

Project Manual

Bid Package 02: Rough Grading



COLLEGE OF
Osteopathic Medicine
AT THE CHEROKEE NATION

Tahlequah, Oklahoma

February 08, 2019



Tel: 479.783.2480

Fax: 479.783.4844

E-mail: breck@childersarchitect.com

Web: www.childersarchitect.com

TABLE OF CONTENTS

DIVISION 31 - EARTHWORK

31 2200 Grading
31 2300 Excavation and Fill

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 1100 Base Courses
32 1300 Rigid Paving
32 1373 Concrete Paving Joint Sealants
32 1613 Curbs and Gutters

END OF TABLE OF CONTENTS



A handwritten signature in black ink, appearing to read "C. Lipps".

February 8, 2019

SECTION 31 2200

GRADING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for GRADING as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for GRADING shall be included in the bid prices for the work.

1.03 SECTION INCLUDES

1.04 RELATED SECTIONS

- A. 31 2300 Excavation and Fill
- B. 31 2500 Erosion and Sedimentation Controls

1.05 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah
 - 2. United State Environmental Protection Agency (USEPA)

1.06 ACTION SUBMITTALS

1.07 INFORMATIONAL SUBMITTALS

- A. Photograph, video, or both the existing trees and plantings, adjoining construction, roadways, utilities, and site improvements to establish preconstruction conditions. Identify preexisting damage to trees, plantings, adjoining construction, pavements, sidewalks, and other site improvements. Include plans and notations to identify and describe any such conditions.

1.08 DELIVERY, STORAGE, AND HANDLING

1.09 QUALITY ASSURANCE

A. PRECONSTRUCTION CONFERENCE

- 1. Conduct a preconstruction conference. Subcontractors that will be performing the work shall attend the preconstruction conference. Notify ENGINEER one week (7 days) prior to the date of the meeting.

B. REGULATORY REQUIREMENTS

- 1. All materials and methods shall comply with the requirements of the AHJ.

1.10 PERMITS

- A. CONTRACTOR shall make application; pay permit fees; provide payment and performance bonds required of the CONTRACTOR by the AHJ.

1.11 TOPOGRAPHIC SURVEY

- A. OWNER has or will perform a survey of the site, stake the property limits, and provide a reference benchmark elevation.

1.12 UNDERGROUND UTILITIES

- A. CONTRACTOR shall contact OKIE (811 or 1-800-522-OKIE) prior to construction for locating existing utilities.
- B. The underground utilities shown on the Drawings have been located from field survey surface information and existing drawings. ENGINEER and Surveyor make no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The underground utilities are located as accurately as possible from information available; however, ENGINEER and Surveyor further do not guarantee that the underground utilities shown are in the exact location indicated either vertically or horizontally. ENGINEER and Surveyor have not physically located the underground utilities by probing, excavating, hydrovac, or by any other means.
- C. CONTRACTOR shall notify all utility companies and governmental agencies who may have utility lines on or about the premises or who may be affected by the construction. Notice shall be given no less than twenty-four hours prior to any work that may interfere with a utility.
- D. All existing structures, improvement and utilities designated to remain shall be adequately protected from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed to be complete or accurate as to location and/or depth. CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR's operations. During construction, all fire hydrants, valve boxes, fire or police call boxes and other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.
- E. Contractor shall satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place prior to beginning work. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary.

1.13 CONSTRUCTION CONTROL

- A. Do not commence work until temporary erosion and sedimentation control measures are in place.
- B. CONTRACTOR shall be responsible for properly laying out the work, and for lines and measurements for the work executed under the Contract Documents. Verify the figures shown on the Drawings before ordering any materials and laying out the work, and report errors or inaccuracies in writing to the ENGINEER before commencing work. The ENGINEER or his representative will in no case assume the responsibility for laying out the work.
- C. Existing survey points other than those shown on the Drawings shall not be considered as acceptable control points unless approved by the ENGINEER. If approval is secured, CONTRACTOR remains responsible for maintaining them and for their accuracy. Be responsible for preserving all existing iron or metal, and all concrete survey points or monuments for the construction period.

1.14 PROJECT CONDITIONS

A. TRAFFIC

1. Obtain any required Work Zone Permits from the AHJ at least two (2) working days prior to the start of work and/or placing or removing any barricades or modifying existing traffic control devices.
2. CONTRACTOR shall be responsible for erecting and maintaining barricades and other traffic warning devices as necessary around the perimeter of construction and adjacent to any open trenches. Provide and maintain adequate detours around the work under construction. Provide sufficient lights, warning signs, and watchmen for the safety of the public.
3. Any temporary street closure shall be coordinated with and approved by the AHJ. CONTRACTOR shall establish all detour routes while streets are closed during construction. CONTRACTOR shall notify Fire, Police, and EMSA headquarters when any street is temporarily closed.
4. CONTRACTOR is responsible for the prompt replacement and/or repair of all traffic control devices and appurtenances damaged or disturbed due to construction. Any existing traffic signals, signal loops, conduits, cables, and other traffic control devices affected by the work shall be reset or replaced according to AHJ's specifications. Coordinate the work with the AHJ's traffic department.

B. UTILITY INTERRUPTIONS

1. Do not interrupt any utility serving facilities occupied by Owner or others unless permitted by OWNER and the owner(s) of the utility. Temporary utility service shall be provided for any interruption. Notify OWNER and ENGINEER one week (7 days) in advance of proposed interruption of utility.

C. SUBSURFACE CONDITIONS

1. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

D. EXCAVATION AND TRENCH SAFETY SYSTEMS

1. CONTRACTOR shall be responsible for complying with State laws and Federal regulations relating to excavation and trench safety, including those which may be enacted during the performance under this Contract. CONTRACTOR is advised that Federal Regulations 29 C.F.R. 1926.650-1926.652 have been, in their most recent version as amended, in effect since January 2, 1990. CONTRACTOR shall fully comply with the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations pertaining to excavations, trenching, and shoring and shall provide and familiarize its employees involved in excavation and trenching with the provisions in OSHA Pamphlet Number 2226, Excavating and Trenching Operations.

1.15 HAZARDOUS CONDITIONS

- A. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning

the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Subgrade Planer

1. An approved subgrade planer shall be provided, mounted on visible rollers riding on the forms, having adjustable cutting blades which shall trim the subgrade to exact sections shown on the plans. Planer frames shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center for the type pavements as set out under "Subgrade Planer," they shall not develop a deflection of more than 1/8 inch. Tractive power equipment used on the subgrade to pull the planer shall not be such as to produce ruts or indentations in the subgrade.

B. Subgrade Template

1. The template for checking the contour of the subgrade shall be provided and operated by the CONTRACTOR. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not develop a deflection of more than 1/8 inch. It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1 foot intervals, and these rods shall be adjusted to the required cross-section when the template is resting on the side forms.

C. Compacting Equipment

1. Compacting equipment shall be designed to produce the pavement density and surface smoothness herein specified, and shall be maintained in first-class operating condition.

PART 3 EXECUTION

- 3.01 After the excavation and embankment has been substantially completed, the subgrade shall be brought to the proper alignment, cross section and elevation, so that after rolling and subsequent finishing operations, it shall conform to the correct alignment, cross section and elevation. Rolling and sprinkling shall be performed when and to the extent directed and the roadbed shall be completed to or above the plane of the typical section shown on the plans and the lines and grades established by the OWNER.
- 3.02 After completion of the compaction and immediately before the application of base or pavement, the subgrade planer shall be operated from approved forms in a manner to finish the subgrade to the required section. The subgrade shall then be tested with the approved template, operated and maintained by the CONTRACTOR. All irregularities which develop in excess of 1/2 inch in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material; reshaping; and re-compacting by sprinkling and rolling.
- 3.03 The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade, until the base or pavement is placed, and shall be kept wetted down sufficiently in advance of placing any base or pavement to insure its being in a firm and moist condition for at least 2 inch below surface of the prepared subgrade. Only such subgrade as is necessary for the satisfactory prosecution of the work shall be completed ahead of the placement of base or pavement. Hauling or operating of unnecessary equipment on the completed

subgrade shall be kept to a minimum. Complete drainage of the subgrade shall be provided at all times.

- 3.04 Finishing of the subgrade by hand shall be permitted on sections where the pavement width is not uniform, at intersections and elsewhere where the operation of the subgrade planer would not be practical. Subgrade finished by hand shall conform to the requirements above specified.
- 3.05 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.
 - A. Provide a smooth transition between adjacent existing grades and new grades.
 - B. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- 3.06 Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - A. Turf or Unpaved Areas: Plus or minus 1 inch.
 - B. Walks: Plus or minus 1 inch.
 - C. Pavements: Plus or minus 1/2 inch.
- 3.07 Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

END OF SECTION 31 2200

SECTION 31 2300

EXCAVATION AND FILL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for EXCAVATION AND FILL as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for EXCAVATION AND FILL shall be included in the bid prices for the work.

1.03 SECTION INCLUDES

- A. Subgrade Preparation
- B. Excavation
 - 1. Trenching
- C. Dewatering
- D. Fill
 - 1. Backfill
 - 2. Compaction

1.04 RELATED SECTIONS

- A. 31 1000 Site Clearing
- B. 31 2200 Grading
- C. 31 2500 Erosion and Sedimentation Controls
- D. 32 1100 Base Courses

1.05 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah
 - 2. United States Environmental Protection Agency
- B. Backfill - Soil material or controlled low-strength material used to fill an excavation.
- C. Initial Backfill - Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
- D. Final Backfill - Backfill placed over initial backfill to fill a trench.
- E. Borrow - Borrow shall consist of required excavation, removal, and proper utilization of materials obtained from designated or approved sources for use as fill or backfill.
- 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 Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation - Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized

excavation, as well as remedial work directed by Architect, shall be without additional compensation.

- G. Embankment - The placement and compaction of all suitable materials obtained from excavation or borrow to raise existing grades.
- H. Structures - Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subgrade - Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- J. Utilities - On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- K. Rock - Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, or ripping.
 - 1. For classifying rock excavation in bulk or mass excavations, use a late model, well-maintained tractor-mounted hydraulic ripper equipped with one digging point of standard manufacturer's design sized for use with, and propelled by, a crawler-type tractor with a minimum net flywheel power rating of 370 hp (276 kW), operating in low gear.
 - 2. For classifying rock excavation in footing, trench, and pit excavations, use a late model, well-maintained, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

1.06 ACTION SUBMITTALS

- A. For each type of the following manufactured products:
 - 1. Geotextiles
 - 2. Warning tapes

1.07 INFORMATIONAL SUBMITTALS

- A. Photograph, video, or both the existing trees and plantings, adjoining construction, roadways, utilities, and site improvements to establish preconstruction conditions. Identify preexisting damage to trees, plantings, adjoining construction, pavements, sidewalks, and other site improvements. Include plans and notations to identify and describe any such conditions.
- B. Material Test Reports: For each borrow material proposed for fill and backfill as follows:
 - 1. Source of borrow material.
 - 2. Classification according to ASTM D-2487.
 - 3. Laboratory Compaction curve according to ASTM D-698.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. See Execution.

1.09 QUALITY ASSURANCE

- A. PRECONSTRUCTION CONFERENCE

1. Conduct a preconstruction conference. Subcontractors that will be performing the work shall attend the preconstruction conference. Notify ENGINEER one week (7 days) prior to the date of the meeting.
- B. REGULATORY REQUIREMENTS
 1. All materials and methods shall comply with the requirements of the AHJ.
- 1.10 PERMITS
 - A. CONTRACTOR shall make application; pay permit fees; provide payment and performance bonds required of the CONTRACTOR by the AHJ.
- 1.11 TOPOGRAPHIC SURVEY
 - A. OWNER has or will perform a survey of the site, stake the property limits, and provide a reference benchmark elevation.
- 1.12 UNDERGROUND UTILITIES
 - A. CONTRACTOR shall contact OKIE (811 or 1-800-522-OKIE) prior to construction for locating existing utilities.
 - B. The underground utilities shown on the Drawings have been located from field survey surface information and existing drawings. ENGINEER and Surveyor make no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The underground utilities are located as accurately as possible from information available; however, ENGINEER and Surveyor further do not guarantee that the underground utilities shown are in the exact location indicated either vertically or horizontally. ENGINEER and Surveyor have not physically located the underground utilities by probing, excavating, hydrovac, or by any other means.
 - C. CONTRACTOR shall notify all utility companies and governmental agencies who may have utility lines on or about the premises or who may be affected by the construction. Notice shall be given no less than twenty-four hours prior to any work that may interfere with a utility.
 - D. All existing structures, improvement and utilities designated to remain shall be adequately protected from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed to be complete or accurate as to location, depth, or both. CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR's operations. During construction, all fire hydrants, valve boxes, fire or police call boxes and other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.
 - E. Contractor shall satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place prior to beginning work. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary.
- 1.13 CONSTRUCTION CONTROL
 - A. Do not commence work until temporary erosion and sedimentation control measures are in place.
 - B. CONTRACTOR shall be responsible for properly laying out the work, and for lines and measurements for the work executed under the Contract Documents. Verify the figures

shown on the Drawings before ordering any materials and laying out the work, and report errors or inaccuracies in writing to the ENGINEER before commencing work. The ENGINEER or his representative will in no case assume the responsibility for laying out the work.

- C. Existing survey points other than those shown on the Drawings shall not be considered as acceptable control points unless approved by the ENGINEER. If approval is secured, CONTRACTOR remains responsible for maintaining them and for their accuracy. Be responsible for preserving all existing iron or metal, and all concrete survey points or monuments for the construction period.

1.14 PROJECT CONDITIONS

A. TRAFFIC

1. Obtain any required Work Zone Permits from the AHJ at least two (2) working days prior to the start of work and/or placing or removing any barricades or modifying existing traffic control devices.
2. CONTRACTOR shall be responsible for erecting and maintaining barricades and other traffic warning devices as necessary around the perimeter of construction and adjacent to any open trenches. Provide and maintain adequate detours around the work under construction. Provide sufficient lights, warning signs, and watchmen for the safety of the public.
3. Any temporary street closure shall be coordinated with and approved by the AHJ. CONTRACTOR shall establish all detour routes while streets are closed during construction. CONTRACTOR shall notify Fire, Police, and EMSA headquarters when any street is temporarily closed.
4. CONTRACTOR is responsible for the prompt replacement and/or repair of all traffic control devices and appurtenances damaged or disturbed due to construction. Any existing traffic signals, signal loops, conduits, cables, and other traffic control devices affected by the work shall be reset or replaced according to AHJ's specifications. Coordinate the work with the AHJ's traffic department.

B. UTILITY INTERRUPTIONS

1. Do not interrupt any utility serving facilities occupied by Owner or others unless permitted by OWNER and the owner(s) of the utility. Temporary utility service shall be provided for any interruption. Notify OWNER and ENGINEER one week (7 days) in advance of proposed interruption of utility.

C. SUBSURFACE CONDITIONS

1. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

D. EXCAVATION AND TRENCH SAFETY SYSTEMS

1. CONTRACTOR shall be responsible for complying with State laws and Federal regulations relating to excavation and trench safety, including those which may be enacted during the performance under this Contract. CONTRACTOR is advised that Federal Regulations 29 C.F.R. 1926.650-1926.652 have been, in their most recent version as amended, in effect since January 2, 1990. CONTRACTOR shall fully comply with the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations pertaining to excavations, trenching, and shoring and shall provide and familiarize its employees involved

in excavation and trenching with the provisions in OSHA Pamphlet Number 2226, Excavating and Trenching Operations.

1.15 HAZARDOUS CONDITIONS

- A. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Excavating and grading equipment shall be approved types and designs, and shall be maintained in first class condition. Equipment used for disposing of excavated materials outside of the limits of the work shall be such as will avoid scattering or wasting material along the line of haul.

2.02 MATERIALS

- A. Provide borrow materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils
1. Controlled, compacted fill shall consist of approved materials that are free of organic matter and debris and contain maximum rock size of 12 inches, or the lift thickness, whichever is less. Frozen material shall not be used, and fill shall not be placed on a frozen subgrade. A sample of each material type shall be submitted to the Geotechnical Engineer for evaluation prior to its use.
 2. On-Site Soils / Imported Fill
 - a. USCS Classification Groups: Gravelly CL, or CL-CH, GC, SC, SW, or GW
 - b. These soils are acceptable for placement at all locations and elevations.
 3. Low Volume Change (LVC) Engineered Fill
 - a. USCS Classification Groups: Gravelly CL, GC, or SC with a liquid limit less than 50.
 - b. Low plasticity cohesive soil or granular soil shall have a liquid limit of less than 50%, contain at least 15% fines retained on the No. 200 sieve, and be preapproved by the Geotechnical Engineer for evaluation prior to its use.
 - c. LVC soils are acceptable for placement within 2 ft below the bottom of the slab elevation.
 - d. On-site soils classified as CL, SC or GC segregated during earthwork may be used as LVC material.
 - e. Topsoil strippings or material containing organics shall not be used as LVC material.
 4. On-Site Natural Soils
 - a. USCS Classification: CH
 - 1) These soils shall not be placed within the upper 2 ft beneath foundations, floor slabs and pavements.
 - b. CH Clays with Liquid Limit equal to or above 50 are considered suitable for use as controlled fill only if the percentage of rock fragments

exceeds 35% or if placed 2 ft below shallow foundations, slab, or pavement areas.

- C. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups; rock or gravel larger than 12 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within the required optimum moisture content at the time of compaction.
- D. Engineered Fill shall be Low Volume Change Engineered Fill.
- E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- H. Sand: ASTM C 33; fine aggregate.
- I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.03 GEOTEXTILES

- A. Geotextiles for Erosion Control
 - 1. Pervious fabric under riprap for slope protection and gabion separation shall meet the requirements of AASHTO M 288, "Permanent Erosion Control Geotextile Requirements."
- B. Geotextiles for Subsurface Drainage Purposes
 - 1. Geotextiles for pipe underdrain and drainage systems shall meet the requirements of AASHTO M 288, "Subsurface Drainage Geotextile Requirements." Geotextile shall be according to AASHTO M 288, Table 2, with from 15 to 50 percent of in-situ soil passing the No. 200 sieve.
- C. Geotextiles for Subgrade Reinforcement
 - 1. Geotextiles for subgrade reinforcement under pavement structures shall meet the requirements of AASHTO M 288, "Stabilization Geotextile Property Requirements."
- D. Geotextiles for Bases
 - 1. Geotextiles used for separation under base courses shall be a non-woven fabric for base course separation in accordance with AASHTO M 288, "Separation Geotextile Property Requirements" with a Class 2 Degree of Survivability.

2.04 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material (CLSM) shall be a self-compacting low strength material with a flowable consistency.
- B. CLSM shall be produced from the following materials:
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C 869.

5. Water: ASTM C 94.
 6. Air-Entraining Admixture: ASTM C 260.
- C. CLSM shall meet the following requirements:
1. Spread diameter of 8 inches or greater according to ASTM D 6103.
 2. Minimum strength of 300 psi according to ASTM D 4832 at 28 days after placement.
 3. Unit weight of 115 to 145 lb/cu.ft measured at the point of placement according to ASTM D 6023.

2.05 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 EXECUTION

3.01 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.

3.02 EXPLOSIVES

- A. Do not use explosives.

3.03 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.

- d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
3. All existing fill material shall be removed and properly replaced according to these specifications.

B. Construction Methods

- 1. All excavation shall be in accordance with the lines, grades and typical sections as shown on the plans or as established by the OWNER. Unless otherwise shown on the plans or established by the OWNER, the excavation shall be made to the subgrade. Where excavation to grades established in the field by the OWNER would terminate in unstable soil, the CONTRACTOR shall remove the unstable soil and backfill to the required grade.
- 2. The on-site soils typically classify as Type B in accordance with OSHA regulations. Temporary excavations classifying as Type B with a total height of less than 20 ft shall be cut no steeper than 1H:1V in accordance with OSHA guidelines.
- 3. Where excavation to grade established in the field by the OWNER terminates in loose or solid rock, the CONTRACTOR shall extend the depth of excavation 6 inches and backfill with select material compacted as required.
- 4. The CONTRACTOR shall conduct his operation in such a manner that adequate measurements may be taken before any backfill, as required above, is placed.

C. Provisions for Drainage

- 1. If it is necessary in the execution of the work to interrupt the natural drainage of the surface or the flow of artificial drains, the CONTRACTOR shall provide temporary drainage facilities that shall prevent damage to public or private interest and shall restore the original drains as soon as the work shall permit.
- 2. The CONTRACTOR shall be held liable for all damages which may result from neglecting to provide for either natural or artificial drainage which his work may have interrupted.

D. Excess Excavation

- 1. Excavation in excess of that needed for construction shall be disposed of by the CONTRACTOR. In general, suitable excess excavation shall be used in construction of streets, drives, parking lots, widening of embankments, flattening of slopes, etc., but, if it becomes necessary to waste any material, it shall be disposed of in such a manner as to present a neat appearance and to not obstruct proper drainage or cause injury to any street improvements or abutting property. If necessary to haul off excess or unsuitable material, the CONTRACTOR should ask approval of the OWNER as to disposition site and method.

3.04 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. All existing fill material shall be removed and properly replaced according to these specifications.
 - C. If relatively chert free fat clay zones are encountered at footing bottom and finish subgrade elevation, they should be undercut 2 ft, or to gravelly clays/clayey gravels, whichever is shallower, and replaced with LVC fill material.
- 3.05 EXCAVATION FOR WALKS AND PAVEMENTS
- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- 3.06 EXCAVATION FOR UTILITY TRENCHES
- A. The length of trench excavated approximately to grade shall not exceed one hundred-fifty feet (150') and no trench excavation whatsoever shall be made farther than three hundred feet (300') in advance of completed backfill.
 - B. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, joining, and embedment. Stipulated minimum trench widths are not minimum average widths, but are minimum widths that shall be required. Stipulated maximum trench widths shall not be exceeded. Trench width shall be the width of the trench excavation measured from bank to bank at the top of the pipe. For rigid pipes, when the maximum trench width is exceeded, the Contractor shall be required to provide a higher strength pipe or higher bedding classification, singly or in combination as directed by the Engineer, at the Contractor's expense. Any additional foundation material and/or embedment material required due to over excavation, beyond the maximum trench width shall be at the Contractor's expense.
 - C. Where trenches are excavated in soil of such nature as to require sheeting and shoring to assure proper installation, and safety of the workmen and any adjacent structures or other objects, the Contractor shall provide the necessary sheeting and shoring. Where possible, shields designed to be portable and moved along as work progresses may be used. The contract pay widths shown in the above shall apply to all trenches with or without sheeting or shoring.
 - D. Excavation shall be made in open-cut from the surface of the ground and shall be made no larger than necessary to permit proper construction of the work in accordance with the plans and specifications. The entire foundation area in the bottom of all excavations shall be firm, stable and of uniform density as nearly as practical, and unless necessary, materials shall not be disturbed below grade. Where trenches are excavated in soft, unsuitable materials, trench bottom may be stabilized by over-excavating unsuitable materials and replaced with engineered fill.
 - E. Where depth of trenching and other excavations are greater than twenty feet (20'), and when not provided for in the plans, an engineer shall be retained by the Contractor to design bank protection as per OSHA rules and regulations. The bank protection design, signed and sealed by a Professional Engineer registered in the State of Oklahoma, shall be submitted to the Engineer.
 - F. The sides of all excavations shall be sufficiently sheeted, shored and braced so as to prevent slides, cave-ins, settlement or movement of the banks. In wet, saturated or

flowing ground where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling of approved design and type shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressures exerted and maintain the walls of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing buildings or other structures, or in paved streets or alleys, particular care shall be taken to adequately sheet, shore, and brace the sides of the excavation to prevent any undermining of or settlement beneath the structures or the pavement. Underpinning of adjacent structures, when necessary, shall be done in an approved manner. The foundation material that is undermined shall be replaced and compacted in accordance with the requirements of this section. Sheeting, shoring, and bracing shall not be left in place unless otherwise shown on the plans or authorized by the Engineer. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either the new structure or any existing structure or property, either private or public, and so as to avoid cave-ins or sliding of the banks. If for any reason the Contractor, with the approval of the Engineer, leaves in place any sheeting, shoring or bracing, no payment will be allowed for such material left in place unless it is classified as a contract pay item. All holes or voids left by the removal of sheeting, shoring or bracing shall be satisfactorily filled and compacted in accordance with the requirements of this section.

3.07 SUBGRADE PREPARATION AND INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Areas to receive controlled fill, building subgrades, pavement subgrades, and undercut bottoms shall be proof-rolled with a fully loaded tandem axle dump truck or similar heavy rubber-tired construction equipment. All soft subgrade areas shall be undercut and replaced with compacted fill.
- D. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 25 tons 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 Architect, and replace with compacted backfill or fill as directed.
- E. After proof-rolling, scarify exposed subgrade to a minimum depth of 8 inches and compact to a least 95 percent of its maximum dry density as determined by the ASTM D-698 at a moisture content of optimum or above.
- F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.08 GROUND PENETRATING RADAR

- A. Once final excavation within the building footprint is achieved, the subsurface area within the footprint shall be inspected with ground penetrating radar (GPR) to potentially locate large shallow subsurface voids, if present.

3.09 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.

- B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 FILL

- A. Prior to the placing of any fill, all clearing and grubbing and site preparation shall have been completed. Stump holes or other small excavations within the limits of the embankment shall have been backfilled before commencing the embankment construction. The surface of the ground, including plowed or loosened ground or small ditches or washes, shall be restored to approximately its original slope.
- B. Embankments shall be constructed to the established grade and to the shape of the typical section shown on the plans, and each section shall conform to the detailed sections of slopes. After completion of the embankment, it shall be continuously maintained to its finished section and grade until the project is accepted.
- C. Earth embankments shall be constructed in successive horizontal layers, for the full width of specified depth or cross sections; and in such lengths as are suitable for the sprinkling and compaction methods to be used. Each layer of earth embankment shall be uniform as to material, density, and moisture content before beginning compaction. Layers of embankment shall be brought up uniformly on each side of the structure, and special care shall be taken to prevent any wedging action against the structure. For such distances along embankments adjacent to structures where it is impracticable to obtain compaction by rolling, the embankment material shall be placed in layers not exceeding 6 inches in depth of loose material wetted uniformly to the moisture content directed; and shall then be compacted by methods approved by the OWNER, maintaining the required moisture content by additional sprinkling, if necessary, supplemented by such hand work as is necessary to secure a uniform and thoroughly compacted fill, until each layer has been uniformly compacted to the satisfaction of OWNER.
- D. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 TRENCH BACKFILL

- A. Backfill is that portion of the total trench backfill down to but not including the pipe embedment material. The backfill shall be only material approved by the Engineer consisting of loose earth, free of clods, stones, organic matter, debris or other objectionable materials.
- B. All backfilling shall be done in such a manner as not to disturb or injure the pipe or structures over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be opened up and repaired and then re-backfilled as herein specified.
- C. The top surface or slopes of all backfill shall be neatly graded off where select topsoil, sod or other material is removed and piled separately; such material shall be carefully replaced in a manner satisfactory to the Engineer. The top twelve inches (12") of backfill material shall be of as good quality as the original topsoil that was removed.
- D. A clay trench plug shall be constructed at the edge of the building and extend at least 5 feet out from the face. The clay shall have a minimum plasticity index (PI) of 15 and be placed in controlled lifts not exceeding 9 inches in loose thickness. Each lift of clay backfill shall be compacted to at least 95 percent of the material's maximum standard Proctor dry density, ASTM 698, at a minimum moisture content that is above its optimum value.
- E. Place trench backfill on subgrades free of mud, frost, snow, or ice.
- F. Place trench backfill and fill soil materials in layers not more than 6 inches in loose depth.
- G. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- H. Backfill voids with satisfactory soil while removing shoring and bracing.

- I. Place and compact initial backfill, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
- J. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 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 for CL, ML, SC, GC, GW & SW Soil Types; and between 0 and 4% above optimum for CH soil types.
- B. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
- C. 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.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches in 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 backfills and fills to not less than the following percentages of maximum dry unit weight according to ASTM D-698:
 - 1. Fill shall be compacted with six (6) passes (3 each direction) minimum using a self-propelled vibratory compactor with a minimum drum diameter of 48-inches for granular soils, or 95% Standard Proctor Density (ASTM D698) for materials containing sufficient fines content.
 - 2. Pavements, sidewalks and exterior slabs shall be compacted to 95% Standard Proctor Density.
 - 3. Non-structural areas shall be compacted to 90% Standard Proctor Density.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Place base course material over subbase course under hot-mix asphalt pavement.
 - 2. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 3. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 4. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of Standard Proctor Compaction according to ASTM D-698.

- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of Standard Proctor Compaction according to ASTM D-698.

3.15 PROTECTION

- A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to the 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 Architect; 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.

3.16 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.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
- C. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.17 DEWATERING

- A. PERFORMANCE
 - 1. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.
- B. PREPARATION
 - 1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 2. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 3. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

4. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
5. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
6. Provide temporary grading to facilitate dewatering and control of surface water.
7. Monitor dewatering systems continuously.
8. Promptly repair damages to adjacent facilities caused by dewatering.
9. Protect and maintain temporary erosion and sedimentation controls during dewatering operations.

C. INSTALLATION

1. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
2. Space well points or wells at intervals required to provide sufficient dewatering.
3. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
4. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
5. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
6. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
7. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
8. Maintain piezometric water level a minimum of 60 inches below surface of excavation.
9. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
10. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
11. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
12. Promptly repair damages to adjacent facilities caused by dewatering operations.

3.18 FIELD QUALITY CONTROL

- A. OWNER shall engage a qualified soils testing laboratory. Contractor shall coordinate and order all testing in conjunction with earthwork operations. The results of the tests shall be forwarded to ENGINEER. The soils laboratory shall determine the suitability of existing site material prior to beginning fill operations.

- B. The soils testing laboratory shall:
1. Classify excavation material as satisfactory soils or unsatisfactory soils.
 2. Determine rock excavation.
 3. Determine prior to placement of fill that site has been prepared in compliance with requirements and determine that fill material.
 4. Determine that maximum lift thickness comply with requirements.
 5. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- C. 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.
- D. Testing agency shall test compaction of soils in place, as applicable. Tests will be performed at the following locations and frequencies:
1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 sq. ft. or less of building slab area, but in no case fewer than three tests.
 2. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 5,000 sq. ft. or less of paved area, but in no case fewer than three tests.
 3. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
 4. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.
 5. Non-Structural Areas: One test for every 5,000 sq. ft. or less, but in no case fewer than three tests.
- E. 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; re-compact and retest until specified compaction is obtained.

END OF SECTION 31 2300

SECTION 32 1100

BASE COURSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for BASE COURSES as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for BASE COURSES shall be included in the bid prices for the work.

1.03 SECTION INCLUDES

- A. Subgrade Modification
- B. Aggregate Base Course

1.04 RELATED SECTIONS

- A. 31 22 00 Grading
- B. 31 23 00 Excavation and Fill
- C. 31 25 00 Erosion and Sedimentation Controls

1.05 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah

1.06 ACTION SUBMITTALS

1.07 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each base course material proposed as follows:
 - 1. Source of base course material.
 - 2. Classification according to ASTM D-2487.
 - 3. Laboratory Compaction curve according to ASTM D-698.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. See Execution.

1.09 QUALITY ASSURANCE

A. PRECONSTRUCTION CONFERENCE

- 1. Conduct a preconstruction conference. Subcontractors that will be performing the work shall attend the preconstruction conference. Notify ENGINEER one week (7 days) prior to the date of the meeting.

B. REGULATORY REQUIREMENTS

- 1. All materials and methods shall comply with the requirements of the AHJ.

1.10 PERMITS

- A. CONTRACTOR shall make application; pay permit fees; provide payment and performance bonds required of the CONTRACTOR by the AHJ.

1.11 TOPOGRAPHIC SURVEY

- A. OWNER has or will perform a survey of the site, stake the property limits, and provide a reference benchmark elevation.

1.12 UNDERGROUND UTILITIES

- A. CONTRACTOR shall contact OKIE (811 or 1-800-522-OKIE) prior to construction for locating existing utilities.
- B. The underground utilities shown on the Drawings have been located from field survey surface information and existing drawings. ENGINEER and Surveyor make no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The underground utilities are located as accurately as possible from information available; however, ENGINEER and Surveyor further do not guarantee that the underground utilities shown are in the exact location indicated either vertically or horizontally. ENGINEER and Surveyor have not physically located the underground utilities by probing, excavating, hydrovac, or by any other means.
- C. CONTRACTOR shall notify all utility companies and governmental agencies who may have utility lines on or about the premises or who may be affected by the construction. Notice shall be given no less than twenty-four hours prior to any work that may interfere with a utility.
- D. All existing structures, improvement and utilities designated to remain shall be adequately protected from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed to be complete or accurate as to location, depth, or both. CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR's operations. During construction, all fire hydrants, valve boxes, fire or police call boxes and other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.
- E. Contractor shall satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place prior to beginning work. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary.

1.13 CONSTRUCTION CONTROL

- A. Do not commence work until temporary erosion and sedimentation control measures are in place.
- B. CONTRACTOR shall be responsible for properly laying out the work, and for lines and measurements for the work executed under the Contract Documents. Verify the figures shown on the Drawings before ordering any materials and laying out the work, and report errors or inaccuracies in writing to the ENGINEER before commencing work. The ENGINEER or his representative will in no case assume the responsibility for laying out the work.
- C. Existing survey points other than those shown on the Drawings shall not be considered as acceptable control points unless approved by the ENGINEER. If approval is secured, CONTRACTOR remains responsible for maintaining them and for their accuracy. Be responsible for preserving all existing iron or metal, and all concrete survey points or monuments for the construction period.

1.14 PROJECT CONDITIONS

PART 2 PRODUCTS

2.01 ADOPTED PRODUCT REQUIREMENTS

- A. All materials and products shall comply with the Oklahoma Department of Transportation’s 2009 Specifications.

2.02 AGGREGATE BASE FOR VEHICULAR PAVEMENTS

A. General Requirements

1. Provide aggregate base course material consisting of a mixture of coarse and fine graded aggregate that is free of vegetation and other deleterious materials.
2. Coarse aggregate is the material retained on a No. 10 sieve. Provide coarse aggregate consisting of the following durable particles or fragments:
 - a. Gravel, Stone, Disintegrated granite, crushed concrete, or
 - b. Provide fine aggregate made of sand, stone dust, or other inert, finely-divided mineral.
3. Ensure at least 40% of the completed Type A or Type B mixture retained on the No. 4 sieve contains uniformly graded, mechanically crushed particles with at least one fractured face.
4. Ensure 100 percent of the completed Type C or Type D mixture retained on the No. 4 sieve contains uniformly graded, mechanically crushed particles with at least two fractured faces. Ensure the completed Type C mixture contains no more than 15 percent natural sand.

B. Physical Properties

1. Ensure the coarse aggregate retained on the 3/8 in sieve of the completed mixture has no more than 50 percent wear in accordance with the Los Angeles Abrasion Test in accordance with AASHTO T 96. Ensure the aggregate has an Aggregate Durability Index of at least 40 in accordance with AASHTO T 210.

C. Gradation and Other Requirements

1. Sample the uniform mixture from the project site before compacting. Ensure samples are in accordance with the following Table for Gradation, Plasticity Index, and Liquid Limit for the provided aggregate base types.

Aggregate Base Gradation				
Sieve Size	Percent Passing per Type			
	Type A	Type B	Type C	Type D
3 in	---	100	---	---
2 in	---	---	100	---
1-1/2 in	100	40 -100	90 – 100	100
1 in	---	---	80 – 100	95 – 100
3/4 in	40 – 100	30 – 75	---	---
1/2 in	---	---	60 – 80	25 – 60
3/8 in	30 - 75	25 -60	---	---
No. 4	25 - 60	20 - 50	40 - 60	0 - 10
No. 8	---	---	---	0 – 5
No. 10	20 – 43	15 – 35	25 – 45	---
No. 40	8 – 26	7 – 22	15 – 30	---
No. 200 ^a	40 – 12.0	3.0 – 10.0	0 – 5.0	0 – 2.0

Other Requirements				
Plasticity Index	≤ 6	≤ 6	≤ 6	---
Liquid Limit	≤ 25	≤ 25	≤ 25	---
^a Ensure the material passing the No. 200 sieve comprises no greater than two-thirds of the quantity of material passing the No. 40 sieve.				
^b When separate aggregates are blended to produce an aggregate mixture, no individual aggregate shall have a plasticity index higher than 8.				

2.03 SAND BASE FOR SIDEWALKS

A. General Requirements

1. Sand base for sidewalks shall consist of sand, stone, rock, screenings, or select sandy soil free of organic material. Ensure there are no frozen lumps or moisture that may prevent the required compaction.

B. Gradation Requirements

Sand Base Material Gradation	
Sieve Size	Percent Passing
3/8 in	100
No. 200	0 - 10

PART 3 EXECUTION

3.01 ADOPTED PLACEMENT REQUIREMENTS

- A. The placement of BASE COURSES shall comply with the Oklahoma Department of Transportation’s 2009 Specifications.

3.02 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.

3.03 STORAGE OF MATERIALS

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

3.04 SUBGRADE PREPARATION AND INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 25 tons 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 Architect, and replace with compacted backfill or fill as directed.
 - C. After proof-rolling, scarify exposed subgrade to a minimum depth of 8 inches and compact to a least 95 percent of its maximum dry density as determined by the ASTM D-698 at a moisture content within +/- 2% of optimum.
 - D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.
- 3.05 SOIL MOISTURE CONTROL
- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to between +/-2 percent of optimum moisture content.
 - B. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - C. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture by +/-2 percent to compact to specified dry unit weight.
- 3.06 COMPACTION OF SUBGRAGE
- A. Compact subgrade to not less than the following percentages of maximum dry unit weight according to ASTM D-698:
 - 1. Under pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
- 3.07 BASE COURSES UNDER PAVEMENTS AND WALKS
- A. Place base course on subgrades free of mud, frost, snow, or ice.
 - B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Place base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent Standard Proctor Compaction according to ASTM D-698.
 - C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent Standard Proctor Compaction according to ASTM D-698.
- 3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Remove surplus base course material and waste materials and legally dispose of them off Owner's property.

3.09 FIELD QUALITY CONTROL

- A. CONTRACTOR shall engage a qualified soils testing laboratory. Contractor shall coordinate and order all testing in conjunction with base course placement. The results of the tests shall be forwarded to ENGINEER. The soils laboratory shall determine the suitability of existing site material prior to placement of base courses.
- B. The soils testing laboratory shall:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements and determine that fill material.
 - 2. Determine that maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer.
- D. Testing agency shall test compaction of soils in place and base courses as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 5,000 sq. ft. or less of paved area, but in no case fewer than three tests.
- E. When testing agency reports that subgrades or base courses have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace materials to depth required; re-compact and retest until specified compaction is obtained.

END OF SECTION 32 1100

SECTION 32 1300

RIGID PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for RIGID PAVING as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for RIGID PAVING shall be included in the bid prices for the work.

1.03 SECTION INCLUDES

- A. Concrete Paving

1.04 RELATED SECTIONS

- A. 31 2300 Excavation and Fill
- B. 31 2500 Erosion and Sedimentation Controls
- C. 32 1100 Base Courses
- D. 32 1600 Curbs and Gutters
- E. 32 1373 Concrete Paving Joint Sealants

1.05 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah
- B. Cementitious Materials - Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.06 ACTION SUBMITTALS

- A. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- B. Paving Plan:
 - 1. Provide a paving plan that shows the proposed concrete placed each day.
 - 2. Provide a joint layout plan that shows isolation joints, longitudinal construction joints, longitudinal contraction joints, transverse contraction joints, and planned transverse construction joints.

1.07 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Applied finish materials.
 - 4. Bonding agent or epoxy adhesive.
 - 5. Joint fillers.

- B. Material Test Reports: For each of the following:
 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.08 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- C. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- D. Preconstruction Conference
 1. Conduct a preconstruction conference. Subcontractors that will be performing the work shall attend the preconstruction conference. Notify ENGINEER one week (7 days) prior to the date of the meeting.
 2. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 3. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving subcontractor.
- E. Regulatory Requirements
 1. All materials and methods shall comply with the requirements of the AHJ.
 2. If the AHJ has not adopted specifications for materials and methods, the Oklahoma Department of Transportation's 2009 Specifications shall be used.

1.09 PERMITS

- A. CONTRACTOR shall make application; pay permit fees; provide payment and performance bonds required of the CONTRACTOR by the AHJ.

1.10 TOPOGRAPHIC SURVEY

- A. OWNER has or will perform a survey of the site, stake the property limits, and provide a reference benchmark elevation.

1.11 UNDERGROUND UTILITIES

- A. CONTRACTOR shall contact OKIE (811 or 1-800-522-OKIE) prior to construction for locating existing utilities.
- B. The underground utilities shown on the Drawings have been located from field survey surface information and existing drawings. ENGINEER and Surveyor make no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The underground utilities are located as accurately as possible from information available; however, ENGINEER and Surveyor further do not guarantee

that the underground utilities shown are in the exact location indicated either vertically or horizontally. ENGINEER and Surveyor have not physically located the underground utilities by probing, excavating, hydrovac, or by any other means.

- C. CONTRACTOR shall notify all utility companies and governmental agencies who may have utility lines on or about the premises or who may be affected by the construction. Notice shall be given no less than twenty-four hours prior to any work that may interfere with a utility.
- D. All existing structures, improvement and utilities designated to remain shall be adequately protected from damage that might otherwise occur due to construction operations. Where construction comes in close proximity to existing structures, utilities or appurtenances, or if it becomes necessary to move services, poles, guy wires, pipe lines or other obstructions, CONTRACTOR shall notify and cooperate with the owner of the utility, structure, or appurtenance. The utility lines and other existing structures shown on the plans are for information only and are not guaranteed to be complete or accurate as to location and/or depth. CONTRACTOR shall be liable for damage to any utilities resulting from the CONTRACTOR's operations. During construction, all fire hydrants, valve boxes, fire or police call boxes and other existing utility controls shall be left intact, unobstructed and accessible unless noted on the plan.
- E. Contractor shall satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location and sizes of pipe or conduits of various kinds in place prior to beginning work. Where the exact depth of any utility or obstruction is not shown on a plan, excavation shall be made prior to reaching the obstruction in order to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary.

1.12 CONSTRUCTION CONTROL

- A. Do not commence work until temporary erosion and sedimentation control measures are in place.
- B. CONTRACTOR shall be responsible for properly laying out the work, and for lines and measurements for the work executed under the Contract Documents. Verify the figures shown on the Drawings before ordering any materials and laying out the work, and report errors or inaccuracies in writing to the ENGINEER before commencing work. The ENGINEER or his representative will in no case assume the responsibility for laying out the work.
- C. Existing survey points other than those shown on the Drawings shall not be considered as acceptable control points unless approved by the ENGINEER. If approval is secured, CONTRACTOR remains responsible for maintaining them and for their accuracy. Be responsible for preserving all existing iron or metal, and all concrete survey points or monuments for the construction period.

1.13 PROJECT CONDITIONS

- A. TRAFFIC
 - 1. A Work Zone Permit must be obtained from the AHJ at least two (2) working days prior to the start of work and/or placing or removing any barricades or modifying existing traffic control devices.
 - 2. CONTRACTOR shall be responsible for erecting and maintaining barricades and other traffic warning devices as necessary around the perimeter of construction and adjacent to any open trenches. Provide and maintain adequate detours around the work under construction. Provide sufficient lights, warning signs, and watchmen for the safety of the public.
 - 3. Any temporary street closure shall be coordinated with and approved by the AHJ. CONTRACTOR shall establish all detour routes while streets are closed during

construction. CONTRACTOR shall notify Fire, Police, and EMSA headquarters when any street is temporarily closed.

4. CONTRACTOR is responsible for the prompt replacement and/or repair of all traffic control devices and appurtenances damaged or disturbed due to construction. Any existing traffic signals, signal loops, conduits, cables, and other traffic control devices affected by the work shall be reset or replaced according to AHJ's specifications. Coordinate the work with the AHJ's traffic department.

B. UTILITY INTERRUPTIONS

1. Do not interrupt any utility serving facilities occupied by Owner or others unless permitted by OWNER and the owner(s) of the utility. Temporary utility service shall be provided for any interruption. Notify OWNER and ENGINEER one week (7 days) in advance of proposed interruption of utility.

C. SUBSURFACE CONDITIONS

1. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

D. EXCAVATION AND TRENCH SAFETY SYSTEMS

1. CONTRACTOR shall be responsible for complying with State laws and Federal regulations relating to excavation and trench safety, including those which may be enacted during the performance under this Contract. CONTRACTOR is advised that Federal Regulations 29 C.F.R. 1926.650-1926.652 have been, in their most recent version as amended, in effect since January 2, 1990. CONTRACTOR shall fully comply with the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations pertaining to excavations, trenching, and shoring and shall provide and familiarize its employees involved in excavation and trenching with the provisions in OSHA Pamphlet Number 2226, Excavating and Trenching Operations.

1.14 HAZARDOUS CONDITIONS

- A. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

PART 2 PRODUCTS

2.01 ADOPTED PRODUCT REQUIREMENTS

- A. All materials and products shall comply with the Oklahoma Department of Transportation's 2009 Specifications.

2.02 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Class AA
 - a. Minimum 28 Day Compressive Strength: 4,000-psi
 - b. Minimum Cement Content: 564 lb/yd³
 - c. Air Content: 6.5% plus or minus 1.5%
 - d. Water/Cement Ratio: 0.25 to 0.44 lb/lb
 - e. Slump: 2 inches, plus or minus 1 inch.
 2. Class A
 - a. Minimum 28 Day Compressive Strength: 3,000-psi
 - b. Minimum Cement Content: 517 lb/yd³
 - c. Air Content: 6% plus or minus 1.5%
 - d. Water/Cement Ratio: 0.25 to 0.48 lb/lb
 - e. Slump: 2 inches, plus or minus 1 inch.
 3. Class A (vehicular pavement)
 - a. Minimum 28 Day Compressive Strength: 4,000-psi
 - b. Minimum Cement Content: 517 lb/yd³
 - c. Air Content: 6.5% plus or minus 1.5%
 - d. Water/Cement Ratio: 0.25 to 0.48 lb/lb
 - e. Slump: 2 inches, plus or minus 1 inch.
 4. Class AP
 - a. Minimum 28 Day Compressive Strength: 3,000-psi
 - b. Minimum Cement Content: 470 lb/yd³
 - c. Air Content: 6% plus or minus 1.5%
 - d. Water/Cement Ratio: 0.25 to 0.48 lb/lb
 - e. Slump: 2 inches, plus or minus 1 inch.
 5. Class C
 - a. Minimum 28 Day Compressive Strength: 2,400-psi
 - b. Minimum Cement Content: 395 lb/yd³
 - c. Air Content: 6% plus or minus 1.5%
 - d. Water/Cement Ratio: 0.25 to 0.62 lb/lb
 - e. Slump: 3 inches, plus or minus 1 inch.
- C. Cementitious Materials: Use fly ash, ground granulated blast-furnace slag, as needed to reduce the total amount of portland cement which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. November through March: Fly ash meeting the requirements of this section may be substituted for up to 15% of the required cement. Ground granulated blast furnace slag meeting the requirements of AASHTO M 302 Grade 100 or Grade 120 may be substituted for up to 25% of the required cement. A combination of up to 25% ground granulated blast furnace slag and up to 15% fly ash may be substituted for up to 40% of the required cement.
 2. April through October: A combination of up to 25% ground granulated blast furnace slag and up to 20% fly ash may be substituted for up to 45% of the required cement.
 3. Substitution shall be by weight: 1.0 pound for each 1.0 pound of cement. The concrete mix design shall be appropriately adjusted. These substitutions will not be allowed for high early strength concrete, Class P concrete or concrete

containing Type IP, Type I (PM), or Type I (SM) cement. If the specified minimum cement content is satisfied, additional fly ash or ground granulated blast furnace slag, or silica fume complying with ASTM C 1240, may be added to the mix when approved as part of the mix design.

- D. Water Cement Ratio. Using the weight in pounds of each material, calculate the water-cement ratio (W/C) by the following equation: $W/C = \text{Water} / (\text{Cement} + \text{Fly Ash} + \text{Blast Furnace Slag} + \text{Silica Fume})$ The water actually used is determined by the water measured into the batch plus the free water on wet aggregate minus the water absorbed by dry aggregate plus water in any admixture solutions and shall not exceed the limit specified.
- E. Slump. The slump shall be as shown, or as specified in the contract documents, or as approved by the Engineer, and the consistency required shall be that which will provide satisfactory workability for the type work being done. Slump tests will be made during the progress of the work as a measure of uniformity of the consistency of the concrete. If using a high-range water reducing admixture, limit the slump to a maximum of 9 inches.
- F. Compressive Strength. Compressive strength is based on the average of three test cylinders. When the class of concrete is not expressly indicated on the Plans, the following requirements shall govern:
 - 1. Class AA. Use Class AA concrete in superstructure items, such as bridge floors, approach slabs, reinforced concrete piles, drilled shaft foundations, parapet walls, concrete rail and handrails.
 - 2. Class A. Use Class A concrete for pavements and in substructures items, such as pier caps, columns, abutments, retaining walls, box culverts, and all reinforced concrete not requiring Class AA concrete.
 - 3. Class AP. Use Class AP concrete in shoulders, merge areas and gore areas for PCC pavements, unless otherwise directed by plan notes.
 - 4. Class C. Use Class C concrete for soil erosion control structures.

2.03 CONCRETE MIXING

- A. Design and produce concrete mixtures that conform to the Class of concrete specified in this section and base the mix design on absolute volume. Proportion the coarse and fine aggregate in accordance with ACI 211.1. Use the least amount of sand and mixing water which will ensure concrete of the required workability for placement conditions. Meet the minimum strength within 72 hours of placement for high early strength concrete. Submit the mix design at least 14 days before production to the Engineer. Include at least the following information with each mix design:
 - 1. Project identification
 - 2. Name and address of contractor and producer
 - 3. Mix design designation
 - 4. Intended use of the mix design
 - 5. Expected travel time from batch to placement
 - 6. If the concrete will be pumped or not
 - 7. Aggregate sources, gradation, moisture content, saturated surface dry batch mass, LA abrasion (AASHTO T 96), and freeze thaw durability (AASHTO T 103).
 - 8. Fineness modulus of fine aggregate.
 - 9. Cement type and source
 - 10. Type of cement replacement, if used, and source
 - 11. Type of admixtures and sources
 - 12. Material proportions
 - 13. Air content
 - 14. Slump
 - 15. Water / cement ratio

16. Strengths at 7 and 28 days
17. Strengths at 72 hours for high early strength concrete.

- B. Do not place any concrete until the mix design is approved. Submit new mix designs if the mix design is rejected by the Engineer, the source of any material changes, or the mix design produces unacceptable workability or production test results.

2.04 CONCRETE MATERIALS

- A. Portland cement: Shall conform to the requirements of AASHTO M 85 or AASHTO M 240. Type I, Type I (SM), Type I (PM), and Type IP shall be used in concrete for general concrete construction. Type II shall be used in concrete exposed to moderate sulphate action or moderate heat of hydration. Type III may be used when high early strength concrete is required. Unless otherwise approved by the Engineer, the product of only one mill of any one brand and type of portland cement shall be used on any structure or adjacent structures. Provide suitable means of storing and protecting the cement against dampness.

1. Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used. All methods of sampling and testing shall be in accordance with the requirements of AASHTO M 85 or AASHTO M 240.

B. Water

1. Provide water in accordance with AASHTO M 157, except as modified by the following:
 - a. Water quality testing is not required if obtained from an approved ODEQ public water source.
 - b. For other water sources, submit water quality test from the concrete producer showing compliance with AASHTO M 157 and the Chemical Limits for Mix Water listed below before use.
 - c. A blend of concrete wash water and other water sources may be used if the concrete producer submits certification that the water meets the requirements of AASHTO M 157 and Chemical Limits for Mix Water and Acceptance Criteria for Questionable Water Supplies listed below.
 - d. Test the blended water weekly for 4 weeks, or provide previous test reports. Test blended water monthly for compliance.
 - e. Chemical Limits for Mix Water
 - 1) Chloride (Cl) shall less than 1,000 ppm (ASTM D 512)
 - 2) Sulfate shall be less than 1,000 ppm (ASTM D 516)
 - 3) Alkalis shall be less than 600 ppm (ASTM D 4191 and ASTM D 4192)
 - 4) Total solids shall be less than 50,000 ppm (AASHTO T 26)
 - f. Acceptance Criteria for Questionable Water Supplies
 - 1) Compressive strength shall be a minimum 90% of the control at 7 days (AASHTO T 106)
 - 2) The time of set shall not deviate from the control less than 1 or more than 1.5 (AASHTO T 131)

C. Fine Aggregates

1. This specification applies to the quality and size of fine aggregates for Portland cement concrete pavements or bases, and incidental structures. Mortar sand shall meet the requirements of AASHTO M 45.
2. General Requirements.

- a. Provide fine aggregates that consists of a single source natural sand in accordance with AASHTO M 6, Class A, except as modified by the Gradation paragraph below.
 - b. Alternatively, provide a fine aggregate that consists of a combination of natural sands or a combination of natural na manufactured sands in accordance with AASHTO M 6, Class A, except as modified by the following:
 - 1) Mix the two materials under controlled conditions and stockpile as a finished aggregate. Alternatively, the two materials may be combined from separate stockpiles during batching operations at a hydraulic cement concrete plant.
 - 2) Ensure the combined fine aggregate meets the gradation requirements below.
 - 3) If a manufactured sand is used in combination with natural sand, ensure the fine aggregate blend has an acid insoluble residue of at least 60 percent by weight when tested in accordance with OHD L-25.
 - 4) Obtain crushed fine aggregate (manufactured sand) from a coarse aggregate source on ODOT Material Division's "Approved Products List" for use in hydraulic cement concrete.
3. Deleterious Substances
- a. The amount of deleterious substances shall not exceed the following limits: Clay lumps and friable particles 3%, Coal and Lignite 0.25%
4. Organic Impurities
- a. All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength test as specified below. Should the aggregate show a darker color than that of samples originally approved for the work, its use shall be withheld until tests satisfactory to the Engineer have been made to determine whether the increased color is indicative of an injurious amount of deleterious substances. A fine aggregate failing in the test may be used provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 and 28 days calculated in accordance with Section 10 of AASHTO T 71 is not less than 95 percent.
5. Gradation
- a. Provide fine aggregate with a fineness modulus between 2.3 and 3.1, that is well graded from coarse to fine, and when tested in accordance with AASHTO T 27 and AASHTO T11 meets the following gradation requirements.
 - 1) Sieve size: 3/8-in, percent passing: 100%.
 - 2) Sieve size: No. 4, percent passing 95-100%.
 - 3) Sieve size: No. 8, percent passing 80-100%.
 - 4) Sieve size: No. 16, percent passing 50-85%.
 - 5) Sieve size: No. 30, percent passing 25-60%.
 - 6) Sieve size: No. 50, percent passing 5-30%.
 - 7) Sieve size: No. 100, percent passing 0-10%.
 - b. The gradation requirements above represent the extreme limits of suitability. Ensure the gradation from one source does not have large changes in percentages of gradation.

- c. Use the average fineness modulus to determine the uniformity of the fine aggregate. The average fineness modulus is the average of the last 10 tests maintained by the ODOT Division Resident Engineer. Fine aggregates will be rejected from any one source having a variation in fineness modulus greater than 0.20 either way from the average. The fineness modulus of an aggregate is determined by adding the total percentages of material in the sample that are coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100; No. 100, No. 50, No. 30, No. 16, No. 8, No. 4, 3/8 inch.
- D. Coarse Aggregate
- 1. Provide coarse aggregate in accordance with AASHTO M 80, Class A, except as modified by the following:
 - a. Ensure coarse aggregate produces Class A concrete with a durability factor of at least 50. Determine the durability factor after 350 cycles of alternate freezing and thawing in accordance with AASHTO T 161, Procedure A.
 - b. The Los Angeles Abrasion percent wear shall be limited to a maximum of 40 percent after 500 revolutions when tested in accordance with AASHTO T 96.
 - c. The sodium sulfate soundness requirement shall not apply.
 - d. Ensure at least 70 percent of the coarse aggregate retained on the No. 4 sieve is crushed stone or mechanically crushed gravel with at least two fractured faces.
 - e. Limit the quantity of flat or elongated pieces to 15 percent or less, at a ratio of 1:5, when tested in accordance with ASTM D 4791.
 - 2. Gradation
 - a. No. 357
 - 1) Sieve size 2-1/2-in., percent passing 100%.
 - 2) Sieve size 2-in., percent passing 95-100%.
 - 3) Sieve size 1-in., percent passing 35-70%.
 - 4) Sieve size 1/2-in., percent passing 10-30%.
 - 5) Sieve size No. 4, percent passing 0-5%.
 - 6) Sieve size No. 200, percent passing 0-1.5%.
 - b. No. 57
 - 1) Sieve size 1-1/2-in., percent passing 100%.
 - 2) Sieve size 1-in., percent passing 95-100%.
 - 3) Sieve size 1/2-in., percent passing 25-60%.
 - 4) Sieve size No. 4, percent passing 0-10%.
 - 5) Sieve size No. 8, percent passing 0-5%.
 - 6) Sieve size No. 200, percent passing 0-2%.
 - c. No. 67
 - 1) Sieve size 1-in., percent passing 100%.
 - 2) Sieve size 3/4-in., percent passing 90-100%.
 - 3) Sieve size 3/8-in., percent passing 20-55%.
 - 4) Sieve size No. 4, percent passing 0-10%.
 - 5) Sieve size No. 8, percent passing 0-5%.
 - 6) Sieve size No. 200, percent passing 0-2%.
 - d. No. 7
 - 1) Sieve size 3/4-in., percent passing 100%.
 - 2) Sieve size 1/2-in., percent passing 90-100%.
 - 3) Sieve size 3/8-in., percent passing 40-70%.

- 4) Sieve size No. 4, percent passing 0-15%.
- 5) Sieve size No. 8, percent passing 0-5%.
- 6) Sieve size No. 200, percent passing 0-2%.
- e. No. 8
 - 1) Sieve size 1/2-in., percent passing 100%.
 - 2) Sieve size 3/8-in., percent passing 85-100%.
 - 3) Sieve size No. 4, percent passing 10-30%.
 - 4) Sieve size No. 8, percent passing 0-10%.
 - 5) Sieve size No. 16, percent passing 0-5%.
 - 6) Sieve size No. 200, percent passing 0-2%.
3. Provide the specified sizes of coarse aggregate for the following types of concrete:
 - a. No. 57 for Class A and Class AP concrete;
 - b. Nol. 357 for massive Class A concrete;
 - c. No. 57, No. 67, or No. 357 for Class C concrete;
 - d. No. 57 or No. 67 for Class AA concrete.

2.05 ADMIXTURES

- A. Provide air entraining admixtures in accordance with AASHTO M 154 and ASTM C 260.
- B. Provide chemical admixtures in accordance with AASHTO M 194 for the type of admixture supplied. Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 1. Color: As indicated on Drawings.

2.06 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
- B. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.07 STEEL REINFORCEMENT

- A. Bar Steel Reinforcement – Billet Steel
 1. Provide plain or deformed billet steel bars for concrete reinforcement and dowels in accordance with AASHTO M 31, Grade 60, except provide deformed billet steel bars for bent tie bars used in concrete paving in accordance with AASHTO M 31, Grade 40.
- B. Welded Steel Wire Fabric

1. Provide cold drawn steel wire fabric for concrete reinforcement in accordance with AASHTO M 55 or AASHTO M 221.
 2. Provide reinforcing fabric in flat sheets or rolls. Straighten bent or distorted materials before use. Ensure the fabric is free of excessive rust, scale, or coating that may impair the concrete bond.
- C. Cold Drawn Steel Wire
1. Provide cold drawn steel wire, in accordance with AASHTO M 32, for spiral ties and other reinforcing shown on the Plans as "W" (Wire) sizes.
- D. Epoxy Coated Reinforcing Bars
1. Provide epoxy coated (an electro-statically applied organic coating) reinforcing bars and epoxy coating material in accordance with AASHTO M 285, except the following:
 - a. Provide reinforcing steel bars in accordance with Bar Steel Reinforcement – Billet Steel.
 - b. Provide finished epoxy coating in a color and tone that easily gives visual indications of damage or corrosion staining.
- E. Tie Bars
1. ASTM A 615, Grade 60, deformed.
- F. Hook Bolts
1. ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports
1. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - a. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - b. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- 2.08 FIBER REINFORCEMENT
- A. Polypropylene fibers shall be 100 percent polypropylene, collated, fibrillated fibers manufactured to graduated lengths of equal proportions for secondary reinforcement. Polypropylene fibers shall be in accordance with ASTM C 1116 for Type III.
 - B. Steel fibers shall be in accordance with ASTM A 820, for Type II, cut-sheet steel. Provide steel fibers with an aspect ratio of 30:60 and from 1-1/2 to 2 inches long.
- 2.09 CURING MATERIALS
- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
 - B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
 - C. Water: Potable.
 - D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.10 RELATED MATERIALS

- A. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.11 DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semi-rigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
 - 1. Size of Stamp: One piece matching detectable warning area shown on Drawings.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

PART 3 EXECUTION

3.01 ADOPTED PLACEMENT REQUIREMENTS

- A. The placement of RIGID PAVING shall comply with the Oklahoma Department of Transportation's 2009 Specifications.

3.02 EARTHWORK AND BASE COURSE

- A. Perform earthwork according to 31 2300 Excavation and Fill.
- B. Provide base course according to 32 1100 Base Courses.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Joint Spacing Requirements
 - 1. Avoid odd-shaped slabs.
 - 2. In parking lots, longitudinal joints shall be parallel to the direction of vehicle travel, and can be made to delineate drive lanes and parking stalls. Transverse joints shall divide the paving lanes into panels.
 - 3. Longitudinal joint spacing shall not exceed 12.5 feet.
 - 4. The maximum transverse joint spacing for drives shall be 24 to 30 times the slab thickness or 15 ft, whichever is less. Divide the length between the concrete being placed into equally spaced joints.
 - 5. Slabs shall be as square as possible. The length of a panel shall not be more than 25% greater than its width.
 - 6. All transverse contraction joints shall be continuous through the curb and have a depth equal to $\frac{1}{4}$ to $\frac{1}{3}$ the pavement thickness.
 - 7. In isolation joints, the filler shall be full depth and extend through the curb. Isolation joints shall be used to isolate the pavement from light standard foundations, storm sewer inlets, manholes, and buildings.
 - 8. If there is no curb, longitudinal joints shall be tied with deformed tiebars.
 - 9. Offsets at radius points shall be at least 1.5 ft wide. Joint intersection angles less than 60 degrees shall be avoided.
 - 10. Minor adjustments in joint location made by shifting or skewing to meet inlets and manholes is allowable.
 - 11. Place joints to meet drainage structures, if possible.
- C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.07 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Rfloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.08 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
- F. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.09 PAVING TOLERANCES

- A. Comply with tolerances in Oklahoma Department of Transportation's 2009 Specifications and as follows:
 1. Elevation: 1/2 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot unlevelled straightedge not to exceed 1/4 inch.
 4. Alignment of tie-bar end relative to line perpendicular to paving edge: 1/2 inch per 12 inches of tie bar.
 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 6. Vertical alignment of dowels: 1/4 inch.
 7. Joint Spacing: 3 inches.
 8. Contraction Joint Depth: Plus 1/4 inch, no minus.
 9. Joint Width: Plus 1/8 inch, no minus.

3.10 PAVEMENT MARKING

- A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.11 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency:
 - a. Obtain at least one composite sample for each 100 cu.yd. or fraction thereof of each concrete mixture placed each day.
 - b. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
- C. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
- D. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- E. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
- F. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
- G. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
 - 1. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- H. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- I. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- J. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- K. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- L. Concrete paving will be considered defective if it does not pass tests and inspections.

- M. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- N. Prepare test and inspection reports.

3.12 ENGINEER'S ACCEPTANCE OF PAVEMENT

- A. Pavement slabs with unsound concrete, uncontrolled cracking, malfunctioning sawed joints, spalling, honeycombing, surface irregularities, insufficient thickness, or other deficiencies associated with poor quality pavements may be rejected by Engineer.
- B. Pavement rejected by Engineer shall be removed and replaced at no additional cost to Owner.
- C. When replacing rejected slabs, remove a width of at least one lane and a length of at least 15 ft. If the removal is within 15 ft of any transverse joint, remove the slab to the joint.
- D. If a deficient unit does not warrant removal, as directed by Engineer, the Owner will not pay for the deficient unit.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1300

SECTION 32 1373

CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.01. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02. SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for CONCRETE PAVING JOINT SEALANTS as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for CONCRETE PAVING JOINT SEALANTS shall be included in the bid prices for the work.

1.03. SECTION INCLUDES

- A. Cold-applied joint sealants
- B. Hot-applied joint sealants

1.04. RELATED SECTIONS

- A. 32 13 00 Rigid Paving

1.05. DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah

1.06. ACTION SUBMITTALS

- A. Product Data: Joint-Sealants.

1.07. INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

1.08. DELIVERY, STORAGE, AND HANDLING

1.09. QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.
- B. REGULATORY REQUIREMENTS
 - 1. All materials and methods shall comply with the requirements of the AHJ.
 - 2. If the AHJ has not adopted specifications for materials and methods, the Oklahoma Department of Transportation’s 2009 Specifications shall be used.

1.10. PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates

PART 2 PRODUCTS

2.01. ADOPTED PRODUCT REQUIREMENTS

- A. All materials and products shall comply with the Oklahoma Department of Transportation's 2009 Specifications.

2.02. MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03. COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.04. HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.

2.05. JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.06. PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03. INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Non-sag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.04. CLEANING

- A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05. PROTECTION

- A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.06. PAVEMENT JOINT SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within cement concrete pavement.
 - 1. Joint Location:
 - a. Expansion and isolation joints in cast-in-place concrete pavement.
 - b. Contraction joints in cast-in-place concrete slabs.
 - c. Other joints as indicated.
 - 2. Silicone Joint Sealant for Concrete: Single component, non-sag; Single component, self-leveling.
 - 3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.
 - 4. Hot-Applied Joint Sealant for Concrete: Single component.
- B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.
 - 1. Joint Location:
 - a. Joints between concrete and asphalt pavement.
 - b. Joints between concrete curbs and asphalt pavement.
 - c. Other joints as indicated.
 - 2. Hot-Applied Joint Sealant for Concrete and Asphalt: Single component.

END OF SECTION 32 1373

SECTION 32 1613

CURBS AND GUTTERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work under this section of the Specifications includes all labor, materials, equipment, and services necessary for CURBS AND GUTTERS as shown on the Drawings and herein specified and in accordance with the Contract Documents. All costs for labor, materials, equipment, and services necessary for CURBS AND GUTTERS shall be included in the bid prices for the work.

1.03 SECTION INCLUDES

- A. Cast-In-Place Concrete Curb and Gutters

1.04 RELATED SECTIONS

- A. 31 2300 Excavation and Fill
- B. 31 2500 Erosion and Sedimentation Controls
- C. 32 1300 Rigid Paving
- D. 32 1373 Concrete Paving Joint Sealants

1.05 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
 - 1. City of Tahlequah

1.06 ACTION SUBMITTALS

- A. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.07 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Applied finish materials.
 - 4. Bonding agent or epoxy adhesive.
 - 5. Joint fillers.
- B. Material Test Reports: For each of the following:
 - 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.08 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
 - B. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
 - C. ACI Publications: Comply with ACI 301 unless otherwise indicated.
 - D. Preconstruction Conference
 1. Conduct a preconstruction conference. Subcontractors that will be performing the work shall attend the preconstruction conference. Notify ENGINEER one week (7 days) prior to the date of the meeting.
 2. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 3. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving subcontractor.
 - E. Regulatory Requirements
 1. All materials and methods shall comply with the requirements of the AHJ.
 2. If the AHJ has not adopted specifications for materials and methods, the Oklahoma Department of Transportation's 2009 Specifications shall be used.
- 1.09 PERMITS
- A. CONTRACTOR shall make application; pay permit fees; provide payment and performance bonds required of the CONTRACTOR by the AHJ.
- 1.10 TOPOGRAPHIC SURVEY
- A. OWNER has or will perform a survey of the site, stake the property limits, and provide a reference benchmark elevation.
- 1.11 CONSTRUCTION CONTROL
- A. Do not commence work until temporary erosion and sedimentation control measures are in place.
 - B. CONTRACTOR shall be responsible for properly laying out the work, and for lines and measurements for the work executed under the Contract Documents. Verify the figures shown on the Drawings before ordering any materials and laying out the work, and report errors or inaccuracies in writing to the ENGINEER before commencing work. The ENGINEER or his representative will in no case assume the responsibility for laying out the work.
 - C. Existing survey points other than those shown on the Drawings shall not be considered as acceptable control points unless approved by the ENGINEER. If approval is secured, CONTRACTOR remains responsible for maintaining them and for their accuracy. Be responsible for preserving all existing iron or metal, and all concrete survey points or monuments for the construction period.

1.12 PROJECT CONDITIONS

A. TRAFFIC

1. A Work Zone Permit must be obtained from the AHJ at least two (2) working days prior to the start of work and/or placing or removing any barricades or modifying existing traffic control devices.
2. CONTRACTOR shall be responsible for erecting and maintaining barricades and other traffic warning devices as necessary around the perimeter of construction and adjacent to any open trenches. Provide and maintain adequate detours around the work under construction. Provide sufficient lights, warning signs, and watchmen for the safety of the public.
3. Any temporary street closure shall be coordinated with and approved by the AHJ. CONTRACTOR shall establish all detour routes while streets are closed during construction. CONTRACTOR shall notify Fire, Police, and EMSA headquarters when any street is temporarily closed.
4. CONTRACTOR is responsible for the prompt replacement and/or repair of all traffic control devices and appurtenances damaged or disturbed due to construction. Any existing traffic signals, signal loops, conduits, cables, and other traffic control devices affected by the work shall be reset or replaced according to AHJ's specifications. Coordinate the work with the AHJ's traffic department.

PART 2 PRODUCTS

2.01 ADOPTED PRODUCT REQUIREMENTS

- A. All materials and products shall comply with the Oklahoma Department of Transportation's 2009 Specifications.

2.02 CONCRETE

- A. Class A PC Concrete (4,000 psi at 28 days, air entrained) shall be used for concrete curbs and gutters.

2.03 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
- B. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.04 STEEL REINFORCEMENT

A. Bar Steel Reinforcement – Billet Steel

1. Provide plain or deformed billet steel bars for concrete reinforcement and dowels in accordance with AASHTO M 31, Grade 60, except provide deformed billet steel bars for bent tie bars used in concrete paving in accordance with AASHTO M 31, Grade 40.

B. Welded Steel Wire Fabric

1. Provide cold drawn steel wire fabric for concrete reinforcement in accordance with AASHTO M 55 or AASHTO M 221.
2. Provide reinforcing fabric in flat sheets or rolls. Straighten bent or distorted materials before use. Ensure the fabric is free of excessive rust, scale, or coating that may impair the concrete bond.

- C. Cold Drawn Steel Wire
 - 1. Provide cold drawn steel wire, in accordance with AASHTO M 32, for spiral ties and other reinforcing shown on the Plans as "W" (Wire) sizes.
- D. Epoxy Coated Reinforcing Bars
 - 1. Provide epoxy coated (an electro-statically applied organic coating) reinforcing bars and epoxy coating material in accordance with AASHTO M 285, except the following:
 - a. Provide reinforcing steel bars in accordance with Bar Steel Reinforcement – Billet Steel.
 - b. Provide finished epoxy coating in a color and tone that easily gives visual indications of damage or corrosion staining.
- E. Tie Bars
 - 1. ASTM A 615, Grade 60, deformed.
- F. Hook Bolts
 - 1. ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports
 - 1. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - a. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - b. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.05 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

PART 3 EXECUTION

3.01 ADOPTED PLACEMENT REQUIREMENTS

- A. The placement of CONCRETE CURBS AND GUTTERS shall comply with the Oklahoma Department of Transportation's 2009 Specifications.

3.02 EARTHWORK AND BASE COURSE

- A. Perform earthwork according to 31 2300 Excavation and Fill.
- B. Provide base course according to 32 1100 Base Courses.

3.03 JOINTS

- A. Expansion Joints - Set 1/2 inch expansion joints at maximum 100 ft spacing using 1/2 inch by 4-inch pre-molded expansion joint material.
- B. Contraction Joints – Set contraction joints at 15 ft to 20 ft spacing.
- C. Fill all joints to surface with silicone sealant.

3.04 TOLERANCES

- A. Comply with tolerances in Oklahoma Department of Transportation’s 2009 Specifications and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot unleveled straightedge not to exceed 1/2 inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 6. Joint Width: Plus 1/8 inch, no minus.

3.05 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu.yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
- C. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
- D. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- E. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
- F. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
- G. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
 - 1. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- H. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- I. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

- J. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- K. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- L. Concrete paving will be considered defective if it does not pass tests and inspections.
- M. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- N. Prepare test and inspection reports.

3.06 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1613