

SECTION 32 13 01

RIGID PAVING AND SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete curb and gutter.
2. Concrete walkway, flumes, and other miscellaneous cast in place elements.
3. ADA ramps.
4. Concrete paving of driveways, roadways, dumpster pads, loading dock pads, and parking lots.

B. Related Sections:

1. 31 22 00 "GRADING" for backfill and compaction of trench excavations prior to paving and for general subgrade preparation.
2. 32 05 00 "COMMON WORKS FOR EXTERIOR IMPROVEMENTS" for graded aggregate base (GAB) if shown on the Plans.

1.2 REFERENCE SPECIFICATIONS AND DOCUMENTS

A. Georgia Department of Transportation (GDOT)

1. Department of Transportation, State of Georgia Standard Specifications, Construction of Roads and Bridges, 2013 Edition. Unless otherwise noted, conform with GDOT Standard Specifications for testing, materials, and methods for bases and concrete pavements.
2. GDOT Test Procedures (GDT), where referenced.

B. American Concrete Institute (ACI)

1. ACI 301: Specifications for Structural Concrete.
2. ACI 308.1: Standard Specification for Curing concrete
3. ACI CP-1: Technical Workbook for ACI Certification of Concrete Field Testing Technician- Grade 1.

C. American Society for Testing Materials (ASTM)

1. ASTM A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Placement
2. ASTM A1064: Standard Specifications for Carbon Steel Wire and Welded Wire Reinforcement.
3. ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field.
4. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
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 D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
9. ASTM D994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
10. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
11. ASTM D2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
12. ASTM D3406: Standard Specification for Joint Sealant, Hot Applied, Elastomeric Type; for Portland Cement Concrete Pavements.
13. ASTM D5893: Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

1.3 SUBMITTALS

- A. Product data for materials, including but not limited to: cementitious material, admixtures (air entraining, etc.), joint filler and sealants, reinforcing material, grout, anchors, curing compounds.
- B. Concrete mix designs or job mix formulas for each proposed concrete mixture, including the following as applicable:
 1. Curbs & sidewalks, minor cast in place structures.
 2. Heavy Duty Concrete paving areas.
- C. Shop drawings for ADA detectible warning strips.

1.4 QUALITY ASSURANCE

- A. Testing Services: The Owner will engage a qualified independent testing agency to perform material evaluation tests described in this Section.
 1. Testing Agency Qualifications: Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- B. Ready-Mix- Concrete Manufacturer Qualifications: Manufacturer must be certified according to the National Ready Mix Concrete Association (NRMCA) Plant Certification Program.
- C. Test sections. Build 10' sample test sections of walkways, curbs, and paving areas (10'x10') to demonstrate aesthetic affects and quality standards for materials and execution. Construct mock ups at approved locations only. Incorporate representative control and joints according to project requirements.
 1. Notify Testing Agency and Design Professional at least 7 days in advance of mock up construction.
 2. Obtain Owner or Design Professional approval of mockup prior to commencement of the work.
 3. Mockup may be incorporated into the work with approval.
 4. Demolish and remove each mockup from the Site when directed.
- D. Comply with ACI 301 – Standard Specifications for Structural Concrete, unless otherwise modified by Contract Documents.

1.5 SITE CONDITIONS

- A. Store materials only in areas designated for Contractor's use.
- B. Complete all underground work and raise all necessary structures prior to paving operations.
- C. Verify all grades and elevations for conformance with the Drawings before proceeding with work. The Design Professional reserves the right to make minor modifications by reasonable field adjustments prior to completion of subgrade work.

1.6 WEATHER LIMITATIONS

- A. Cold weather protection - Whenever the air temperature may be expected to reach the freezing point, spread straw or other blanketing material to sufficient depth to keep concrete from freezing, or provide enclosure and a heating device capable of maintaining concrete temperature of at least forty-five (45) degrees five (5) days and maintain above freezing for the entire specified curing period. The Contractor shall be responsible for removing and replacing any concrete injured by freezing or frost.
- B. Placing During Hot Weather: The temperature of the concrete as placed shall not exceed 85° F, mixing water or aggregates may be cooled as necessary to maintain a satisfactory placement temperature. Do not place concrete when air temperatures exceed 95° F.

1.7 PAVEMENT DESIGN

- A. Pavement sections are shown on the Plans and may include, but are not limited to, the following applications:
 - 1. Concrete Paving within the Right-of-Way.
 - 2. Heavy Duty Concrete Paving.
 - 3. Medium Duty Concrete Paving.
- B. All depths shown or specified are measured after compaction or construction.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Cementitious materials. Type I or Type II Portland cement. Portland cement may be partially replaced with either fly ash or slag cement at the following maximum proportions:
 - 1. Fly ash, 15%
 - 2. Slag cement, 50%
- B. Fine and coarse aggregates for concrete mixes. The ratio of fine to total aggregate shall be such as will produce a dense, homogeneous and workable mixture, which can be placed without segregation of materials and which will attain the design compressive strength. Aggregates shall comply with ASTM C33.

2.2 CONCRETE MIXTURES

- A. Concrete for rigid paving (heavy duty and normal). Proportion such that the following are met:
 - 1. Minimum compressive strength at 28 days ($f'c$) = 4000 p.s.i (heavy duty); 3000 p.s.i. (normal)
 - 2. Air content acceptance 3.5 to 6.0%, design air content 4.0 to 5.5%.
 - 3. Maximum slump = 4 inches.
- B. Unless otherwise shown, proportion concrete for curb, paving, walks, planters, seat walls, flumes and all other miscellaneous site work concrete to meet:
 - 1. Minimum compressive strength at 28 days ($f'c$) = 3000 p.s.i.
 - 2. Air content acceptance = 2.0 to 6.0%, design air content 2.5 to 6.0%.
 - 3. Maximum slump = 4 inches.

2.3 FILLER AND SEALER

- A. Expansion joint material: 1/2 inch performed strips of cellular fiber impregnated with suitable bituminous binder. Filler shall conform to section area and extend through section to within 1/2 inch of top surface and conforms to ASTM D1751 or D1752, unless otherwise indicated.
- B. Contraction Joint Sealer Material: Only apply joint sealant when otherwise shown in the Plans. Cold applied is the default.
 - 1. Cold applied silicone rubber type; ASTM D5893
 - 2. Hot-poured elastomeric type; ASTM D3406
 - 3. Single-Component Elastomeric Type (preformed); ASTM D2628

2.4 STEEL BAR, WELDED WIRE FABRIC

- A. Provide steel bars and welded wire fabric of intermediate grade steel in specified sizes as shown on plans.
- B. Plain-steel welded wire fabric: ASTM 1064, fabricated from steel wire formed into flat sheets.
- C. Reinforcement bars: ASTM A615, Grade 60, deformed unless otherwise indicated. Cut bars true to length with ends square and free of burs.
- D. Dowel bars: ASTM A615, Grade 60, plain steel bars unless otherwise indicated. Dowel bars shall be cut true to length with ends square and free of burs.

2.5 FORMS

- A. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 1. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 2. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete

2.6 EPOXY RESIN GROUT

- A. Epoxy adhesive used for anchors and dowel bars in accordance with Type VIII per GDOT Standard Specification 886 unless otherwise noted.

2.7 DOVETAIL ANCHOR SLOTS

- A. Galvanized steel, 22 gage (0.8 mm) thick, foam filled, release tape sealed slots, anchors for securing to concrete forms.

2.8 DETECTABLE WARNING

- A. Provide tactile warning surface (truncated dome) via pavers or monolithic concrete pour systems at ADA ramps.
 - 1. Provide shop drawings for proposed system.
 - 2. Dome Size: Diameter of 0.9 inch (23 mm), height of 0.2 inch (5 mm) and a center-to-center spacing of 2.35 inches (60 mm).
 - 3. Visual Contrast: Contrast visually with adjoining walking surfaces either light-on-dark or dark-on-light. The material used to provide contrast shall be an integral part of the truncated dome surface.
 - 4. Audible Contrast: Differ from adjoining walking surfaces in resiliency or sound-on-cane contact.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADES

- A. Prepare subgrades as specified in Section 31 22 00 "Grading" to bring subgrade to required lines and grade for site improvements.
- B. Maintain all subgrade in satisfactory condition, protected against traffic where necessary, and properly drained until site improvements are placed. Immediately in advance of concrete, check subgrade levels with templates riding the forms, correct irregularities, and re-compact any added fill material.

3.2 STRUCTURE LOCATIONS

- A. Check for correct elevation and position of all manhole covers, valve boxes, and similar structures located within areas to be poured and make any necessary adjustments in such structures.

3.3 AGGREGATE BASES

- A. If shown on the Plans- place, compact, and maintain aggregate bases in accordance with Division 32 "COMMON WORKS FOR EXTERIOR IMPROVEMENTS".

3.4 FORM CONSTRUCTION

- A. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the work and so forms can remain in place at least 24 hours after concrete placement.

- B. Check completed formwork for grade and alignment to the following tolerances:
 - 1. Top of Forms not more than 1/8" in 10' from indicated elevation.
 - 2. Vertical face on longitudinal axis, not more than 1/4" in 10' from indicated alignment.
- C. Clean forms after each use, and coat with form release agent after each use and as often as required to ensure separation from concrete without damage.

3.5 MIXING AND TRANSPORTING CONCRETE

- A. Ready-Mixed Concrete - Certificates and laboratory strength test data shall be furnished from the mixing plant that concrete has a twenty-eight (28) day compressive strength when tested in accordance with methods described in ASTM Standard C39. No change shall be made in materials or the established mix without prior approval of the Design Professional.
- B. Ready-mixed concrete shall be transported to the site in transit-mix or agitator trucks having watertight drums loaded not in excess of rated capacities. Concrete shall be delivered and discharged within one (1) hour after water is added to the cement. Concrete which, when delivered is not plastic and workable will be rejected.
- C. Retempering of concrete that has partially hardened (remixing with or without additional cement, aggregate or water) will not be permitted.

3.6 PLACING CONCRETE

- A. Subgrade- Place concrete only on a moist compacted subgrade or base, free from loose material. Place no concrete on a muddy or frozen subgrade.
- B. Forms - All forms shall be free from warp, tight enough to prevent leakage of concrete, and substantial enough to maintain their shape and position without springing or settlement when concrete is placed or vibrated. Forms shall be staked, braced, and/or tied together securely. Forms shall be clean and those for surfaces to be exposed shall produce a smooth, even finish without fins or board marks. Set forms for slabs on ground at exact finished grade. Check for line and grade and correct as necessary immediately before concreting. Provide uniform bearing for such forms.
- C. Reinforcement shall be accurately placed, and securely supported and fastened to prevent movement during placement of concrete.
- D. Concrete shall be deposited to require as little rehandling as practical. Placing shall be continuous between transverse joints or in individual sections of the work. Vibrate concrete thoroughly along forms and expansion joints, and work carefully into corners and around reinforcement. Tamp and screed to a dense mass. If the temperature may be expected to fall below forty (40) degrees F within twenty-four (24) hours after concrete is placed, heat water and aggregates to bring the temperature of concrete mix to at least fifty (50) degrees.
- E. Do not remove forms for at least 24 hours after concrete has been placed. After forms are removed, clean ends of joints and point-up any minor honeycombed areas. Remove and replace sections with major defects, as directed by Design Professional.

3.7 JOINTS

- A. General: Construct expansion, control (also may be called weakened-plane or contraction, and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
- B. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.
- C. Control Joints: Provide control (contraction) joints, sectioning concrete into areas not to exceed 25 feet in length. Construct control joints for a depth equal to at least 1/4 of concrete thickness, as follows:
 - 1. Tooled Joints: Form control joints in fresh concrete by grooving top portion of concrete. Finish edges with a jointer. Joints in walks shall be 1/4" x 1" deep and at a spacing equal to walk width.
 - 2. Sawed Joints: Form control joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
- D. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints. Construct joints as shown or, if not shown, use standard metal keyway-section forms.
- E. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.

3.8 CONCRETE CURB AND GUTTER

- A. Furnish and install formed concrete curb and gutter as detailed. Curb and gutter shall be accurately formed to a true, clean, straight, even profile. Unless otherwise shown:
 - 1. Provide expansion joints 40 feet on center. Control (tooled) joints shall be provided at 10 feet on center.
 - 2. Finish of concrete shall be a fine broom finish.
- B. All curves shall be accurately formed to detail.

3.9 CONCRETE WALKS AND FLUMES

- A. Concrete walks shall be four (4) inches thick and of width as shown on the Site Plan. Unless otherwise shown:
 - 1. Provide expansion joints through walks at a maximum of 40 feet on-center and control (tooled) joints at the same intervals as the width of the walk.
 - 2. Slope walks toward curb unless otherwise indicated.
 - 3. Finish shall be a fine broom finish.
 - 4. Finished surfaces shall be smooth and not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiencies in section thickness is up to 1/4".
 - 5. Minimum slope shall be 1.0% unless specifically noted.

3.10 SAND BLAST FINISH

- A. Provide abrasive blast (sand blast) finish where indicated on the Drawings.
- B. Perform sand blasting 24 to 72 hours after casting when concrete strength is between 1000 and 1500 psi.
- C. Surface Continuity: Perform sand blasting in a continuous manner, utilizing same crew or personnel.
- D. Depth of Cut: Use an abrasive grit of proper tyhpe and gradation to expose aggregate and surrounding matrix surfaces to match the design reference sample or mock up as follows:
 - 1. Brush: Remove cement matrix to eliminate surface sheen and expose face of fine aggregate. No reveal.
 - 2. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color. Maximum reveal 1/16 inch.
 - 3. Medium: Generally expose coarse aggregate with slight reveal. Max reveal ¼”.
 - 4. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third of its diameter, reveal ¼ to ½ inch.
- E. Sand blasting: Blast corners and edges carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match the mockup.
- F. Cleaning: After sand blasting is complete, clean surface with commercial concrete cleaner according to manufacturer instructions and recommendations. Thoroughly neutralize and flush cleaning solution from finished surface with water under pressure.
- G. Protect adjacent surfaces and materials from washing and run-off.

3.11 HANDICAP RAMP

- A. Locate and construct concrete handicap ramps per Plan and details. Provide tactile warning surface (truncates dome) via pavers or monolithic concrete pour systems provide shop drawings for said system. Apply a fine broom finish. Do not exceed eight (8) percent slope at any point.

3.12 HEAVY DUTY CONCRETE PAVING

- A. Place steel reinforcing where indicated prior to placing concrete.
- B. Pour heavy duty concrete mix in forms so that when consolidated struck off, compacted and finished, paving will be to the thickness shown on the Plans. If not shown on the Plans, paving thickness shall be eight (8) inches.
- C. Locate expansion joints at 40' o.c. and control joints at minimum of 10' o.c. for each pavement lane.
- D. Test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
- E. Compact in such a manner that aggregate is forced down and not less than three eights (3/8) inch of mortar is left on top. Apply heavy broom finish.

3.13 CURING CONCRETE

- A. Protect unhardened concrete from rain and flowing water and protect concrete against loss of moisture and rapid temperature change for at least a 7 day curing period.
- B. Impervious membrane - Where applicable, concrete will be cured through the application of a transparent, impervious membrane of a type approved by the Design Professional. The liquid shall contain a fugitive dye and shall be of such composition as not to react with the concrete nor alter its color. Apply the liquid immediately after free water has disappeared from the finished surface of the concrete; apply in the form of a fine mist and in such manner as to cover the surface with a uniform film, ample to seal the surface thoroughly and without marring the concrete finish in accordance with manufacturer recommendations. Keep workmen, equipment and materials off the membrane during the curing period, except as required for joint sawing operations and surface tests.

3.14 TOLERANCES

- A. Elevation tolerance for finish grade surfaces are:
 - 1. General areas ± 0.04 ft unless field adjustments are directed or approved by the Design Professional.
- B. Cross slope, thickness, and smoothness tolerances are as follows:

Layer	Cross Slope ²	Thickness	Smoothness ¹
Base (Aggregate or treated)	$\pm 1.0\%$	$\pm 1/4$ in	1/2 inch
Finished Concrete Surface (Pedestrian Areas)	$\pm 0.25\%$	$\pm 1/4$ in	5/16 inch
Curb Sections	$\pm 0.5\%$	$\pm 1/4$ in	1/4 inch
Rigid Pavement Sections	$\pm 0.3\%$	$\pm 1/4$ in	1/4 inch

¹ In any direction within a single plane of asphalt, do not exceed the gap below a 10 foot straightedge resting on high spots.

² Cross slope tolerance does not alleviate the requirement to provide positive drainage. Minimum slope shall be 1.0%.

3.15 TESTING- QUALITY ACCEPTANCE

- A. Inspections: Prior to commencement of portions of the work, the Testing Agency shall be notified 3 days in advance to verify the following items:
 - 1. Subgrade preparation, stiffness (proofrolling).
 - 2. Subgrade profile, cross slope, and elevation.
 - 3. Grades, elevations, compaction, surface smoothness of base aggregate if used.

- B. Additional testing (or retesting) after failing tests shall be paid for by the Contractor.
- C. Replace concrete in all areas (between joints) that fail to meet cross slope, thickness, and smoothness tolerances. Also, replace concrete in all areas that does not meet material testing acceptance criteria shown below.
- D. Appearance: Exposed surfaces of finished work shall not exhibit excessive cracking, discoloration, form marks, or tool marks which are inconsistent from the overall appearance. Such deficient surfaces shall be removed and replaced between joints.
- E. Minimal testing requirements Owners Quality Assurance are summarized below. Contractor may elect to collect additional samples and perform additional tests, or prepare additional specimens for testing at its sole discretion in accordance with their own quality control program.

Material or Product	Characteristic /Test Method	Minimum Sample Frequency	Acceptance Criteria	Sampling Point
Concrete Mixture	Compressive Strength <i>ASTM C31, ASTM C39</i>	Min. 1 composite sample per day (2 sets of 2 standard 6"x12" cylinder), per 250 CY placed, per each class. <i>ASTM C172</i>	Average of three consecutive tests exceed specified strength, and no test is deficient by more than 500 psi.	Molded onsite, lab test.
	Air Content <i>ASTM C173, or C231</i>	(min) 2 tests per day, per class placed.	+/- 0.5% of the design air content	On site
	Slump <i>ASTM C143</i>	(min) 2 tests per day, per 250 CY placed, per each class.	Refer to mix composition.	On site
Aggregate base courses	Gradation; max dry density, optimum moisture by modified proctor, <i>ASTM D1557</i>	1 per source	Gradation within limits.	Stockpile at source
	Compaction <i>GDT 21, 59, ASTM D6938</i>	1 per 2000 sq yards of finished concrete surface, per lift	100% of max dry density, $\pm 2\%$ optimum moisture *	In-place, prior to next lift

- F. Deficient work that test reports and inspections indicated does not comply with this specification, shall be fully replaced. Corrective action not involving full replacement may be approved by the Architect in writing, provided such corrective action equals or better the original specification

3.16 MAINTENANCE OF CONCRETE SITE IMPROVEMENTS

- A. Concrete site improvements damaged during construction shall not be spot patched. If a portion of a panel is damaged between control or expansion joints, the entire panel shall be replaced.

END OF SECTION