.
   4. Provide doweled joints as shown on drawings with one end of dowel set in capped sleeve to allow longitudinal movement.
   5. Repair damaged coating to match shop finish.

D. PLACING CONCRETE
   1. The subbase shall be thoroughly moistened immediately prior to the placing of the concrete.
   2. Concrete shall be proportioned, mixed and placed in accordance with the requirements for the class of concrete specified.

3. Place concrete in accordance with ACI 301 and PennDOT Publication 408.
4. Ensure reinforcing, inserts, embedded parts, formed joints and forms are not disturbed during concrete placement.
5. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
6. Consolidate by tamping and spading or vibrated until mortar entirely covers the surface, strike off and float.

E. JOINTS

1. Expansion joints shall be carried through the sidewalk, with preformed joint filler. Expansion joints shall be a minimum of 1/2 inch wide, full depth and spaced at a distance not to exceed 25 feet. Remolded expansion joint filler 1/2 inch thick shall be provided between new and old sidewalks and driveways and abutting existing buildings or steps. Seal all expansion joints with sealant.
2. Dummy transverse joints shall be evenly spaced between expansion joints and/or drives and steps with a maximum spacing of 5 feet, approximately 1/8 inch wide, and at least 1 inch deep. Seal with sealant.
3. Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalks. Pre-molded expansion joint filler 1/4 inch thick shall be installed in these joints. This expansion joint material shall extend for the full depth of the sidewalk.
4. Curbing:
    a. For curb and gutter installation, where the adjacent pavement contains joints, such joints shall be continued through the integral curb. Contraction joints shall be carried through integral curb with preformed joint material 1/4 inch thick, shall conform to the cross section of the curb, and shall be set perpendicular to the face and top of the curb. Preformed expansion joints shall be placed at the beginning and end of all curb returns and also at all castings.
    b. Curbing that is not constructed integral with adjacent pavement shall be constructed with intermediate planes of weakness, 2 inch depth, sawed at 10 foot intervals (not less than 4 feet). The width shall not be less than 3/16 inch and they shall be placed at the beginning and end of all curb returns and also at all castings.

F. Finishing:

1. All outside edges of the slab and all joints shall be edged with a radius edging tool of the size shown on the Contract Drawings.
2. Heavy Duty Concrete Paving: Light broom.
3. Sidewalk Paving: Light broom, trowel joint edges.
4. Median Barrier: Light broom, trowel joint edges.
5. Direction of Texturing: Transverse to paving direction.
6. Inclined Vehicular Ramps: Broomed perpendicular to slope.

7. Place curing compound on exposed concrete surfaces immediately after finishing.
8. Curbing: Forms shall be left in place for 24 hours or until the concrete has set sufficiently so that they can be removed without injury to the curbing. Upon removal of the forms, the exposed curbing face shall be rubbed immediately to a uniform surface. Rubbing shall be accomplished by the use of water and a carborundum brick. For the purpose of matching adjacent concrete finishes or for other reasons, the Engineer may permit other methods of finishing. Plastering will not be permitted.

G. Curing and Protection
1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
3. Concrete shall be cured for at least 72 hours. Curing shall be by means of moist burlap or mats or by approved curing compounds.

3.04 DRIVEWAY CLOSURE AND RESTORATION

A. Property owners shall be notified of work at driveway a week prior to driveway closure.

B. Replace and repair driveways back to original condition and as specified.

3.05 INSTALLATION TOLERANCES

A. Maximum Variation of Surface Flatness: ¼ inch in 10 ft.

B. Maximum Variation From True Position: ¼ inch.

C. Grade: The surface shall be within ¼ inch of the grades shown on the Contract Drawings.

D. Portions showing irregularities more than tolerances shall be removed and replaced at the expense of the Contractor.

3.06 FIELD QUALITY CONTROL

A. Inspect reinforcing placement for size, spacing, location, support.

B. Strength Test Samples:
1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, field cured.
3. Sample concrete and make one set of six cylinders for every 75 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area

paving.

4. Make one additional cylinder during cold weather concreting, and field cure.

C. Field Testing:
   1. Slump Test Method: ASTM C143/C143M.
   2. Air Content Test Method: [ASTM C173/C173M] [ASTM C231].
   3. Temperature Test Method: ASTM C1064/C1064M.
   4. Measure slump and temperature for each compressive strength concrete sample.
   5. Measure air content in air entrained concrete for each compressive strength concrete sample.

D. Cylinder Compressive Strength Testing:
   1. Test Method: ASTM C39/C39M.
   2. Test Acceptance: [Average compressive strength of three consecutive test maximum 500 psi less than specified compressive strength
   3. Test two cylinder at 7 days.
   4. Test two cylinders at 28 days.
   5. Retain two cylinder for 56 days for testing when requested by Engineer.
   6. Dispose remaining cylinders when testing is not required.

E. Remove and replace placed concrete material where test results or measurements indicate that it does not comply with specified requirements.

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

3.07 PROTECTION

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

B. Do not permit pedestrian or vehicular traffic over concrete for 7 days minimum after finishing and until 75 percent design strength of concrete has been achieved.

END OF SECTION