

SECTION 800
CONCRETE MIX DESIGN AND CONSTRUCTION

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SECTION 800 CONCRETE MIX DESIGN AND CONSTRUCTION

801.00 GENERAL CONDITIONS

Refer to Section 100 TITLE, SCOPE AND GENERAL CONDITIONS of these CONSTRUCTION STANDARDS & SPECIFICATIONS for additional requirements that apply to all projects within Elbert County.

810.00 SCOPE

All Portland cement concrete work within any street, parking lot or R.O.W. or in any part of the water system, sanitary sewer system, or storm drainage system of Elbert County shall meet the requirements of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

811.00 Inspections

Refer to Section 154.00 Inspections and Section 931.00 Roadway Inspections of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

Adequate inspections assure compliance to Elbert County requirements and are the basis for Elbert County's recommendation that improvements be accepted for maintenance and/or for release of performance guarantees. It is the responsibility of the Contractor to contact the Road & Bridge Superintendent / Elbert County Engineer a minimum of one (1) full working day (twenty-four [24] hours) in advance of the required inspections. Required inspections shall include:

- A. Subgrade – Verify that material on which concrete shall be placed is to the line, grade, and cross-section shown on the approved plans, is not frozen or excessively dry at the surface, and meets all compaction requirements.
- B. Forms/Reinforcing Steel – Verify that forms are set to proper grade and alignment, adequately braced, and set for proper thickness of concrete. Rebar is properly placed and spaced, at least fifty (50) percent of intersections are tied, and proper distances from surface grade and forms are maintained.
- C. Concrete Delivery and Testing – Confirm that mix design submittals are approved by Elbert County, and testing/sampling frequency, slump, air, and minimum/maximum air and concrete temperatures comply with these CONSTRUCTION STANDARDS & SPECIFICATIONS.
- D. Cure and Flush – Verify that Finished concrete complies with approved grades and alignment and is properly cured. If required by the Road & Bridge Superintendent / Elbert County Engineer, verify that concrete pavement surfaces comply with the

smoothness requirements of Section 412.17 Surface Smoothness Test of the CDOT *Standard Specifications for Road and Bridge Construction*

- E. General Items Include:
 - 1. All temporary structures, debris, mud and waste materials shall be removed from public property. Grout and seal all cracks in concrete. Fill all gouged areas of concrete with an approved epoxy. Remove and replace all areas of broken concrete. Subgrade failures shall be corrected before pouring back.
- F. Construction Acceptance – Refer to Section 200 ACCEPTANCE PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS.
- G. Final Acceptance – Refer to Section 200 ACCEPTANCE PROCEDURES of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

820.00 CONCRETE MIX DESIGN

Concrete shall be composed of Portland cement, aggregate and water, and shall be reinforced with steel bars or steel wire fabric where required.

Concrete mix design information shall be prepared in accordance with ACI 301 Section 4.2 and submitted to Elbert County for approval. At least two (2) sets of certified twenty-eight (28) day strength test results shall also be submitted. No concrete shall be placed until the concrete mix design has been approved by the Road & Bridge Superintendent / Elbert County Engineer.

A separate mix design submittal shall be required for concrete to be pumped. Mix designs shall be prepared in accordance with ACI 211 and 304, as applicable.

821.00 Materials

821.01 Cement

All cement used in concrete work shall be Portland cement that complies with ASTM C150, Type I or Type II, except where Type V cement is required for sulfate-resistant concrete. In general, Type II cement that complies with ASTM C150 shall be used in concrete in contact with the soil, unless otherwise allowed or directed by the Road & Bridge Superintendent / Elbert County Engineer. Cement, which for any reason has become partially set or which contains lumps shall be rejected.

The Contractor shall be responsible for proper storage of all cement until it is used. When requested by the Road & Bridge Superintendent / Elbert County Engineer, the Contractor shall furnish the Road & Bridge Superintendent / Elbert

County Engineer with a certificate from the manufacturer or an acceptable testing laboratory stating that the cement meets the requirements of these CONSTRUCTION STANDARDS & SPECIFICATIONS for Portland cement.

821.02 Fly Ash

Fly ash may be utilized in the concrete mix design when permitted by the Road & Bridge Superintendent / Elbert County Engineer. Fly ash shall be Class C and shall comply with ASTM C618. The pozzolanic index shall be eighty-five (85). Fly ash may replace a maximum of twenty (20) percent of the amount of Portland cement that otherwise is required to produce concrete of the specified compressive strength. Class C fly ash shall not be permitted where sulfate resistant cement is required.

The Contractor shall notify the Road & Bridge Superintendent / Elbert County Engineer of the source of the fly ash prior to use in the project. When required by the Road & Bridge Superintendent / Elbert County Engineer, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions. The Road & Bridge Superintendent / Elbert County Engineer may require a certificate from an approved testing laboratory stating that the fly ash meets the requirements of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

821.03 Water

Water for concrete shall be clean and free from sand, oil, acid, alkali, organic matter, or other deleterious substances and shall meet the requirements for mix water as published in ASTM C94. Water from public supplies or water that has been proven to be suitable for drinking is satisfactory.

821.04 Admixtures

The following requirements apply for admixtures:

- A. The Contractor shall use air-entraining admixtures for all surfaces of exposed concrete. Air entraining admixtures shall comply with ASTM C260.
- B. When weather restraints, site conditions or project requirements require the ability to place concrete at a lower temperature, produce accelerated concrete setting time or increase early and ultimate compressive strengths, an accelerating admixture may be utilized in the design mix when allowed by the Road & Bridge Superintendent / Elbert County Engineer.
- C. Calcium chloride may be utilized in the design mix when allowed by the Road & Bridge Superintendent / Elbert County Engineer.

- D. Type C accelerating admixtures and Type E water reducing and accelerating admixtures shall meet ASTM C494.
- E. When concrete is to be used with reinforcing steel, a non-chloride / non-corrosive, admixture shall be used.
- F. Dosage rates shall be determined by recommendation of the ready mix company and shall be specified for daily site conditions.

821.05 Fine Aggregate

The fine aggregate shall be clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate shall be well graded, and when tested by means of laboratory sieves shall comply with ASTM C33.

The fine aggregate gradation shall comply with CDOT Fine Aggregate.

821.06 Coarse Aggregate

The coarse aggregate shall consist of broken stone or gravel that is clean, hard, tough and durable, and free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, vegetable, or other deleterious matter.

Coarse aggregate shall be well graded and when tested by means of laboratory sieves shall comply with ASTM C33. The coarse aggregate gradation shall comply with CDOT Coarse Aggregate Gradation # 467.

821.07 Fibrous Reinforcing

Fibrous concrete reinforcing shall not be used, unless approved by the Road & Bridge Superintendent / Elbert County Engineer.

822.00 Mix Properties

Mix properties of Portland cement concrete for flatwork shall comply with the following:

Property	Mix Design
Minimum compressive strength - 28 days*	3000 psi
Minimum cement - sacks/cubic yard	6
Maximum water/cement ratio - by weight	0.50
Slump - inches	1-4
Air entrainment - % by volume	5-8

* When tested in accordance with ASTM C31

The grading and composition requirements for coarse and fine aggregate for concrete shall be in accordance with the CDOT *Standard Specifications for Road and Bridge Construction*. Additional concrete mix designs may be approved for decorative, non-

structural concrete at the discretion of the Road & Bridge Superintendent / Elbert County Engineer.

822.01 Colored Patterned Concrete

COLOR SHALL BE AS NOTED ON THE APPROVED DRAWINGS OR AS APPROVED BY THE ROAD & BRIDGE SUPERINTENDENT / ELBERT COUNTY ENGINEER.

Where required on the approved plans, colored patterned concrete shall comply with the following:

- A. Minimum twenty-eight (28) day compressive strength of concrete shall be 4,000 psi.
- B. Air entrainment shall be six (6) percent [+ 1%] for maximum aggregate size of three-quarter ($\frac{3}{4}$) inch or one (1) inch and shall be seven and one-half ($7\frac{1}{2}$) percent [+ 1%] for a maximum aggregate size of three-eighth ($\frac{3}{8}$) inch or one-half ($\frac{1}{2}$) inch.
- C. Normal set or retarded set water reducing admixture shall comply with ASTM C494.
- D. No calcium chloride shall be added to the concrete mix.
- E. Matching integral color shall be used as a supplement, but not as a color hardener.
- F. Color hardener shall be specially formulated for installation of patterned concrete, grade "Heavy Duty". Color curing compound shall comply with ASTM C309 and with all applicable air pollution regulations.

822.02 Controlled Low Strength Materials (CLSM)

CLSM ("Flowable Fill") mix designs shall be submitted to the Road & Bridge Superintendent / Elbert County Engineer for approval prior to placement. CLSM used as structure backfill, as backfill for pipelines and service lines, or to fill abandoned pipelines and appurtenances shall have a twenty-eight (28) day compressive strength between fifty (50) and one-hundred fifty (150) psi, as tested by ASTM D4832.

CLSM shall be placed in confined areas and under pipe haunches with methods approved by Elbert County. When backfilling pipelines and service lines, CLSM shall be properly layered to prevent pipe from floating.

Onsite material mix designs may be approved. Test sections may be required and a placement plan may be required to be submitted for approval by the Road & Bridge Superintendent / Elbert County Engineer.

The following CLSM mix properties and proportions apply:

CLSM Mix Requirements

Property	Mix Design
Minimum 24-hour strength	15 psi
Maximum 28-day strength	50-150 psi
Maximum aggregate size	1" (100% Passing)
Portland Cement	ASTM C150 Type I-II (or Type V for sulfate resistance)
Slump	4" – 8"

Mix Proportions (per cubic yard of concrete)

Material	lbs./yd ³
Cement	501
Water ³	325 (39 gallons) or as needed
Coarse Aggregate (AASHTO No. 57 or 67)	1700
Fine Aggregate (AASHTO M6) ³	1845

- ¹ 40 lbs. /yd³ cement and 10 lbs. /yd³ Class C fly ash may be substituted for 50 lbs. /yd³ cement.
- ² CLSM shall flow into place without excessive segregation or bleed water.
- ³ The percent passing the #200 sieve shall be between 8% - 20%.

823.00 Ready-Mixed Concrete

The use of ready-mixed concrete shall in no way relieve the Contractor or Developer of the responsibility for proportion, mix, delivery, or placement of concrete. All ready-mixed concrete shall comply with ASTM C94.

Concrete shall be continuously mixed or agitated from the time the water is added until the time of use, and discharge from the truck should begin within ninety (90) minutes or three-hundred (300) revolutions after it comes in contact with the mixing water or with the aggregates. In accordance with ASTM C94, water may be added to ready-mix concrete one time in order to get slump within range, as long as the specified water-cement ration is not exceeded.

Elbert County shall have free access to the ready mix plant at all times. The organization supplying the concrete shall have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate.

The contractor shall collect delivery or batch tickets from the driver for all concrete used on the project and shall deliver them to the Road & Bridge Superintendent / Elbert County Engineer. Batch tickets shall provide the following information in accordance with ASTM C94:

- A. Name of ready-mix batch plant
- B. Serial number of ticket
- C. Date
- D. Truck number
- E. Name of purchaser
- F. Specific designation of job (name and location)
- G. Mix # or specific class or designation of the concrete
- H. Amount of concrete in cubic yards
- I. Time loaded or of first mixing of cement and aggregates
- J. Water added by receiver of concrete and his initials
- K. Weights of fine and coarse aggregates
- L. Type, brand and amount of cement
- M. Type, brand and amount of admixtures
- N. Weight (in gallons) of water, including surface water on aggregates

824.00 Steel Reinforcing and Forms

824.01 Steel Reinforcing

The placement, fastening, splicing and supporting of reinforcing steel and wire mesh or bar mat reinforcement shall comply with the plans and the latest edition of *CRSI Recommended Practice for Placing Reinforcing Bars*. Before being positioned, all reinforcing steel shall be thoroughly cleaned of mill and rust scale and of coatings that may destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement shall be reinspected and cleaned if necessary. Reinforcement shall be carefully formed to the dimensions indicated on the approved plans by the cold bending method. Cold bends shall be made so that the inside diameter of the bend measured on the inside of the bar shall be as follows:

Bar Size	Grade 60
#3 through #8	6 bar dia.
#9, #10, and #11	8 bar dia.
#14 and #18	10 bar dia.

The inside diameter of bend for stirrups and ties shall not be less than four (4) bar diameters for sizes #5 and smaller, and five (5) bar diameters for #6 and #8. Reinforcement shall not be bent or straightened in a manner that may injure the material. Bars with kinks or bends shall not be used except where shown on the plans. Heating of reinforcement shall not be permitted.

Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or by suitable clips at intersections. A minimum of fifty (50) percent of intersections shall be secured. Where necessary, reinforcing steel shall be supported by metal chairs or spacers, pre-cast mortar blocks, or metal hangers. Splicing of bars, except where shown on the plans, shall not be allowed without approval of the Road & Bridge Superintendent / Elbert County Engineer.

Welded wire fabric for concrete reinforcement shall be of the gauge, spacing, dimensions, and form specified on the plans or Detailed Drawings and shall comply with “Specifications for Welded Steel Wire Fabric for Concrete Reinforcement” (ASTM A185) or “Specifications for Welded Deformed Steel Wire Fabric for Concrete Reinforcement” (ASTM A497).

Contractor shall submit shop drawings of the reinforcement to the Road & Bridge Superintendent / Elbert County Engineer for approval. Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel shall be the following, as specified in Section 5.5 of ACI 301:

Bottom bars on soil bearing foundations & slabs	3 inches
Bars adjacent to surfaces exposed to weather or earth backfill	1½ inches
Interior surfaces	¾ inches

824.02 Forms and Form Setting

Forms shall have sufficient strength to withstand—without deformation—the pressure resulting from placement and vibration of the concrete. Forms shall be constructed so that the finished concrete shall conform to the shapes, lines, grades and dimensions indicated on the approved plans. Any form which is not clean and which has not had the surface prepared with commercial form oil to effectively prevent bonding, staining, and softening of concrete surfaces shall not be used.

Forms may generally be wood or metal and shall have a depth equal to or greater than the slab thickness. Plywood forms, plastic coated plywood forms, or steel forms shall be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

Forms that have become worn, bent, or broken shall not be used. Each section of form shall be straight and free from warps. The Contractor shall set a minimum length of three hundred (300) feet of forms to grade prior to placing concrete. In

cases where the length of one run is less than three hundred (300) feet, the Contractor shall set forms to grade for the entire run.

The face of curbs shall be formed, unless otherwise permitted by the Road & Bridge Superintendent / Elbert County Engineer. Forms shall be secured to resist the pressure of the poured concrete without springing or settlement. The connection between sections shall be performed by a method in which the joint shall be free from movement in any direction.

Forms shall not deviate more than one-quarter ($\frac{1}{4}$) inch from the design line and grade.

When concrete pavement is constructed on a curve, flexible forms shall be used having a radius of two hundred (200) feet or less, unless otherwise directed by the Road & Bridge Superintendent / Elbert County Engineer. Face forms shall be preformed to the proper radius. Care shall be exercised to ensure the required cross section is maintained around the entire radius.

The Contractor shall provide an approved metal straight edge, ten (10) feet in length, to check the alignment of the forms prior to placing the concrete, and to check the concrete surface during the finishing operation.

Forms shall not be disturbed until the concrete has hardened sufficiently to permit removal without damaging the concrete, or until forms are not required to protect the concrete from mechanical damage. The minimum duration of time before removal of forms after placing concrete shall be one (1) day for footings and two (2) days for all other concrete. Crowbars or other heavy tools shall not be used against green concrete when removing forms. Forms shall be thoroughly cleaned before re-oiling and reuse.

825.00 Concrete Testing

The requirements of this section shall apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.

The required concrete testing services shall be performed by a designated concrete testing agency approved by the Road & Bridge Superintendent / Elbert County Engineer, and that meets the requirements of ASTM E329.

A representative of the concrete testing agency shall inspect, sample, and test material and production of concrete as required by the Road & Bridge Superintendent / Elbert County Engineer. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency shall report such deficiency to the Road & Bridge Superintendent / Elbert County Engineer and the Contractor.

The concrete testing agency shall report all test and inspection results to the Road & Bridge Superintendent / Elbert County Engineer and Contractor immediately after they are performed. All test reports shall include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test shall include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).

The concrete testing agency or its representative is not authorized to revoke, alter, relax, expand or release any requirements of these CONSTRUCTION STANDARDS & SPECIFICATIONS, nor to approve or accept any portion of the work.

826.00 Tests Provided by the Developer

The Developer shall provide the concrete testing agency with the following:

Any labor necessary to assist the designated concrete testing agency in obtaining and handling samples at the project or from other sources of material.

Provide and maintain for the sole use of the concrete testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.

The use of concrete testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance with these CONSTRUCTION STANDARDS & SPECIFICATIONS.

In the case of questionable concrete materials or work, the Road & Bridge Superintendent / Elbert County Engineer may direct that core tests be taken on all questionable concrete placements, at the Contractor's expense. If the concrete shows inadequate strength or other deficiencies, it shall be removed and replaced at the Contractor's expense. If any core shows a deficiency of thickness greater than one-half ($\frac{1}{2}$) inch, exploratory cores shall be taken in increments as dictated by the Road & Bridge Superintendent / Elbert County Engineer, and all concrete deficient by more than one-half ($\frac{1}{2}$) inch shall be removed and replaced at the Contractor's expense.

The following services shall be performed by the designated concrete testing agency at the expense of the Developer:

- A. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141. Mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be fifteen (15) minutes. If cylinders or beams cannot be returned to the laboratory and cast within the forty-five (45) minutes, they shall be cast in the field and transported to the

laboratory in twelve (12) to twenty-four (24) hours. One (1) field cured test series and one (1) lab cured test series shall be taken in the first fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, and one (1) field cured test series and one (1) lab cured test series shall be taken fifty (50) cubic yards after that. One (1) field cured test series and one (1) lab cured test series shall continue to be taken every one-hundred (100) cubic yards until the end of the work day. Special projects may require more frequent testing, as directed by the Road & Bridge Superintendent / Elbert County Engineer.

1. Field cured test series (if required by the Road & Bridge Superintendent / Elbert County Engineer):

Four (4) cylinders; two (2) to be broken at seven (7) days; two (2) to be broken at fourteen (14) days or as directed by the Road & Bridge Superintendent / Elbert County Engineer.

2. Lab cured test series:

Six (6) cylinders; Two (2) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days*; two (2) to be broken at forty-five days. *If the specified strength is not obtained at twenty-eight (28) days, two (2) cylinders shall be broken at forty-five (45) days.

- B. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Road & Bridge Superintendent / Elbert County Engineer, in accordance with AASHTO T119.
- C. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- D. Sample additional concrete at point of placement, and perform other testing or inspection services as required.
- E. The Developer or Contractor shall provide two (2) copies of all concrete strength test results to the Road & Bridge Superintendent / Elbert County Engineer.
- F. The Developer or Contractor shall provide additional testing and inspection required due to changes in materials or proportions or irregularities in specified procedures.
- G. When the work fails to pass inspection or previous tests fail to meet specifications, additional tests shall be taken as directed by the Road & Bridge Superintendent / Elbert County Engineer.
- H. Core samples shall be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions of these CONSTRUCTION STANDARDS & SPECIFICATIONS. Obtaining and testing cores shall comply with ASTM C42. Concrete in the area represented by a core test shall be considered adequate if the average strength of the cores is

equal to at least eighty-five (85) percent of the specified strength (f'_c), and if no single core is less than seventy-five (75) percent of the specified strength. Core holes shall be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.

- I. Failure of the Contractor to furnish testing as herein described shall be sufficient cause for rejection of the work in question.

830.00 CONCRETE CONSTRUCTION

831.00 Placing Concrete

Before placing concrete, debris shall be removed from the space to be occupied by the concrete. The forms and all concrete surfaces shall be thoroughly wetted. The concrete shall be placed on damp but not wet or muddy subgrade. Concrete shall be placed and compacted so that it is free from honeycomb and free from pockets of segregated aggregate. Sections of segregation or honeycomb revealed by removal of the forms shall be removed and replaced or otherwise repaired as approved by the Road & Bridge Superintendent / Elbert County Engineer.

Concrete shall not be placed until all forms and reinforcing steel have been inspected and approved by the Elbert County Inspector/Representative. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods that prevent separation or loss of ingredients. The concrete shall be deposited in the forms as close as practicable in its final position to avoid re-handling. It shall be deposited in continuous layers, the thickness of which generally shall not exceed twelve (12) inches. Concrete shall be placed in a manner to avoid segregation and shall not be dropped freely more than five (5) feet. If segregation occurs, the Elbert County Inspector/Representative may require the concrete to be removed and replaced at the Contractor's expense.

Concrete shall be placed in one continuous operation, except where keyed construction joints are shown on the plans or as approved by the Road & Bridge Superintendent / Elbert County Engineer. Delays in excess of thirty (30) minutes may require removal and replacement of concrete by the Road & Bridge Superintendent / Elbert County Engineer. At the end of the work day, or in case of an unavoidable interruption of more than thirty (30) minutes, a transverse construction joint shall be placed at the point of stopping work, provided that the section on which work has been suspended shall not be less than five (5) feet long. Sections less than five (5) feet in length shall be removed. Concrete shall not be placed when the weather is stormy, dusty, or inclement to a degree that precludes good workmanship.

831.01 Vibrating

All concrete shall be compacted by internal vibration using mechanical vibrating equipment. Concrete in floor slabs, sidewalks, or curb and gutter which is not

placed against form linings shall be either tamped or vibrated. Care shall be taken to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration shall stop before any segregation of the concrete occurs. Mechanical vibrators shall be an approved type as specified in ACI 309, Chapter 5. Vibrators shall not be used to move or spread the concrete.

Any evidence of lack of consolidation or over-consolidation shall be regarded as sufficient reason to require removal and replacement of concrete at the Contractor's expense. The Contractor shall be responsible for any defects in the quality and appearance of the concrete.

831.02 Workability

The consistency of concrete shall be kept uniform and shall be checked by means of certified slump tests. The workability of the concrete shall be varied as directed by the Road & Bridge Superintendent / Elbert County Engineer. At all times concrete shall have a consistency such that it can be worked into corners and angles of the forms and around joints, dowels and tie-bars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or laitance on the surface. If, concrete fails to conform to the proportions of the approved mix design for any reason, such concrete shall not be incorporated in the work but shall be discarded from the project site as waste material at the Contractor's expense. **NO WATER MAY BE ADDED AT THE JOB SITE WITHOUT PERMISSION OF THE ROAD & BRIDGE SUPERINTENDENT / ELBERT COUNTY ENGINEER.** If approval is obtained and water is added at the job site, slump tests shall be performed and test cylinders cast at the Contractor's expense.

831.03 Installation of Colored Patterned Concrete

Special concrete mix with integral color shall be placed and screeded to the proper grade, and floated to a uniform surface in the normal manner for slabs on grade. Color hardener shall be applied evenly to the plastic surface by the dry shake method using a minimum of sixty (60) pounds per one hundred (100) square feet. Color hardener shall be applied in two (2) or more shakes, floated after each, and troweled only after the final floating.

While the concrete is still plastic, the imprinting tools shall be applied to make the desired patterned surface. The pattern shall be matched at imprint edges and joints.

Color curing compound, thinned in the proportion of one (1) part curing compound to one (1) part mineral spirits (paint thinner), shall be applied uniformly with a roller or sprayer. The coverage shall be approximately six hundred (600) to six hundred fifty (650) square feet per gallon of unthinned curing compound. At times when the air temperature is at or near freezing, the

slab shall be cured using suitable curing blankets. The slab shall later be sealed with the color curing compound when the air temperature is above freezing.

Use of blankets and/or heaters may be necessary to maintain the concrete at or above fifty (50) degrees F for three (3) days after placement. The cured surface shall be cleaned to remove any residual materials.

831.04 Weather Limitations

831.04.01 Cold Weather Concreting

During extreme weather conditions, placement of concrete shall be allowed only when the temperature of the concrete placed in the forms is between 60 degrees F and 90 degrees F. Cold weather placement of concrete shall comply with ACI 306.

Concrete may be placed when the air temperature in the shade is 40 degrees F **AND RISING**. No concrete shall be placed, regardless of the present temperature, when the weather forecast predicts freezing weather before final set of the concrete unless special means of heating and protection are used. Protection against freezing is the Contractor's responsibility regardless of the weather forecast or climatic conditions at the time of placement.

Small structures and slabs shall be protected by completely covering fresh concrete with suitable curing blankets to prevent freezing. Large structures and vertical walls shall be protected against freezing by enclosing the structure with heating devices capable of providing uniform and even heat throughout the structure. Heaters shall be vented so that combustion gases are exhausted outside the enclosure in order to avoid carbonation of the fresh concrete.

Cold weather is defined as a period when, for more than three (3) consecutive days, the following conditions exist:

- A. The average air temperature is less than 40 degrees F.
- B. The air temperature is not greater than 50 degrees F for more than one half of any 24-hr. period.

Concrete placed in cold weather shall be protected from extreme temperatures as follows:

- A. A temperature of at least 50 degrees F for the first seventy-two (72) hours shall be maintained.
- B. After the first seventy-two (72) hours and until the concrete is seven (7) days old, it shall be protected from freezing temperatures.
- C. Concrete adjacent to heating devices shall be insulated from direct heat of the unit that may dry it out prior to being properly cured.

- D. Temperatures shall be measured by maximum and minimum thermometers furnished by the Contractor and installed adjacent to the concrete.

Concrete slabs shall not be placed, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent concrete from freezing is not allowed. Concrete which has been frozen shall be removed and replaced as required by the Road & Bridge Superintendent / Elbert County Engineer.

**MINIMUM EXPOSURE TEMPERATURE FOR CONCRETE FLATWORK
(FOR PORTLAND CEMENT CONCRETE = 500 lb./CY)**

Slab Thickness (inches)	Minimum Ambient Air Temperature Allowable For Values of Thermal Resistance (R), hr*ft*F/BTU		
	R=2	R=4	R=6
4	**	**	**
8	**	**	**
12	42°F	36°F	30°F
18	30°F	12°F	-6°F
24	21°F	-5°F	-31°F

** > 50°F. Additional heat required.

831.04.02 Hot Weather Concreting

Except by written authorization, concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at 90 degrees F or lower. Placement of concrete in hot weather shall comply with ACI 305.

832.00 Concrete Pavement and Flatwork

The installation of Portland cement concrete pavement, including materials, equipment, foundation and construction methods shall comply with Section 412 of the CDOT *Standard Specifications for Road and Bridge Construction* and these CONSTRUCTION STANDARDS & SPECIFICATIONS.

Concrete pavements shall be installed as shown on the approved plans or as approved by the Road & Bridge Superintendent / Elbert County Engineer. The Contractor shall furnish steel pins to use in setting grades for concrete pavement.

The subgrade shall conform to the specified cross section. Immediately prior to placing concrete, the subgrade shall be tested for adequate compaction and moisture to a minimum depth of six (6) inches or as specified in the approved Geotechnical Report. Concrete shall not be placed on any portion of the subgrade that has not been

inspected by a Elbert County Inspector/Representative. There shall be no puddles or pockets of mud when the concrete is placed, and the subgrade shall be cleared of any loose material.

Curb, curb ramps, gutter, sidewalk, cross pan, and driveway construction shall conform to all applicable provisions of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

832.01 Portland Cement Treated Base

In those instances where deemed necessary by the project Soils Engineer and approved by the Road & Bridge Superintendent / Elbert County Engineer, Portland cement treated base may be required.

832.02 Curb and Gutter

The section to be constructed shall be as identified on the approved plans and as shown on the Detail Drawings of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

832.03 Sidewalks

Detached sidewalks shall be a minimum of four (4) inches thick and attached sidewalks shall be a minimum of six (6) inches thick, and shall be constructed as shown on the approved plans. Areas of sidewalk crossed by driveways or in parks, open spaces or greenbelts shall be constructed with a minimum of six (6) inch thick concrete.

832.04 Crosspans and Curb Return Fillets

Crosspans and curb return fillets shall be constructed twelve (12) inches thick or eight (8) inches thick one-half (1/2) inch (#4) reinforcing steel bars placed at eighteen (18) inch centers (each way) in residential, commercial and industrial areas. Typical crosspan sections are shown in the Detail Drawings. Where unusual conditions exist, additional reinforcing steel and special joints may be required by the Road & Bridge Superintendent / Elbert County Engineer.

832.05 Curb Cuts and Driveways

Curb cuts in six (6) inch vertical curbs shall be constructed at all driveway locations and at additional locations, as shown on the approved plans and in the Detail Drawings.

832.06 Curb Ramps

Curb ramps shall be installed at locations designated by the County Engineer and as shown on the approved plans. Curb ramps shall be constructed with slopes, landings, and detectable warnings (truncated domes) as shown in the Detail Drawings. Specific installation details shall be per the manufacturer.

The following materials may be used for truncated domes:

- A. Fiber reinforced polymer tiles
- B. Cast iron tiles
- C. Preformed cementitious tiles
- D. Thermoplastic tiles

The actual truncated dome material to be installed for a specific project or location shall be designated by the Road & Bridge Superintendent / Elbert County Engineer.

832.07 Joints

Joint materials shall comply with the following specifications:

Concrete joint sealer, hot-poured elastic	M173
Preformed expansion joint filler (Bituminous Type)	M33
Preformed sponge rubber and cork expansion joint fillers	M153
Preformed expansion joint fillers (fiber board)	M213

Non-bituminous type materials shall be placed in widths shown on the approved plans or three-eighths ($\frac{3}{8}$) inch wide when not specified. Bituminous type materials shall be used for concrete paving and structural construction where joint sealers are not required.

All joints shall be constructed straight and plumb and shall extend through the entire section from edge to back and to the depths specified.

832.07.01 Expansion Joints

Expansion joint material shall be provided at the following locations and shall be in place prior to placement of concrete:

- A. Each end of curb return
- B. Between back of sidewalk and driveway slab or service walk
- C. Between new concrete and existing masonry buildings
- D. As shown on the approved plans
- E. As directed by the Road & Bridge Superintendent / Elbert County Engineer

Reinforcing steel bars (#4, 18" long minimum) shall be used to tie together new and existing concrete pavements and flatwork. Refer to the Detail Drawings for expansion joints.

Expansion joint filler, which is one-half ($\frac{1}{2}$) inch thick, preformed, non-extruding bituminous-treated fiber board conforming to AASHTO Specification M-213, shall be used to form transverse expansion joints. Concrete tie-ins shall have reinforcing steel bars (#4 minimum) extending a minimum of twelve (12) inches into the concrete in each direction. Expansion joints shall be constructed at each tangent point of the curb radius, at each end of valley gutters, at approximately one hundred fifty (150) foot intervals on tangent, or at other points as directed by the Road & Bridge Superintendent / Elbert County Engineer. Expansion joints shall be formed at the contact of the new construction with concrete driveways, intersecting sidewalks, or other unyielding structures unless otherwise directed by the Elbert County Inspector/Representative.

832.07.02 Contraction Joints

Transverse joints shall be placed at maximum intervals of ten (10) feet to control random cracking. Joints shall be formed, sawed, or tooled to a minimum depth of one-third ($\frac{1}{3}$) of the total thickness of the pavement or flatwork (no less than two (2) inches). If divider plates are used, the maximum depth of plates shall not be greater than one-half ($\frac{1}{2}$) depth at the finished surface and shall be no less than fifteen-sixteenths ($\frac{5}{16}$) inch thick. Refer to the Detail Drawings for contraction joint details.

The curb and gutter or sidewalk shall be divided into blocks not less than five (5) feet or more than ten (10) feet long using metal templates not less than one-sixteenth ($\frac{1}{16}$) inch or more than one-quarter ($\frac{1}{4}$) inch thick. Templates shall be a minimum of four (4) inches deep. Templates shall be designed to attach securely to the forms in such a manner as to prevent movement while the concrete is being placed and consolidated. Templates shall be removed prior to the concrete taking its initial set.

If a curbing machine or other method not requiring the use of templates is approved, dummy joints formed by a jointing tool or other approved means shall be used. Dummy joints shall extend into the concrete for at least one-third ($\frac{1}{3}$) of the depth (no less than two (2) inches) and shall be approximately one-eighth ($\frac{1}{8}$) inch wide.

832.07.03 Tooled Joints

Tooled joints shall be spaced as follows:

- A. Not more than ten (10) feet or less than five (5) feet apart in curb and gutter, sidewalk, and combination curb-walk
- B. Joints in both directions, equally spaced at not greater than ten (10) foot intervals, as applicable in driveways
- C. As directed by the Road & Bridge Superintendent / Elbert County Engineer

832.08 Ponding

Ponding of water in concrete pavement and flatwork shall not exceed one-eighth ($\frac{1}{8}$) inch in depth. Where ponding exceeds one-eighth ($\frac{1}{8}$) inch in depth, pavement or flatwork shall be removed and replaced at the Contractor's expense.

833.00 Appurtenant Concrete Structures

833.01 Forms

Refer to Section 824.02 Forms and Form Setting of these CONSTRUCTION STANDARDS & SPECIFICATIONS for requirements for appurtenant concrete structures

833.02 Concrete Placement

Refer to Section 831.00 Placing Concrete of these CONSTRUCTION STANDARDS & SPECIFICATIONS for requirements for appurtenant concrete structures.

833.03 Expansion Joints

Expansion joint filler, which is one-half ($\frac{1}{2}$) inch thick, preformed, non-extruding bituminous-treated fiber board conforming to AASHTO Specification M-213, shall be used to form transverse expansion joints. Concrete tie-ins shall have reinforcing steel bars (#4 minimum) extending a minimum of twelve (12) inches into the concrete in each direction.

833.04 Curing

Curing shall comply with Section 838.00 Finishing, Curing and Protection of these CONSTRUCTION STANDARDS & SPECIFICATIONS.

834.00 Cleanup

The exposed surfaces of concrete shall be thoroughly cleaned upon completion of the work.

WITHIN FORTY-EIGHT (48) HOURS AFTER FORMS ARE REMOVED, THE AREA BEHIND THE SIDEWALK OR CURB SHALL BE CLEANED, BACKFILLED AND GRADED TO PROVIDE A SMOOTH EVEN SURFACE.

835.00 Backfill of Concrete Work

When forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete shall be promptly backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete for at least two (2) feet and then sloped as shown on the approved plans or as directed by the Road & Bridge Superintendent / Elbert County Engineer.

836.00 Protection Against Vandalism

It shall be the responsibility of the Contractor to protect all concrete work against damage or vandalism. When required, a guard shall be stationed over fresh work until the concrete is sufficiently set to prevent damage at the Contractor's expense. Concrete damaged in any way by vandals shall be removed and replaced at the Contractor's expense.

Anti-graffiti materials shall be installed as shown on the approved plans or as required by the Road & Bridge Superintendent / Elbert County Engineer. Prior to installation, technical information regarding proposed anti-graffiti materials shall be submitted to the Road & Bridge Superintendent / Elbert County Engineer for approval.

837.00 Repairs

After stripping concrete forms, any concrete found to be inconsistent with the approved plans, is out of alignment, not level, or showing a defective surface shall be removed and replaced at the Contractor's expense as directed by the Road & Bridge Superintendent / Elbert County Engineer. The Road & Bridge Superintendent / Elbert County Engineer may give written permission to patch the defective area. Ridges and bulges may be removed by grinding if approved by the Road & Bridge Superintendent / Elbert County Engineer. Honeycombed and other defective concrete that does not affect the integrity of the structure may be chipped out and the vacated areas filled if approved by the Road & Bridge Superintendent / Elbert County Engineer.

The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive strength of five thousand (5,000) psi in twenty-eight (28) days. All repair areas treated with an epoxy-bonding agent shall have the approval of the Road & Bridge Superintendent / Elbert County Engineer before the repair filling is placed.

837.01 Flatwork Repairs and Replacement

All edges of the existing flatwork to remain shall be saw cut. Flatwork repairs and replacement shall be as directed by the Road & Bridge Superintendent / Elbert County Engineer and at the Contractor's expense

837.02 Concrete Structure Repairs

Bolt-holes, tie-rod holes, and minor imperfections as approved by the Road & Bridge Superintendent / Elbert County Engineer, shall be filled with dry-patching mortar composed of approximately one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water so that after the ingredients are mixed thoroughly, the mortar sticks together when molded. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar.

838.00 Finishing, Curing and Protection

838.01 Finishing

Where applicable, finishing shall be performed with a metal screed designed to give proper shape to the section as detailed. Particular care shall be used to finish the gutter flowline to a true uniform grade. Face forms shall be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb.

The Contractor shall use at all times, a ten (10) foot straightedge for finishing curb and gutter sections. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be floated with a wooden or metal float that is not less than three (3) feet long and not less than six (6) inches wide, and screeded. No water or cement shall be added to the surface of the concrete to aid in finishing. Edges of the concrete and joints shall be carefully finished with an edger having a one-eighth inch ($\frac{1}{8}$) inch radius prior to the concrete reaching initial set. Concrete shall be finally finished with a wood float and lightly broomed to a slightly roughened surface. On grades less than one (1) percent, the Contractor shall check for depressions before final finish so that no ponding exists.

Exposed faces of curbs and sidewalks shall be finished to the line and grade shown on the plans. Surface shall be floated to a smooth but not slippery finish. Sidewalk and curb shall be broomed or combed and edged, unless otherwise indicated by the Road & Bridge Superintendent / Elbert County Engineer. After completion of brooming and before concrete has initial set, all edges in contact with the forms shall be tooled with an edger having a three-eighths ($\frac{3}{8}$) inch radius.

No dusting or topping of the surface or sprinkling with water to facilitate finishing shall be permitted.

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface shall be left sound, smooth, even, and uniform in color. Mortar used in pointing shall not be more than thirty (30) minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

838.02 Curing and Protection

Fresh concrete shall be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Road & Bridge Superintendent / Elbert County Engineer. The selected curing process shall be started as soon as it can be performed without injury to the concrete surface. The use of a membrane-curing compound is recommended. The following curing procedures may be used subject to the approval of the Road & Bridge Superintendent / Elbert County Engineer:

- A. Ponding (for slabs or footings)
- B. Spraying
- C. Wet burlap, earth, or cotton mats
- D. Waterproof paper or polyethylene plastic cover

Membrane curing compound shall not be used when the concrete surface shall be painted. The membrane curing compound shall not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process shall be as follows:

- A. Surfaces being wetted by ponding, spraying, or wetted material shall be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule shall be followed whereby the concrete is wetted on a schedule approved by the Road & Bridge Superintendent / Elbert County Engineer.
- B. Surfaces being protected by waterproof paper or polyethylene plastic cover shall receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Road &

Bridge Superintendent / Elbert County Engineer may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient moisture for curing. After the first seventy-two (72) hours the cover shall be kept tightly in place for the remainder of the curing period.