

## CHAPTER 5-PAVEMENT DESIGN AND TECHNICAL CRITERIA

### INDEX

<b>Section</b>	<b>Topic</b>	<b>Page</b>
5.1	General	5.1
5.2	Pavement Design Report Submittal Options	5.1
5.3	Field Investigation	5.1
5.4	Laboratory Testing	5.2
5.5	Design Requirements	5.2
5.6	Report Requirements	5.2
5.7	Material Specifications	5.2
5.8	Subgrade Investigation and Pavement Design Report	5.5

## CHAPTER 5 PAVEMENT DESIGN AND TECHNICAL CRITERIA

### 5.1 GENERAL

**5.1.1** This chapter provides the basic criteria and design procedures for roadway pavements. Recommended design methodologies for asphalt and Portland Cement Concrete are addressed and essentially follow the **Metropolitan Government Pavement Engineering Council (MGPEC) “Pavement Design Standards and Construction Specifications” (Most recent revision), hereafter called MGPEC Standards.**

**5.1.2** The MGPEC Standards shall pertain to all roadway related public improvements including but not limited to new roadways, auxiliary lanes, curb and gutter, sidewalks and medians. Any roadway construction related improvements shall require a Pavement Design Report as detailed in the following section. In an effort to ensure the integrity of all pavement sections, auxiliary lanes shall be designed using the same parameters as the through lanes.

### 5.2 PAVEMENT DESIGN REPORT SUBMITTAL OPTIONS

There are two acceptable submittal options for Pavement Design Reports related to the Final Construction Plans:

1. The Preliminary Pavement Design may be completed concurrent with the Final Construction Plans, with the pavement section dimensions and pavement material and construction specifications included in the Final Construction Plan submittal. A Design Confirmation Report shall be submitted, to confirm the assumptions regarding soil type, expansion or settlement potential, moisture content, density and other engineering properties, prior to issuance of applicable permits.
2. The Final Pavement Design Report may be completed after County approval of the associated Construction Plans but prior to issuance of paving permits.

#### **5.2.1 Preliminary Design Report**

The Preliminary Design Report shall be prepared per the requirements in the MGPEC Standards, section 2.1.

#### **5.2.2 Design Confirmation Report**

The Design Confirmation Report shall be prepared per the requirements detailed in the MGPEC Standards, Section 2.3.

#### **5.2.3 Final Design Report**

The Final Design Report shall be prepared per the requirements detailed in the MGPEC Standards, Section 2.2.

### 5.3 FIELD INVESTIGATION

#### **5.3.1 Preliminary Design and Final Design Reports**

Field Investigation for the Preliminary and Final Design Reports shall conform to the MGPEC Standards, Section 3.1.

#### **5.3.2 Design Confirmation Report**

To confirm the assumptions made in the Preliminary Design Report the Design Confirmation Report shall conform to the Field investigation requirements set forth in the MGPEC Standards, Section 3.2.

## **5.4 LABORATORY TESTING**

### **5.4.1 Preliminary Design Report and Final Design Report**

#### **5.4.1.1 Soil Classification**

Soils shall be classified per the MGPEC Standards, Section 4.1.1.

#### **5.4.1.2 Swell Tests**

Soils shall be tested per the MGPEC Standards, Section 4.1.2.

#### **5.4.1.3 Strength Tests**

Soils shall be tested per the MGPEC Standards, Section 4.1.3.

#### **5.4.1.4 Life Cycle Cost Analysis**

Life Cycle Cost Analysis shall be completed per the MGPEC Standards, Section 5.4 for all Private Roadways that will be owned and maintained in common ownership.

### **5.4.2 Design Confirmation Report**

Laboratory Testing Requirements are detailed in the MGPEC Standards, Section 4.2, for a Design Confirmation Report.

## **5.5 DESIGN REQUIREMENTS**

**5.5.1** The Design, Costs and Maintenance recommendations shall conform to Chapter 5 of the MGPEC Standards.

## **5.6 REPORT REQUIREMENTS**

### **5.6.1 Preliminary Design Report and Final Design Report**

The reports shall be inclusive of all requirements set forth in the MGPEC Standards, Section 6.1.

### **5.6.2 Design Confirmation Report**

The report shall be inclusive of all requirements set forth in the MGPEC Standards, Section 6.2.

## **5.7 MATERIAL SPECIFICATIONS**

### **5.7.1 General**

The Specifications presented in this section are performance oriented. The County's objective in setting forth these Specifications is to achieve an acceptable quality of roadway structures. All sources for the mined or manufactured materials listed in paragraph 5.7.5 must be annually approved by Arapahoe County Public Works and Development as having met the appropriate materials performance specifications. This approval is a condition of using those material sources for public improvement construction. For the purpose of these Standards, public improvements are all roadway improvements, sidewalks, curbs and gutters, appurtenant drainage basins or structures, storm sewers and their access ways, other public works within County right-of-way and County mandated stormwater detention structures built on private property and maintained by the property owner.

**5.7.2 Procedure for Material Source Approval**

On or before April 1<sup>st</sup> each year, a material supplier for any Arapahoe County public improvement may supply written documentation and material test results from a competent material-testing laboratory that describes:

- a. Material(s) being tested to meet Arapahoe County Specifications.
- b. The test procedures employed.
- c. The supplier's manufacturing, mining or treating process by which the tested materials were created.
- d. The material test results.
- e. A signed statement by the material supplier that the materials produced and tested for this certification are truly representative of the materials to be provided for public improvements in Arapahoe County during the coming 365 day period.

**5.7.3 Violations of Approval Conditions**

**5.7.3.1 Random Testing.** Arapahoe County Public Works and Development may order random tests of materials used in County public improvement projects to verify compliance with material specifications. These tests are in addition to the requirements of Chapter 8 of these Standards.

**5.7.3.2** Any and all material used to construct Arapahoe County Public Improvements that is not from a certified source, or that is from a certified source and fails one or more random material tests, will be subject to complete removal as a condition of County acceptance of that public improvement. The extent of the material to be removed will be at the discretion of the Director, Public Works and Development, Arapahoe County.

**5.7.4 Use of Materials not listed in Section 5.7.5**

Materials listed in this section and provided with a set of specifications are those deemed by the County to be the primary structural materials commonly or typically used in public improvements. Ancillary public improvement materials such as manufactured paints and coatings, bonding agents, sealers, gaskets, insulating materials, etc. should be in compliance with Colorado Department of Transportation material specifications for the appropriate material employed. Alternate materials for construction may be proposed for use except where expressly prohibited by Subdivision Regulations. The Director, Public Works and Development will make decisions on acceptability of alternate materials.

**5.7.5 Material Specifications**

**5.7.5.1 Hot Mix Asphalt Pavement**

The material shall consist of a mixture of aggregate, filler (if required) and asphalt cement. The aggregate mixture shall meet the grading requirements of the job mix formula. Tests on the aggregate for cleanliness, abrasion loss and fractured faces shall meet the Aggregate Properties and Gradation ranges allowed by the MGPEC Standards, Appendix Item 9.

- a. Aggregates shall not contain clay balls, organic matter or other deleterious substances.

- b. After the job mix formula is established, all mix furnished for the project shall conform to it within the tolerances allowed per the MGPEC Standards.
- c. Hydrated Lime shall be added to aggregate per the requirements of the MGPEC Standards, Appendix Section 9.2.3.
- d. A mix design, including the job mix formula, shall be submitted for review and approval a minimum of seven (7) days prior to placing mix on the project. The mix design shall be performed using the standards and procedures detailed in the MGPEC Standards.

**5.7.5.2 Portland Cement Concrete Pavement**

This material shall consist of a mixture of coarse and fine aggregates, Portland cement, water and other materials or admixtures as required per MGPEC Standards, Appendix Item 11 except as described below.

- a. Portland Cement shall comply with MGPEC Standards, Appendix Section 11.2.1 except as described below.

Concrete shall conform to the following requirements:

Min. 28 day Field Compressive Strength	4000 Psi
Min. Cementitious Materials	610 lbs./cu. yd.
Max. Water/Cement Ratio	0.48 lbs H2O/lbs cement
Air Content % Range	5-8
Maximum Slump	4"
Max. Fine Aggregate % of total Aggregate	50%

- b. Fine aggregates shall meet MGPEC Standards aggregate properties and gradation requirements, Appendix Section 11.2.3.
- c. Coarse aggregates shall meet MGPEC Standards aggregate properties and gradation requirements, Appendix Section 11.2.4.
- d. Fly Ash properties shall comply with MGPEC Standards, Appendix Section 11.2.2.
- e. Water shall comply with MGPEC Standards, Appendix Section 11.2.5.
- f. Admixtures shall comply with MGPEC Standards, Appendix Section 11.2.6.
- g. Curing materials and method of application shall comply with MGPEC Standards, Appendix Section 11.8.
- h. Reinforcement materials and method of placement shall comply with MGPEC Standards, Appendix Section 11.4.3.
- i. Minimum laboratory trial mix strength shall comply with the MGPEC Standards, Appendix Section 11.2.8.

**5.7.5.3 Aggregate Base Coarse**

This material shall consist of hard, durable particles or fragments of stone or gravel, crushed to required sizes, containing an appropriate quantity of sand or

other finely divided mineral matter, which conform to the requirements or MGPEC Standards, Appendix Item 7.

Only aggregate from Arapahoe County approved sources shall be used. Unless otherwise approved in writing by the Department of Public Works and Development. Approval of sources will be at the discretion of the Department of Public Works and Development and submissions will, at a minimum, consist of supplying documented gradation, Atterburg Limits and CBR/R-Value testing on an annual basis. See section 5.7.2.

Arapahoe County requires all aggregate base coarse material used for public improvements to meet the design properties and gradation requirements detailed in the MGPEC Standards, Appendix Section 7.2.

**5.7.5.4 Moisture Treatment**

Equipment and Moisture Treatment Methods shall comply with MGPEC Standards, Appendix Item 4.

**5.7.5.5 Stabilized Subgrade**

The materials, mix designs and methods of placement for stabilizing the subgrade soils before paving shall comply with MGPEC Standards, Appendix Item 5. For detached sidewalks and landscaped medians the subgrade stabilization shall end at the back of curb. For attached sidewalks and hardscape medians the subgrade stabilization shall extend to back of walk and under the full width of the median respectively.

**5.7.5.6 Stabilization Fabric**

Where required by design, Stabilization Fabric materials and method of placement shall comply with MGPEC Standards, Appendix Item 8.

**5.7.5.7 Paving Fabric**

Where required by design or County recommendation, Paving Fabric Materials and method of placement shall comply with MGPEC Standards, Appendix Item 10.

**5.7.5.8 Concrete Curbs, Gutters and Sidewalks**

Materials, Equipment and Methods for Placement shall comply with MGPEC Standards, Appendix Item 6.

**5.8 SUBGRADE INVESTIGATION AND PAVEMENT DESIGN REPORT**

The report shall be prepared by or under the supervision of, signed and sealed by a Professional Engineer, registered in the State of Colorado and shall include the following information:

- a. Vicinity Map to locate the investigated area.
- b. Scaled drawings showing the locations of all borings.
- c. Scaled drawings showing the estimated extent of subgrade soil types and ESAL for each roadway.
- d. Pavement design alternatives for each street on a scaled drawing.
- e. Tabular listing of sample designation, sample depth, Group Number, Liquid Limit, Plasticity Index, percent passing the no. 200 sieve, AASHTO Classification, Group Index and soil description.

- f.** CBR (R-Value) test results for each soil type used in the design.
- g.** All design parameters and input data for MGPEC Design Software (if necessary).
- h.** All design calculations.
- i.** A discussion regarding potential subgrade soil problems including but not limited to:
  - 1.** Heave or settlement prone soils.
  - 2.** Frost susceptible soils.
  - 3.** Ground water.
  - 4.** Drainage considerations (surface and subsurface).
  - 5.** Cold weather construction (if applicable).
  - 6.** Other factors or properties, which could affect the design, performance and/or life span of the pavement system.
- j.** Recommendations to alleviate or mitigate the impact problems discussed in Item i above.