

Rigid Paving



RIGID PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 REFERENCES

- A. ACI 214 - Recommended Practice for Evaluating Compression Test Results of Field Concrete
- B. ACI 301 - Specifications for Structural Concrete for buildings
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- D. ACI 305/305R - Hot Weather Concreting
- E. ACI 306/306R - Cold Weather Concreting
- F. ACI 308 - Standard Practice for Curing Concrete
- G. ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement
- H. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement
- I. ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- J. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
- K. ASTM C31 - Making and Curing Concrete Test Specimens in the Field
- L. ASTM C33 - Concrete Aggregates
- M. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens
- N. ASTM C94 - Ready Mix Concrete
- O. ASTM C143 - Test Method of Slump of Hydraulic Cement Concrete
- P. ASTM C150 - Portland Cement
- Q. ASTM C260 - Air-Entraining Admixtures for Concrete
- R. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete

- S. ASTM C494 - Chemical Admixtures for Concrete
- T. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- U. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- V. ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type
- W. ASTM D1751 - Preformed Expansion Joint Fillers for concrete Paving and Structural Construction
- X. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- Y. Town of Winter Park construction specifications, standards and details.

1.3 SUBMITTALS

- A. Provide under provisions of Division One Specifications
- B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
 1. Existing data on proposed design mixes, certified and complete
 2. Submit reports of field quality control testing

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation, Colorado Department of Highways, and the Town of Winter Park construction specifications, standards and details.

1.5 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way conform to the requirements Town of Winter Park construction specifications, standards and details
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Obtain cementitious materials and aggregate from same source for all work

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover

- B. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight
- C. Prepare a delivery ticket for each load of ready-mixed concrete
- D. Contractor shall submit tickets for all concrete delivered to site:
 - 1. Quantity delivered
 - 2. Actual quantity of each material in batch
 - 3. Outdoor temp in the shade
 - 4. Time at which cement was added
 - 5. Numerical sequence of the delivery
 - 6. Quantity of water that can be added in the field based on mix design
 - 7. Free moisture in fine and coarse aggregate in percent by weight
 - 8. Temperature of batch

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen
- B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 PRODUCTS

2.1 MATERIALS

- A. Form Materials
 - 1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
 - 2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
 - 3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
 - 4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise
- B. REINFORCEMENT
 - 1. Where reinforcement is specified herein or indicated on the plans:
 - a. Bars: ASTM A615, Grade 60
 - b. Reinforcing Welded Wire Fabric (WWF): ASTM A185, steel, 16 gage minimum
 - i) Furnish in flat sheets
 - c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
 - d. Fibrous reinforcement: Collated, fibrillated, polypropylene fibers, tensile strength 70,000 psi
 - i) Use 1.5 lbs. Per cubic yard minimum
 - ii) Fibermesh or accepted substitution

2.2 ACCESSORIES

- A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane
- B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions
- C. Sheet Materials: AASHTO M171, 4 mil
- D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethylene foam; Texmastic "vinylex 3600," Sonneborn "Sonoflex F," or accepted substitutions

2.3 CONCRETE MIX

- A. Comply with ASTM C94
- B. Maximum Coarse Aggregate Size: 1-inch
- C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete
- D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.45
- E. Slump: 4-inch maximum
 - 1. May be increased to 4.5 inches for hand work, acceptable to Town
 - 2. As low as possible consistent with proper handling and thorough compaction
- F. Volumetric Air Content: 5.5%-6.5% +/- 1% after placement for 1-inch aggregate
 - 1. Maximum 5%-7% +/- 1% after placement
 - 2. Vary air content with maximum size aggregate, ASTM C94, Table 3.
- G. Strength: Compressive strength as determined by ASTM C39, 4000 psi minimum at 28 days
- H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded
- I. Adjust mix as required to meet specifications
- J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 20 percent Class C or 30 percent Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
 - 1. The loss on ignition shall not exceed 3.0 percent
 - 2. The CaO in Class F fly ash shall not exceed 18 percent
- K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification

1. Include a water reducing admixture
2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Provide under provisions of Division One Specifications
- B. Submit proposed mix design to Town for review prior to commencement of work
- C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements
- D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads
- B. Verify gradients and elevations of base are correct
- C. Check completed formwork for grade and alignment to the following tolerances:
 1. Top of forms not more than 1/8-inch in 10 feet
 2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

- A. Subgrade
 1. Prepare subgrade in accordance with Earthwork Section
 2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete
 3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Earthwork Section
 4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
 5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete
- B. Frame Adjustment
 1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
 2. Set frames of structures in full grout bed to provide bearing. Set to final grade
 3. Form construction joints and blockouts as indicated on drawings

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete

1. Transporting of mixed concrete shall conform to ACI 305R
2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Town. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site
5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming

1. Place and secure forms to correct location, dimension, profile, and gradient
2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
4. Oil forms prior to concrete placement
5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement

1. Add fiber reinforcement to mix at plant prior to delivery to jobsite
2. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
 - a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
 - b. Support with metal chairs, brick or stone is unacceptable
3. Hold all tie and marginal dowels in proper position by sufficient supports or pins
4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
5. Interrupt reinforcement at expansion joints
6. Place dowels to achieve pavement and curb alignment as detailed.
7. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
8. Grease dowels on one side of joints with caps on greased end

D. Placing concrete

1. Place concrete in accordance with ACI 301

2. Lightly moisten subgrade or base course immediately before placing concrete.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
4. during concrete placement
5. Deposit concrete near final position. Minimize segregation and damage to subgrade
6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials
7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
8. Do not place concrete in forms that has begun to set
9. Do not place more concrete in one day than can be finished before dark the same day
10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified
11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting

1. Conform to ACI 306/306R, except as modified herein
2. Minimum concrete temp at the time of mixing

Outdoor Temp Placement (in shade)	at Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

3. Do not place heated concrete which is warmer than 80 degrees F
4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
5. Do not allow concrete to cool suddenly

F. Hot weather concreting

1. Conform to ACI 305/305R, except as modified herein
2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
3. Do not allow concrete temperature to exceed 70 deg F at placement
4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints

1. Provide concrete joints per CDOT Standard Details

2. Sidewalk and pavement
 - a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut
 - b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
 - c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length
3. Curb and Gutter
 - a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.
 - b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
 - c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.
4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing

1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Town before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
10. Direction of Texturing:

- a. Curb and Gutter: At right angles to the curb line
 - b. Sidewalk: At right angles to centerline of sidewalk.
11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Town

I. Joint sealing

1. Seal joints and clean concrete prior to opening to traffic.
2. Seal all expansion joints.
3. Separate concrete from other structures with 3/4-inch thick joint filler.
4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection

1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.4 FIELD QUALITY CONTROL

A. Tolerances

1. Division One Specifications - Quality Assurance: Tolerances
2. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
3. Maximum Variation from True Alignment: 3/8-inch in 10 ft

B. Take cylinders and perform slump and air entrainment tests in accordance with ACI 301. Unit weight and mix temperature will also be taken

C. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cu yds or less cu yds of concrete placed each day

D. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents

E. One slump and air entrainment test will be taken for each set of test cylinders taken

F. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and 1 at a later date, if necessary, as directed by the Town

- G. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken
- H. Thickness of fresh concrete may be checked by Town at random. Coring will be conducted in accordance with Town of Winter Park requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY

Deficiency in Thickness (Determined by Cores) INCHES	Proportional Part of Contract Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Town is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

- I. Failure of Test Cylinders or Coring Results: Town may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.5 SCHEDULE OF CONCRETE

- A. See plans for concrete thicknesses and subgrade preparation.

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

- A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement
- B. Rebar reinforcement required for all cross pans

END OF SECTION