

# PROJECT MANUAL

Poudre School District

## 2019 ASPHALT PROJECT AT BENNETT, CLP ES/MS, DUNN, O'DEA, POLARIS AND RMHS FRONT ENTRY



POUDRE SCHOOL DISTRICT

**Owner:**

Poudre School District  
2407 LaPorte Avenue  
Fort Collins,  
Colorado 80521

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SECTION 03 30 00  
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Work performed under this section consists of cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for structures and pavements in locations or, over the areas as shown on the Drawings in conformance with the dimensions, lines, grades, thicknesses, and typical sections shown on the Drawings or established by the Owner.

1.2 DEFINITIONS

- A. ASTM: American Society of Testing and Materials
- B. AASHTO: American Association of State Highway and Transportation Officials
- C. ACI: American Concrete Institute
- D. CRSI: Concrete Reinforcing Steel Institute

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.4 INFORMATION SUBMITTALS

- A. Material certificates, test reports or manufacturer data sheets showing that the materials or products being supplied comply with these specifications. At a minimum these shall include:
  - 1. Portland cement and other cementitious materials

2. Flyash
3. Aggregate
4. Metal reinforcement and accessories
5. Admixtures
6. Concrete embedments

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment and certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

## PART 2 - PRODUCTS

### 2.1 CEMENTITIOUS MATERIALS:

- A. Portland Cement: ASTM C 150, Type I or Type II.
- B. Fly Ash : ASTM C 618, Class F or C
- C. Silica Fume: ASTM C 1240, amorphous silica

### 2.2 AGGREGATES

- A. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, well graded. Provide aggregates from a single source.
  1. Coarse Aggregate: ASTM C 33, Size #67 gradation or approved alternate (See Table 1). The nominal maximum size of the coarse aggregates shall not be larger than one-fifth of the narrowest dimension between sides of forms, one-third the

depth of slabs, nor three-fourths of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least.

TABLE 1					
Sieve Size	1	3/4	3/8	4	8
% Retained	0	0-10	45-80	90-100	95-100

2. Fine Aggregate: Fine aggregate shall consist of clean, hard, durable, uncoated siliceous or calcareous particles and free of materials with deleterious reactivity to alkali in cement within the limits shown in Table 2. The Fineness Modulus (F.M.) of the fine aggregate furnished shall be not less than 2.5 nor more than 3.4 when determined by using a sieve series consisting of the No. 4, 8, 16, 30, 50 and 100 sizes. After acceptance of a gradation for use in the work the F.M. shall not vary more than + 0.2.

TABLE 2							
Sieve Size	3/8	4	8	16	30	50	100
% Retained	0	0-5	0-20	15-50	40-75	70-90	90-99

3. Deleterious substances in aggregates shall not exceed the following percentages by weight when tested under the designated ASTM method.

TABLE 3			
	Coarse	Fine	Test
Material Passing No. 200 Sieve	1.0	3.0	C117
Shale	0.5	0.5	C123
Soft Friable Pieces	0.5	0.5	C142
Sticks (wet)	0.1	0.1	
Coal	0.3	0.3	C123
Clay Lumps (wet, on No. 4 Sieve)	1.5	0.3	C142

4. The Fineness Modulus (F.M.) of the fine aggregate furnished shall not be less than 2.5 nor more than 3.4 when determined by using a sieve series consisting of the No. 4, 8, 15, 30, 50 and 100 sizes. After acceptance of a gradation for use in the work the F.M. shall not vary more than +0.2.
5. Stockpiles - Aggregates shall be stockpiled by building up free-draining horizontal layers not greater than 4 feet in thickness. Aggregates that have become mixed with earth or foreign material shall not be used. If the water content in coarse aggregate is below that which the aggregate will absorb, such aggregate shall be wet down at least 12 hours in advance of the time the mix is to be batched.
6. Aggregate Tests
  - a. General - All aggregates proposed by the Contractor for use in the work shall be certified by an approved Testing Laboratory as complying with the above requirements covering deleterious materials and gradation. In addition, unless waived by the Engineer, certified tests also shall be

provided in accordance with Paragraphs (b) thru (e) below. All costs of testing shall be borne by the Contractor.

- b. Soundness - Coarse aggregate for concrete when tested for soundness with magnesium sulfate in accordance with ASTM Standard C88 shall have a total loss not greater than 18% by weight.
- c. Abrasion - The percentage of wear of the coarse aggregates by the Los Angeles Abrasion Test, ASTM C131, shall be less than 40%.
- d. Absorption - Coarse aggregate for concrete shall have an absorption limit of 4% or less, as determined by ASTM C127.
- e. Mortar Strength - Fine aggregates shall be of such quality that when made into a mortar and tested in accordance with ASTM C87 the mortar shall develop compressive strengths at 7 and 28 days of not less than 100 percent of that developed by the control mortar specified in C87.

### 2.3 ADMIXTURES

- A. Admixtures are defined by these specifications as a material, other than Portland Cement, aggregate or water, added to concrete to modify its properties. The following admixtures shall be used when required and may be used when permitted.
  1. Air-Entraining Admixture: ASTM C 260.
  2. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
    - a. Water-Reducing Admixture: ASTM C 494, Type A, F & G.
    - b. Retarding Admixture: ASTM C 494, Type B & D.
    - c. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
    - d. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
    - e. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
    - f. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.4 WATER: ASTM C 94, Potable.

### 2.5 METAL REINFORCEMENT:

- A. Welded Steel Wire Fabric: ASTM A185. Fabric shall conform to the size and dimensions shown on the Drawings.

2.6 FORMING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels constructed of plywood, metal, or other approved panel materials that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

PART 3 - EXECUTION

3.1 PROPORTIONING

- A. Concrete mixes are to meet the requirements of Table 4 with mix proportions complying with ACI 211.

TABLE 4				
Concrete Class <sup>(1)</sup>	Concrete Compressive Strength f'c (psi)	Maximum Water/Cement Ratio	Air Entrainment (%)	Slump (in.)
Class I				
Slabs & Walks	4000		5 +/- 1	2 to 5
Pavement	4000	.45	5 +/- 1	1 to 3
Curbs & Gutters	4000	.45	5 +/- 1	1 to 3

NOTES:

- 1) The Class of concrete to be used in the various parts of the work shall be as specified herein or as noted on the drawings. Where no specific class has been designated, Class I concrete shall be used.
- B. Fly ash conforming to ASTM C 618, Class F or C may be used to replace a maximum of 20% of the cement.

- C. Coarse Aggregates shall be no less than 50% of the total concrete aggregates by weight.
- D. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, ASTM C 1116 and ACI 304R, and furnish batch ticket information to the Contractors Site Superintendent.
- E. Site batched and mixed concrete is not allowed by the provisions of this specification. Should the Contractor seek to utilize site prepared concrete, separate application for approval shall be submitted to the Owner including, but not limited to, plans for batching facility, quality control, material handling, etc.

### 3.2 FORMS

- A. Forms shall conform to the shape, lines and dimensions of the concrete as shown on the Drawings. Forms shall be provided for all vertical surfaces. The materials, design, and construction of formwork shall conform to the applicable portions of the American Concrete Institute Standard "Recommended Practice for Concrete Formwork" (ACI 347) and to these specifications.
- B. The design of the formwork shall be the responsibility of the Contractor.
- C. Forms shall be built true to line and shall be mortar-tight and sufficiently rigid to prevent displacement or bulging between supports. Bends, chamfers and other offsets shall be provided when the forms are built. Joints shall be kept to a minimum and framing shall solidly back all joints.
- D. Before forms are placed, material to form exposed surfaces shall be oiled thoroughly. Forms for unexposed concrete may be oiled at the Contractor's option. All forms not oiled shall be wetted immediately before placing concrete and points at which water has gathered within the forms shall be drained.
- E. The removal of forms shall not be started until the concrete has attained the necessary strength to support its own weight and any construction loads. Forms shall not be removed before the expiration of 30 hours from any construction. Forms supported by false work shall not be removed until the concrete has attained its design strength.

### 3.3 REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
- B. Prior to positioning, reinforcing steel shall be cleaned of all loose mill scale and rust or coatings which might prevent or reduce bond. Reinforcement shall be positioned accurately and secured against any displacement by using annealed iron wire ties or suitable clips and be supported by suitable metal supports, spacers or hangers. All reinforcing shall be in place and securely fastened before placing any concrete.



### 3.4 PLACING CONCRETE

- A. Concrete placement to be in accordance with ACI 301, 304, 318 and 302.
- B. In the case of special site conditions and/or when requested by the Owner, the method selected by the Contractor to place the concrete shall be submitted for approval along with sufficient details and data to review the procedure.
- C. Cold-Weather Placement: Comply with ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40°F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- D. Hot-Weather Placement: Comply with ACI 305 and as follows:
  - 1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.5 CURING OF CONCRETE

- A. All concrete surfaces shall be protected to insure that loss of moisture from the surface is held to a minimum for a period of at least seven (7) days following initial set. Concrete damaged by improper curing shall be subject to removal and replacement as directed. The method of curing, regardless of type, will not relieve the Contractor of his responsibility to provide concrete having required strength and surface finish. Unless otherwise specified for a specific item of work, the prevention of the loss of moisture from the concrete surface shall be accomplished by one of the following methods:
  - 1. Surface maintained continuously wet by sprinkling or inundation.
  - 2. Covering with burlap mats kept continuously wet.
  - 3. Covering surfaces with 4 mil polyethylene sheeting. Splices shall be made with a minimum lap of 4 inches and sealed with tape. Materials to be approved by the Engineer.

4. Application of a membrane curing compound approved by the Engineer
- B. Forms left in place during the specified curing period shall be sprinkled and maintained moist as required to prevent rapid drying of the concrete;

### 3.6 CONTROL TESTS

- A. All concrete and concrete materials used in the work shall be tested as directed by the Engineer. The Contractor shall provide material for all samples and test specimens required.
- B. So long as the Contractor's work progresses in an orderly and reasonable manner the costs of field sample preparation and testing of all specimens will be borne by the Owner. Should the Contractor use methods or procedures that require unreasonable or excessive field testing to determine whether specification requirements are being met, or if field testing is performed with continued negative results that indicate the Contractor's methods or procedures are not adequate to provide the specified results, the Engineer shall notify the Contractor in writing that the costs of all additional testing beyond specific limits, which shall be set out in the written notice for the particular area or material in question, shall be the responsibility of the Contractor.
- C. Control tests which will be conducted on a continuing basis include:
  1. Slump Test: (ASTM-C143) as directed during concrete placement, generally once each day on the first truck of concrete during concrete placement.
  2. Yield Test: (ASTM-C138) as directed during concrete placement, generally once each day during concrete placement.
  3. Compressive Strength: (ASTM-C39) two (2) test specimens plus (1) spare for each 50 cubic yards or less of each class of concrete placed during one day's operation to be tested at 7 and 28 days. Test specimens to be prepared in accordance with ASTM-C31.
  4. Air Entrainment: (ASTM-C231) as directed during concrete placement, generally at least once each day during concrete placement.

### 3.7 DEFECTIVE CONCRETE

- A. Deficient Strength: Where the results of strength tests indicate concrete which fails to conform to these specifications, additional test specimens shall be taken, in accordance with ASTM C42, from the questioned areas, as directed by the Engineer. If the strength indicated by these core samples meets the specification requirements the concrete will be accepted. In the event that the core tests fail to meet the specifications, all concrete represented by the deficient test specimen shall be removed and replaced by the Contractor at no additional cost to the Owner. The cost of all coring and testing, including satisfactory patching of core holes, shall be borne by the Contractor.

- B. Defective Area: Areas of concrete which are defective for reasons other than strength (i.e. Honeycombs, finish irregularities, misalignment of forms, etc.) shall be repaired by methods approved by the Engineer. When in the opinion of the Engineer satisfactory repairs cannot be made the defective concrete shall be removed and replaced by the Contractor at no additional cost to the Owner.

### 3.8 CONSTRUCTION

- A. The Contractor shall ensure all pipe, pipe sleeves, reinforcing and other embedment's are properly set and placed prior to any concrete pours. Concrete items shall be constructed to the detailed thickness and to the lines and grade as shown on the Drawings.
- B. After the specified curing period, the faces of all joints to be sealed shall be thoroughly cleaned, using compressed air, sweeping, brooming or other methods approved by the Owner. The faces of the joint shall be dry after being thoroughly cleaned, and filled with joint sealing compound using a nozzle designed to completely fill the joint.
- C. Joints shall be filled to within the top surface, but in no case shall they be overfilled. Upon completion of the joint sealing operations, all excess material and foreign material shall be removed from the concrete surface.
- D. Finishing of Related Unformed Surface: Equipment or structure foundations, floor slabs and steps shall receive a troweled finish. Slabs to receive a coating shall have a finish as recommended by coating manufacturer.
- E. All surfaces exposed to view which have been in contact with the forms shall receive a smooth rubbed finish in accordance with ACI 30. All air bubbles shall be filled flush with a bonding grout before final rubbing as specified above.

END OF SECTION

SECTION 31 10 00  
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Temporary erosion- and sedimentation-control measures.

1.2 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs, videotape, or digital media.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### 1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify Colorado 811 before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant protection measures are in place.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 - Earth Moving.
  1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 48 inches above the ground. Erect temporary construction fence at dripline of trees/shrubs/vegetation to be protected.
- C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- B. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants not specifically designated for removal on the drawings.
- B. Unauthorized Tree/Plant Removal on Public Property: If trees/plants not designated for removal are removed from public property or right-of-way, the contractor shall be charged damages equal to \$200.00 for each inch in diameter of the tree removed, measured at 3 feet above the ground. Said damages shall be deducted from the project payment that is to be made to the contractor.
- C. Unauthorized Tree/Plant Removal on Private Property: If tree/plants not designated for removal are removed from easements on private property, the contractor shall pay the landowner within whose property said easement is located an amount equal to \$200.00 for each inch in diameter of the tree removed, measured at 3 feet above the ground. In addition to the aforementioned payment of \$200.00 per caliper inch, the contractor shall also replace all non-designated trees that are removed. The replaced deciduous trees shall be a minimum of 10 feet in height and be of the same species as the removed tree or a substitute approved by the landowner. Replaced conifers shall be a minimum of 6 feet in height and be of a species approved by the landowner.

### 3.4 PROTECTION OF EXISTING IMPROVEMENTS

- A. Work around and protect all structures, fences, pavement or other improvements not in direct conflict with construction. Contractor shall bear all costs for the removal, resetting, replacement, adjustment and/or repair of improvements not in conflict with construction that are impacted by Contractor's operations.

### 3.5 CLEARING AND GRUBBING

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. In areas outside of engineered fill, place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 SITE IMPROVEMENTS

- A. Remove, sidewalks, paving, curbs, gutters, and aggregate base as indicated.
  1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut a long line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 20 00  
EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades.
2. Subbase course for concrete slabs on grade and/or concrete or asphalt pavements.
3. Subsurface drainage backfill for walls, trenches, and subbases.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Controlled Low Strength Materials (Excavatable Flowable Fill): Blend of Portland Cement, fly ash, fine aggregate, and water admixtures used to fill an excavation as an alternate to backfill.

D. Impervious Material: Used to provide a relatively impermeable barrier to reduce seepage. Generally, consists of low to medium plasticity clay as classified by the Unified Soil Classification System (USCS).

E. Engineered Fill: Material designated and placed in a compacted manner in accordance with Geotechnical Engineering report.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.



- G. Fill: Soil materials used to raise existing grades.
- H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a Portland Cement concrete pavement or a Portland Cement concrete or hot-mix asphalt walk.
- I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase course, granular drainage fill, structures, or pavement materials.
- J. Utilities: On-site pipes, conduits, ducts, and cables, as well as services within buildings.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
  - 1. Aggregates

### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487.
  - 2. Laboratory compaction curve according to ASTM D 698.

### 1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
  - 3. Traffic control devices shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD).
- B. Utility Locator Service: Notify utility locator service Colorado 811 before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures.

## PART 2 - PRODUCTS

## 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups CL, ML, MH, CH, SC, GC, GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups OL, OH, and PT according to ASTM D 2487, or a combination of these groups.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained between optimum and three percent (3%) above optimum moisture content at time of compaction.
- D. Aggregate Base Course (ABC) Material: Aggregates for bases (except for RAP) shall be crushed stone, crushed slag, crushed gravel, natural gravel, or crushed reclaimed concrete. All materials shall conform to the quality requirements of AASHTO M 147 except that the requirements for the ratio of minus 75  $\mu\text{m}$  (No. 200) sieve fraction to the minus 425  $\mu\text{m}$  (No. 40) sieve fraction, stated in 3.2.2 of AASHTO M 147, shall not apply.
  - 1. The requirements for the Los Angeles wear test (AASHTO T 96 & ASTM C535) shall not apply to Class 1, 2, and 3. Aggregates for bases shall meet the grading requirements of Table 1 for the class specified for the project, unless otherwise specified.
  - 2. The liquid limit shall be as shown in Table 1 and the plasticity index shall not exceed six when the aggregate is tested in accordance with AASHTO T 89 and T 90 respectively.

TABLE 1 – CLASSIFICATION FOR AGGREGATE BASE COURSE							
Sieve Size	Percent by Weight Passing Square Mesh Sieves						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
6"			100				
4"		100					
3"		95-100					
2 ½"	100						
2"	95-100			100			
1 ½"				90-100	100		
1"					95-100	100	100
¾"				50-90		95	
#4	30-65			30-50	30-70	30-65	
#8						25-55	10-85
#200	3-15	3-15	20 max	3-12	3-15	3-12	5-15

- E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

### 3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

### 3.4 EXCAVATION, GENERAL

- A. Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Material to be excavated will be classified as unclassified. No additional payment will be made for rock and/or water which may be encountered.
  1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
  2. Remove material to lines and grades indicated to permit installation of permanent construction.

### 3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.6 SUBGRADE INSPECTION

- A. Notify Owner when excavations have reached required subgrade.
- B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the pavements with a pneumatic-tired and heavily loaded vehicle to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer/Owner, without additional compensation.

### 3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.8 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Removing concrete formwork.
  - 2. Removing trash and debris.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use satisfactory soil material.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  - 1. Under pavements and walkways, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at a minimum of 90 percent.

### 3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
  - 2. Pavements: Plus or minus 1/2 inch.

### 3.13 FIELD QUALITY CONTROL

- A. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil

materials to depth required; recompact and retest until specified compaction is obtained.

- D. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

### 3.14 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 12 16  
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work performed under this section consists of bituminous material to be placed over the areas as shown on the drawings in conformance with the lines, grades, thicknesses, and typical sections shown on the Drawings.

1.2 DEFINITIONS

- A. ASTM: American Society of Testing and Materials
- B. AASHTO: American Association of State Highway and Transportation Officials
- C. HMA: Hot Mix Asphalt

1.3 ACTION SUBMITTALS

- A. Product Data for the following:
  - 1. Asphalt Mix Design
  - 2. Material Sources
  - 3. Certified test reports of bituminous material in current production or stored in tanks under the ownership of the Contractor.

PART 2 - PRODUCTS

2.1 BITUMINOUS MATERIAL

- A. Bituminous materials for Plant Mix Asphalt Mixture -Commercial Grade shall be a PG 64-22 asphalt produced by a supplier holding an Approved Supplier Certification (ASC) in accordance with AASHTO Standard PP26-96.2.
- B. Bituminous materials for tack and priming of contact surfaces of gutters, etc. shall be CSS-1h emulsified asphalt meeting the requirements of AASHTO M208.



2.2 AGGREGATES

- A. Aggregates for hot mix asphalt (HMA) shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, natural gravel, or crushed slag. Excess of fine material shall be wasted before crushing. A percentage of the aggregate retained on the 4.75 mm (No. 4) sieve for Gradings S and SX shall have at least two mechanically induced fractured faces when tested in accordance with Colorado Procedure 45. The angularity of the fine aggregate shall be a minimum of 45.0 percent when determined according to AASHTO T 304. Aggregate samples representing each aggregate stockpile shall be non-plastic if the percent of aggregate passing the 2.36 mm (No. 8) sieve is greater than or equal to 10 percent by weight of the individual aggregate sample. Plasticity will be determined in accordance with AASHTO T 90. The material shall not contain clay balls, vegetable matter, or other deleterious substances.
- B. The aggregate for Gradings S and SX shall have a percentage of wear of 45 or less when tested in accordance with AASHTO T 96.774
- C. Combined Gradation
  - 1. Provide combined aggregates for the mixes required in the Contract Documents as shown in Table 1.

TABLE 1 - COMBINED AGGREGATE REQUIREMENTS												
Mix	Percent by Weight Passing Square Mesh Sieves											
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
SX			100	90-100	*	*	28-58		*			2-10
S		100	90-100	*	*	*	23-49		*			2-10

Notes:

\*These additional Form 43 Specification Screens will initially be established using values from the As Used Gradation shown on the Design Mix.

2.3 ASPHALT CEMENTS

- A. Superpave Performance Graded Binders. Superpave Performance Graded Binders shall conform to the requirements of PG 64-22 as listed in Table 2. Asphalt cement shall not be acid modified or alkaline modified. Asphalt cement shall not contain any used oils that have not been rerefined. Modifiers that do not comply with environmental rules and regulations including 40 CFR Part 261.6(a) (3) (IV), and part 266/Subpart C shall not be added. Modifiers shall not be carcinogenic. The supplier of the PG binder shall be certified in accordance with CP 11.

<b>TABLE 2 – SUPERPAVE PERFORMANCE GRADED BINDERS</b>		
<b>Property</b>	<b>Requirement for PG Binder</b>	<b>AASHTO Test No.</b>
	<b>64-22</b>	
<b>Original Binder Properties</b>		
Flash Point Temp., °C, minimum	230	T 48
Viscosity at 135 °C, Pa•s, maximum	3	T 316
Dynamic Shear, Temp. °C, were $G^*/\sin \delta$ @ 10 rads/s $\geq 1.00$ kPa	64	T 315
Ductility, 4 °C (5 cm/min), cm minimum	-	T 51
Toughness, joules (inch-lbs)	-	*CP-L 2210
Tenacity, joules (inch-lbs)	-	*CP-L 2210
Acid or Alkali Modification (pass-fail)	Pass	*CP-L 2214
<b>RTFO Residue Properties</b>		<b>*CP-L 2215</b>
Mass Loss, percent maximum	1.00	*CP-L 2215
Dynamic Sear, Temp. °C, were $G^*/\sin \delta$ @ 10 rads/s $\geq 2.20$ kPa	64	T 315
Elastic Recovery, 25 °C, percent min.	-	T 301
Ductility, 4 °C (5 cm/min.), cm minimum	-	T 51
<b>PAV Residue Properties</b>		<b>R 28</b>
Dynamic Shear, Temp. °C, were $G^*\bullet\sin \delta$ @ 10 rads/s $\leq 5000$ kPa	25	T 315
Creep Stiffness, @ 60 s, Test Temperature in °C	-12	T 315
S. maximum, MPa	300	T 313
m-value, minimum	0.300	T 313

Notes:

\*Colorado Procedure

## PART 3 - EXECUTION

### 3.1 SURFACE PREPARATIONS

- A. Subgrade Surface: The subgrade surface shall be maintained by the Contractor and shall not be excessively dry or wet prior to placing of bituminous mixture. No asphalt priming of the subgrade surface will be required, but moistening of the surface will be required when directed by the Engineer.
- B. Bituminous Base Surfaces: Fresh Bituminous Base Surfaces shall be free of any foreign matter or moisture prior to placing of any additional courses of bituminous material. Each lift of bituminous mat base course which will be covered by another lift of bituminous mat, shall receive a bituminous tack coat. The entire bituminous surface shall be tacked at the rate of 0.1 gallon per square yard prior to placing of the next course of bituminous material.

- C. Existing Pavement Surfaces: Existing pavement surfaces of any type shall be free of any foreign matter or moisture prior to placing of any course of bituminous material. The entire pavement surface shall be tacked at the rate of 0.1 gallon per square yard prior to placing of the covering course of bituminous material.

### 3.2 TRANSPORTATION AND DELIVERY OF HOT BITUMINOUS MIXTURE

- A. Mixture shall be transported from plant to point of use in pneumatic-tired vehicles having tight bodies previously cleaned of all foreign materials. Inside surface of each vehicle may be lubricated lightly with oil or soap solution prior to loading, but excessive use of lubricant or use of gasoline, kerosene, or similar products will not be permitted.
- B. Material shall be weighed then delivered and dumped into hopper of a self-propelled power machine for placing and spreading material as hereinafter specified.
- C. During transportation of hot bituminous mixtures from remote central mixing plant to point of usage and placement on the prepared subgrade or base course, trucks shall be provided with tarpaulin covers or other adequate protection to prevent undue loss of heat. In any case, temperature of mixture at time of placement shall be within the range of 275° to 325° F.

### 3.3 PLACING HOT BITUMINOUS MIXTURE

- A. Bituminous mixture shall be placed in layers of not more than 2- inch compacted thickness for Surface Courses nor more than 4-inch compacted thickness for Base Courses.
- B. Equipment for spreading, shaping and finishing bituminous paving mixture shall consist of an approved self-contained power machine utilizing an integral electronic automatic control system. The machine shall be suitably equipped and operated to obtain a finished course of proper depth, grade and surface.
- C. The speed of machine shall be regulated so that the surface of the pavement is smooth.
- D. The Contractor shall develop a laydown plan that ensures that his equipment operates within its tolerances and also ensures that longitudinal joints of upper lifts do not align with those of lower lifts.
- E. All joints shall present the same texture, density and smoothness as other sections of the course. Placing of any course shall be as nearly continuous as possible.
- F. Rollers shall pass over unprotected end of freshly laid mixture only when laying of the course is to be discontinued. In such cases, provisions shall be made for proper bond by cutting back the joint to expose an even, vertical surface for full thickness of the

course. Exposed edges shall be given a light fog coat of tack material. Fresh mixture shall be raked against joints, thoroughly tamped and rolled.

- G. Do not place asphalt mixture on any wet or frozen surface or when weather conditions otherwise prevent the proper handling and finishing of the mixture.
- H. Only place asphalt mixture when either the minimum ambient air temperature or the road surface shown in Table 5 is met. The Engineer may waive the temperature and weather condition requirements if warranted.

<b>TABLE 7 - MINIMUM HMA PLACEMENT TEMPERATURES</b>			
<b>Paving Course</b>	<b>Thickness (inches)</b>	<b>Air Temperature (°F)</b>	<b>Road Surface Temperature (°F)</b>
Surface	All	50	55
Subsurface	< 1.5	50	55
Subsurface	≥1.5 and < 3	40	45
Subsurface	≥ 3	30	35

### 3.4 COMPACTION OF BITUMINOUS MIXTURES

- A. All bituminous base and bituminous surface lifts shall be compacted in a workman like manner and in accordance with accepted construction practices.
- B. Rollers or other compactive devices shall be operated by competent and experienced roller operators and shall be kept in operation continuously, if necessary, so that all parts of the pavement will receive substantially equal compaction at the time desired. The Engineer shall order the mixing plant to cease operations at any time proper compaction is not being performed.
- C. A rolling procedure should be established to insure that the maximum feasible density is being obtained with care being taken not to damage the pavement from over rolling. The required percentage of the Field Mold Density will be the absolute minimum density permitted and shall not be considered as a goal or an average. Unless otherwise specified, the completed asphaltic concrete pavement shall have a density greater than or equal to 92% of theoretical maximum specific gravity (Gmm).
- D. Rollers shall be self-propelled and shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment and/or rolling procedures which results in excessive crushing of the aggregate will not be permitted. A minimum of two rollers will be required for compaction of the bituminous mixture. One shall be a steel wheel type and the other a pneumatic-tired type, unless otherwise required. A vibratory roller will be considered as a steel wheel type.

- E. The final rolling of the top or surface course shall be accomplished with a steel roller unless otherwise designated. Vibratory rollers used for finish rolling shall be operated with the vibratory unit in the off position. Final rolling shall be completed when the temperature is approximately 175° F or above.

### 3.5 CONTROL TESTS

- A. All asphaltic concrete and asphaltic concrete materials used in the work shall be tested as directed by the Owner. The Contractor shall provide material for all samples and test specimens required.
- B. The costs of testing shall be the responsibility of the Contractor.
- C. Smoothness Tests: Finished surface of bituminous pavement shall not vary more than 1/4 inch when measured by a 10-foot straightedge applied parallel to the centerline. Tests for conformity with specified crown and grade shall be made immediately after initial compression and any variation shall be corrected by removing or adding materials and continuing rolling. After completion of final rolling, smoothness shall again be checked, and irregularities that exceed specified tolerances or that retain water on the surface shall be corrected by removing defective work and replacing with new material or by adding additional material, as determined by the Owner.
- D. Asphaltic Cement Content: Minimum one test per day, one test per 500 tons of asphalt; according to ASTM D6307.
- E. Percent (%) Voids and Percent (%) VMA: Minimum one test per day, one test per 500 tons of asphalt; according to ASTM D2041.
- F. Compaction: At the option of the Contractor, either of the following methods may be used to determine pavement density:
  - 1. Furnish 3 cores, 4 inches in diameter, suitable for determining pavement density, per 5,000 square feet of pavement.
  - 2. A nuclear meter may be used to determine the road density per 5,000 square feet of pavement.

### 3.6 PROTECTION OF PAVEMENT

- A. The contractor shall protect all sections of newly compacted base and surface courses from traffic until hardened.

### 3.7 UNSUITABLE MATERIAL

- A. Any mixture that becomes loose, broken, mixed with foreign material, or which is in any way defective in finish or density, or which does not comply in all other respects

with the requirements of the specifications shall be removed, replaced with suitable material, and finished in accordance with this project manual.

END OF SECTION

SECTION 32 13 13  
CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work performed under this section consists of construction of concrete pavements, over the areas as shown on the Drawings in conformance with the dimensions, lines, grades, thicknesses, and typical sections shown on the Drawings. The term “concrete pavements” shall include street and parking lot paving, curb and gutter, sidewalks, driveways, valley gutters and other similar exposed, slab on grade construction.

1.2 DEFINITIONS

- A. ASTM: American Society of Testing and Materials
- B. AASHTO: American Association of State Highway and Transportation Officials

1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. As Per Division 03 Concrete.
  - 2. Joint Sealing Material.
  - 3. Expansion Joint Filler.
  - 4. Concrete Curing Materials.
- B. Construction methods:
  - 1. Method of concrete placement.
  - 2. Materials and Equipment for concrete placement.

PART 2 - PRODUCTS

2.1 CONCRETE PAVEMENT

- A. Portland Cement Concrete as per Division 03 Concrete and the information provided on the Drawings. Concrete minimum 28-day compressive strength shall be 4000 psi, unless indicated otherwise on the Drawings.

- B. Steel Reinforcement as Per Division 03 Concrete and the information provided on the Drawings.
- C. Hot Joint Sealing Compound.
  - 1. Provide a joint sealant that is a homogeneous blend of elastomers and other plasticizers and agents blended to result in a product that seals cracks in pavements from water intrusion.
  - 2. The sealant must retain adhesion and flexibility during extremes of expansion and contraction of the crack through a temperature range of 0°F to 140°F. Heat and apply the material according to manufacturer's recommendations.
    - a. Bond: When tested at -20°F to 200% extension of 1/2 inch to 1-1/2 inch for 3 cycles, the material exhibits no cracking, separation, or other opening that at any point is greater than 1/4 inch deep in the sealer or between the sealer and the mortar block. A minimum of 2 test specimens in a set of 3 representing a given sample must comply with this requirement.
    - b. Flow: 5 mm maximum.
    - c. Resilience: 50 -80% recovery.
    - d. Penetration: 0° F, 150 grams, 5 seconds: 18 - 80
  - 3. Provide material capable of a minimum 12-hour pot life at application temperature and of being re-heatable at least once (in a normal field application) without experiencing changes in application characteristics, polymer and oil separation, balling or other signs of gelling.
  - 4. Package the material in pails or boxes clearly marked with recommended pouring temperature, maximum heating temperature, shelf life if appropriate, and batch number. The size of a batch, which is any well-defined quantity produced by essentially the same process during a designated amount or time (such as an 8-hour shift), must be a minimum of 10,000 lbs.
  - 5. Lots from the same manufacturer may be commingled during application. Do not commingle materials from different manufacturers.
- D. Preformed Expansion Joint Filler
  - 1. Provide material that complies with AASHTO M 213.
  - 2. Asphalt Expansion Joints shall be composed of asphalt, vegetable fibers, and mineral fillers, formed under heat and pressure between two asphalt-saturated felt liners. Asphalt Expansion Joints shall conform to AASHTO M33 or ASTM D994, shall be 1/2" thick and weigh approximately 3 pounds per square foot, unless shown otherwise on the Drawings.
- E. Liquid Membrane Curing Compound
  - 1. Provide liquid membrane forming compound that complies with AASHTO M 148 for Type 1-D, clear or translucent with fugitive dye, or Type 2, white pigmented compound.



2. Type 2 white pigmented compound will be further classified into Type 2 (Wax Based) and Type 2 (Other). This is to allow specifying of wax based compound for certain applications where a bond breaker is desired. Either formulation base may be supplied except when wax based is specified.
3. Do not allow water-emulsion based material to freeze. Material that has been subjected to freezing temperatures will be rejected.

F. Fly Ash as Per Division 03 Concrete.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Concrete pavement shall be constructed to the detailed thicknesses and to the lines and grades shown on the Drawings. Concrete shall be placed over moistened and unfrozen subgrade. The ambient temperature shall be at least 40° F. and rising. If the ambient temperature exceeds 90° F, the Owner has the authority to suspend operations until weather conditions improve. The subgrade shall be free of excessive moisture prior to concrete placement.

### 3.2 PREPARATION OF THE SUBGRADE

- A. Before placing any surfacing material on any section, complete the ditches and drains along that section to effectively drain the surface to be paved.
- B. Trim the base or subgrade to the line, grade and typical cross-section as shown in the Drawings. Maintain the subgrade or base to the as-constructed condition, repairing any encountered defects to the specifications.
- C. Maintain the subgrade surface to readily drain at all times. Protect the subgrade from damage when handling materials, tools and equipment. Do not store or stockpile materials on the subgrade.
- D. Do not place material or lay pavement on a frozen or muddy subgrade, or when it is raining or snowing.
- E. Lightly spray the subgrade or base with water to obtain a thoroughly moistened condition when the concrete is deposited on it. Do not puddle water on the grade.
- F. Subgrade Preparation shall be of the types and thicknesses as shown on the Drawings.

### 3.3 PLACING REINFORCEMENT

- A. Place the wire mesh reinforcement in the pavement at the locations shown in the Drawings.
  - 1. When two layers of wire mesh reinforcement are required, support the bottom layer in the required position with bar chairs. Use separators for the top layer if the strike-off cannot be used properly for the operation.
  - 2. Lap the reinforcement as shown in the Drawings. Laps parallel to the centerline of the pavement are prohibited except for unusual width of pavement lanes or for irregular areas.
  - 3. If the Drawings do not show dimensions for laps, the minimum lap either perpendicular or parallel to the centerline of the pavement is 6 inches.
  - 4. Fasten or tie adjacent wire mesh sheets together to hold all parts of the wire mesh sheets in the same plane.
- B. If a “wire pattern” appears on the surface of the fresh pavement, immediately modify placement procedures to eliminate the problem.
- C. Use reinforcing steel free from detrimental materials that could impair the bond between the steel and concrete.

### 3.4 FIXED FORM PAVING

- A. Forms
  - 1. Use straight, wood or metal forms having adequate strength to support the proposed operations. Each section shall be a minimum of 10 feet in length. Use forms with a depth equal to the prescribed edge thickness of the concrete, a base width at least equal to the depth of the forms and without a horizontal joint.
  - 2. Forms to be used as track for subgrade planers and finishing machines shall have a base width at least eight inches wide.
  - 3. Use flexible or curved forms of proper radius for curves of 150-foot radius or less, except approved straight forms of 5-foot lengths may be used for curves of a radius from 75 to 150 foot.
  - 4. Secure the forms in place to withstand the impact and vibration of the consolidating and finishing equipment without visible spring or settlement. Extend flange braces outward on the base a minimum of  $\frac{2}{3}$  the height of the form.
  - 5. Remove forms with battered top surfaces or bent, twisted or broken forms.
  - 6. Do not use buildup forms, except where the total area of pavement of any specified thickness on the project is less than 2,000 square yards.
  - 7. Do not vary the top face of the form from a true plane more than  $\frac{1}{8}$  inch in 10 feet, and do not vary the vertical face of the form by more than  $\frac{1}{4}$  inch.
  - 8. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

9. Provide a foundation under the forms that is compact and true to the specified grade so that the whole length of the form will be set firmly in contact with the grade.

B. Form Setting

1. Set forms sufficiently in advance of the point where concrete is being placed so that line and grade may be checked.
2. After the forms have been correctly set, thoroughly tamp the grade mechanically at both the inside and outside edges of the base of the forms.
3. Stake forms into place with a minimum of 3 pins for each 10 foot section. Place a pin at each side of every joint.
4. Tightly lock form sections, free from play or movement in any direction.
5. Do not deviate the form from true line by more than ¼ inch at any point.
6. No excessive settlement or springing of forms under the finishing machine is permitted.
7. Clean and oil forms before the placing of concrete.

C. Grade and Alignment

1. Check the alignment and grade elevations of the forms immediately before placing the concrete and make any necessary corrections. When any form has been disturbed or any grade has become unstable, reset and recheck the form.

D. Removing Forms

1. Unless otherwise provided, do not remove forms from freshly placed concrete until it has set for a minimum of 12 hours, except auxiliary forms used temporarily in widened areas.
2. Remove forms carefully to avoid damage to the pavement.

### 3.5 CONSOLIDATION AND FINISHING

- A. Perform hand spreading with shovels, not rakes. Do not allow workers to walk in the fresh concrete with boots or shoes coated with earth or foreign substance.
- B. Do not apply moisture to the surface of the concrete pavement unless the Engineer approves the use of additional water on the fresh concrete surface to lubricate the float of the longitudinal finisher. If unusual weather conditions require the addition of superficial water to the concrete surface, apply it only in the form of a fine, fog mist.
- C. Consolidate and finish the concrete to the cross-section and elevation shown in the Drawings.
- D. Use vibrators or other approved equipment to consolidate each layer of concrete, when placed in more than 1 lift, or full depth if placed in 1 lift. Uniformly vibrate the

concrete across the full width and depth of the pavement so that the density of pavement concrete is a minimum of 98% of the vibrated unit weight. The 98% density requirement may be eliminated on miscellaneous areas such as entrance pavement, median pavement and gore areas.

- E. Vibrators, either of the surface type (pan or screed) or the immersion type (tube or spud) may be attached to the spreader, paver or finishing machine, or may be mounted on a separate carriage. Only operate the vibrators when the machine they are mounted on is moving forward. Do not operate hand vibrators more than 15 seconds, or less than 5 seconds in any one location. Place vibrators in and withdraw from concrete vertically in a slow deliberate manner.
- F. Additional requirements for vibrators for concrete pavement:
  - 1. The frequency of vibration of surface, pan or screed vibrators shall be a minimum of 3,500 cycles per minute,
  - 2. The frequency of vibration of immersion tube vibrators attached to the paving machine shall be a minimum of 5,000 cycles per minute; and
  - 3. The frequency of vibration of immersion spud vibrators (both hand operated and gang mounted) shall be a minimum of 8,000 cycles per minute.
  - 4. In addition, when epoxy coated reinforcing steel is involved use vibrators with heads of rubber or other resilient material. Rubber covers securely fastened over steel heads shall be acceptable. The requirement does not apply to dowel bars and tie bars for pavement.
- G. Maintain a uniform, continuous roll of concrete over the vibrators ahead of the strike-off. The height of the roll shall be approximately the same height as the thickness of the pavement being vibrated.

### 3.6 TEXTURING

- A. Provide a transverse or longitudinal tined finish where shown in the Drawings.
  - 1. Use a burlap drag as soon as all excess moisture has disappeared and while the concrete is still plastic enough to make a granular surface possible.
  - 2. Following the dragging operation, make a final finish or texture of the surface of the plastic pavement with grooving equipment with a metal comb that is capable of producing a uniform pattern of longitudinal grooves approximately 3/16-inch-wide, spaced at 3/4 inch centers and 1/8 to 1/4 inch deep. Perform the operation at such time to minimize displacement of larger aggregate particles and before the surface permanently sets.
- B. Unless otherwise noted in the Drawings, parking lot pavement, curb and gutters, sidewalks, driveways, valley gutters and other similar exposed, slab on grade construction shall receive a light broom finish.

- C. Before final texturing, finish the exposed edge of the pavement to a radius of  $\frac{1}{4}$  inch with an edger. Edge the interior longitudinal joints on multiple-lane pavement to a radius of  $\frac{1}{8}$  inch. Eliminate any tool marks appearing on the slab adjacent to the joints or edge of the slab. Do not disturb the rounding of the corner of the slab.

### 3.7 JOINTS

#### A. General

1. Failure to construct the joints in the best possible manner will be cause for suspension of work until the cause of the defective work is remedied.
2. If existing pavement of any type is required to abut with the new pavement, and the termination of the removal is not at an existing joint, make the new joint by sawing the existing pavement full depth with a diamond saw before removal.
3. The objective is to create or form a plane of weakness in the fresh concrete before uncontrolled or erratic cracking occurs. The following methods are acceptable:
  - a. Use concrete saws to saw all contraction joints no wider than the initial saw cut and to a depth of  $D/3 \pm \frac{1}{4}$  inch. Extreme conditions could exist which make it impracticable to prevent erratic cracking by sawing the joints early. At the onset of the project, devise methods, with the approval of the Owner, to control this cracking.
  - b. Make a “plastic concrete cut” straight and well defined so it can be sawed out by the saw crew. The “plastic concrete cut” would replace the specified initial saw cut. Suggested procedures could be the use of a stiff metal parting strip, with or without handles that would be gently inserted in the fresh concrete and removed, thereby parting the interlocking coarse aggregate and providing a plane of weakness.
  - c. Cut the fresh concrete with a mason’s trowel and straightedge from a worker’s bridge. It is imperative that the “plastic concrete cut” joint and the second stage saw cut are in the same exact location.
  - d. At the Contractor’s option, “early entry” saws may be used based on satisfactory performance and depth of cut recommended by the equipment manufacturer.
  - e. Procedures to control erratic cracking are not limited to these examples.
4. Edge any transverse joint requiring hand finishing and edging with a tool having a radius of  $\frac{1}{8}$  inch. Do not indent the surface of the pavement with the horizontal face of the edger.

#### B. Contraction Joints

1. Install contraction joints of the type, dimensions and spacing as stated below:
  - a. Curbs and gutters: Joint spacing not to exceed 10 feet.
  - b. Sidewalks: Joint spacing not to exceed 5 feet.

### C. Construction Joints

1. Make a butt construction joint perpendicular to the centerline of the pavement at the close of each day's work, or when the process of depositing concrete is stopped for a length of time sufficient for the concrete to take its initial set. Form this joint by using a clean header having a nominal thickness of 2 inches, and minimum cross-sectional area equal to pavement thickness by pavement width. Cut the header true to the crown of the finished pavement. Accurately set and hold it in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.
2. Protect the top surface of the header with steel. Securely fasten a trapezoidal piece of metal or wood approximately 2 inches wide and a minimum of 1 inch in depth on the face of the header, along the center of the header to form a grooved or keyed joint.
3. The Contractor may pave beyond the joint location a distance to maintain the line and grade. Saw the construction joint when the concrete has hardened. Drill holes for reinforcing tie bars and epoxy the bars in-place. Place fresh concrete against the previously placed concrete taking care to avoid injury to the edge. Vibrate the concrete to obtain an interlocking joint and prevent a honeycombed face of the joint. The additional concrete, removal of debris and other work created by this alternative is at the Contractor's expense.
4. Unless shown otherwise in the Drawings, do not place any construction joint within 5 feet of an expansion, contraction or other construction joint.

### D. Isolation (Expansion) Joint Construction

1. Isolation joints shall be formed around fixed objects, structures, walks.

### E. Joint Construction

1. Repair or replace any curing medium damaged during joint construction. Construct joints as follows:
  - a. Induced Plane of Weakness. The first saw cut is a relief cut at the proper joint location, approximately  $\frac{1}{8}$  inch wide and to the full joint depth as shown in the Drawings ( $D/3 \pm \frac{1}{4}$  inch). Make the relief cut as soon as the concrete has hardened enough so that no excess raveling or spalling occurs, but before any random cracks develop. The sequence of the relief sawing is at the Contractor's option, provided all relief sawing is completed before random cracking develops. Use suitable guide lines or devices to cut the joint straight and in the correct location. Repair curing membrane damaged during sawing. Alternate methods to the first stage sawing as specified in this Section may also be used.
  - b. Reservoir Construction. Do not perform widening of the relief joints to full width until the concrete is a minimum of 48 hours old. Delay it longer if the sawing causes raveling of the concrete. If second stage sawing is performed

before completion of the curing period, maintain the cure by use of curing tapes or plastic devices. Center the joint groove over the relief cut, and saw it to the dimensions shown in the Drawings. Should any spalling of the sawed edges occur that would detrimentally affect the joint seal, patch it with an approved epoxy patching compound and allow it to harden before installing the joint material. Make each patch true to the intended neat lines of the finished cut joint.

#### F. Cleaning Joints

1. Immediately clean freshly cut sawed joints by flushing with a jet of water under pressure and other necessary tools to remove the resulting slurry from the joint and immediate area.
2. To clean the joints, use air compressors equipped with suitable traps capable of removing all surplus water and oil from the compressed air. When contaminated air is found to exist, work will be stopped until suitable adjustments are made, and the air stream is found to be free of contaminants.
3. Just before applying the hot or cold joint sealant, complete a final cleaning by air blasting to clean incompressibles from the joint.

#### G. Sealing Joints

1. applicable materials to obtain the required joint sealant configuration. Seal longitudinal pavement joints full depth with either a cold applied chemically cured joint sealant or a hot joint sealing compound. Use only 1 type of longitudinal joint sealant on a project. Seal joints before opening to traffic.
2. Hot Applied Joint Sealing Compound
  - a. Do not seal joints until they are clean and dry, and the pavement has attained the age recommended by the manufacturer of the joint sealing compound. Install joint sealing compound according to the manufacture's recommendations.
  - b. Completely clean out the application unit when changing brands of materials, or if the material exhibits any sign of changes in application characteristics, polymer or oil separation, balling or any signs of jelling. If the application unit contains compatible material from a previous project at start-up, provide a certification covering the material in the application unit, including the manufacturer, type, etc. Material that cannot be identified and certified shall be completely cleaned out before start-up.
  - c. After a joint has been sealed, promptly remove all surplus joint sealer from the pavement or structure surfaces.
  - d. Do not permit traffic over sealed joints until the sealer is tack free, or until debris from traffic cannot imbed into the sealant.

### 3.8 PROTECTION AND CURING OF CONCRETE

- A. Cure the pavement by using burlap, liquid membrane-forming compounds, white polyethylene sheeting, concrete curing blankets or reinforced white polyethylene sheeting. Failure to provide proper curing is cause for immediate suspension of the concreting operations.
- B. Burlap, Concrete Curing Blankets, White Polyethylene Sheeting and Reinforced White Polyethylene Sheeting.
  - 1. Place the curing material on the pavement immediately after the pavement has been finished, and the concrete has hardened sufficiently to avoid harmful marring of the surface, yet early enough to prevent undue loss of moisture from the concrete. If the pavement becomes dry before the curing material is placed, moisten the concrete with a fine spray of water. Place burlap-polyethylene blankets with the dampened burlap side down. Dampen burlap and place on the surface. Keep burlap damp throughout the entire curing period.
  - 2. Lap adjacent units of curing materials approximately 18 inches. Upon removal of the forms, extend the material to completely cover the full depth of the exposed pavement.
  - 3. Weight the curing material down using continuous windrows of earth placed along the sides and edges of the pavement and transversely across the pavement on the laps to cause the material to remain in contact with the covered surface throughout the curing period.
  - 4. Walking on the pavement surface to place the curing material is prohibited. Walking on the curing material is prohibited until the pavement has cured sufficiently to prevent damage to the surface.
  - 5. Leave the curing material in place for a minimum of 4 days, unless otherwise directed by the Engineer. Immediately repair any tears or holes appearing in the material during the curing period, or replace it with material in good condition.
  - 6. The material may be reused, provided it is kept serviceable by proper repairs, and it will provide water retention during the curing period.
- C. Liquid Membrane-Forming Compounds.
  - 1. After finishing operations have been completed and immediately after the free water has left the surface, completely coat and seal the surface of the slab with a uniform layer of white membrane curing compound. Apply the compound in 1 application at a minimum rate of 1 gallon per 150 square feet of surface. Thoroughly mix the curing compound at all times during usage. Do not dilute the white membrane curing compound.
  - 2. Protect the treated surface from injury a minimum of 4 days. If the newly coated film is damaged in any way, apply a new coat of material to the affected areas equal in coverage to that specified for the original coat. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the



work, provided any damage to the film is immediately repaired by application of an additional coat of compound.

3. Immediately after the forms are removed (fixed form and slip form), coat the entire area of the sides of the slab with white membrane curing compound at the rate specified for the pavement surface, regardless of whether or not further concrete placement will be made against the pavement edge. Approved hand spray equipment will be permitted only for the application of curing compound on the sides of the slab, for repairing damaged areas and for hand finished areas. Repair any damaged areas caused by joint sawing.

### 3.9 OPENING TO TRAFFIC

- A. No motorized traffic is allowed on the pavement until all of the following conditions are met.
  1. Construction Traffic Only
    - a. The flexural strength of the pavement shall meet or exceed 450 psi. Determine the flexural strength of the pavement by testing flexural strength specimens utilizing the third point loading method, or by use of a calibrated maturity meter.
    - b. If testing is not done, observe a 4-day curing period before allowing motorized traffic on the pavement.
    - c. Provide protection to keep foreign material out of the unsealed joints by an approved method.
  2. All Traffic
    - a. In addition to requirements for Construction Traffic Only given above, the joints shall be sealed according to this Section.
    - b. The pavement surface shall be swept and/or washed down to remove all dirt, debris or foreign materials prior to opening to traffic
  3. The Contractor may, at own expense, increase the cement content from the minimum as per Division 03 Concrete to accelerate the strength gain of the Portland Cement Concrete Pavement.

### 3.10 COLD WEATHER CURING.

- A. Maintain the concrete pavement at a minimum temperature of 40°F, as measured along the surface of the concrete, for a minimum of 4 days after placing. When the ambient air temperature is expected to drop below 35°F, anytime during the curing period, take precautions to maintain the concrete temperature. Keep a sufficient supply of approved moisture barrier material, other than liquid curing compound, and suitable blanketing material, such as straw, hay and burlap close by. Be prepared to cover the pavement

with a moisture barrier and protect all pavement less than 4 days old with blanketing material. Remove, dispose of and replace concrete damaged by cold weather, as determined by the Owner.

3.11 QUALITY CONTROL.

- A. Field testing and sampling of materials shall conform to the requirements of Division 03 Concrete.
- B. Laboratory testing of materials shall conform to the requirements of Division 03 Concrete.
- C. Correction of deficient materials shall conform to the requirements of Division 03 Concrete.

END OF SECTION

SECTION 32 17 23  
PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pavement markings applied to asphalt and concrete pavement.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Pavement Marking Paint
  - 2. A copy of the manufacturer's application instructions.

1.3 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 45° F, and not exceeding 95° F.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
  - 1. Color: As indicated.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

- C. Use equipment designed for the preparation and application of the appropriate type of pavement marking material.
- D. On existing pavements, remove the existing pavement markings according to the recommendations of the manufacturer of the new pavement markings. Remove the existing pavement markings and symbols without damaging the pavement surface. As the work progresses, remove all material deposited on the pavement as a result of the removal operations. Use methods approved by the Engineer to repair all pavement damaged during the pavement marking removal operations. Remove temporary pavement markings, if any, the same day the durable pavement markings are applied. Remove loose particles, dirt, tar, grease, residue of prior pavement markings and other deleterious material from the pavement surfaces.
- E. Lay out the pavement marking as detailed in the Drawings. If the Drawings do not provide details, submit to the Engineer for approval, a layout plan for the pavement markings that complies to the MUTCD. Locate longitudinal pavement marking stripes a minimum of 2 inches and a maximum of 8 inches from longitudinal joints. Provide adequate guide marks (approximately 2 inches by 12 inches at approximately 30 to 50 foot intervals) for the application of the pavement markings.
- F. Apply the pavement markings according to the manufacturer's recommendations.
- G. Follow the manufacturer's recommendations regarding pavement and ambient temperature at the time of application. The Engineer will verify the pavement and ambient temperatures before beginning work and when deemed necessary. Apply pavement markings straight and close to the intended alignment without abrupt changes that result in an unacceptable appearance.

### 3.2 PAINTED PAVEMENT MARKING

- A. Allow asphalt paving to age for a minimum of 30 days before starting pavement marking. If markings are required before 30 days, install temporary pavement markings.
- B. Sweep and clean surface to eliminate loose material and dust.

### 3.3 BASIS OF ACCEPTANCE

- A. Defects: Remove and replace pavement markings that:
  - 1. Have drag marks, gashes, gouges, foreign covering, discolored areas or areas that have failed to solidify.
  - 2. Have improper adhesion, width, length or thickness.
  - 3. Have areas that present a ragged appearance, areas that do not present sharply defined edges, or areas with abrupt unintended changes in alignment.

3.4 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION