City of Carthage

JASPER COUNTY, MISSOURI

America's Maple Leaf City

Standard Specifications

for

Street Construction

ADOPTED _____

Revised: July 2026

STATE OF MISSOURI
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ECKHART
NUMBER
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REGISTERED PROFESSIONAL ENGINEER

PREPARED BY

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ENGINEERING · LAND SURVEYING · GEOSPATIAL

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DEFINITION OF TERMS 01000

1. City: City of Carthage, Missouri, a municipal corporation.

2. Engineer: Registered Professional Engineer currently holding position of City Engineer, whether contracted or city employee.

3. Public Works Director: The Public Works Director of the City of Carthage, Missouri, only appointed and holding office at the time of execution of a contract, or during the fulfillment thereof, or such people or official as may succeed to the duties of the Public Works Director. The Public Works Director is the representative of the City of Carthage, Missouri. The Public Works Director may appoint an inspector, or delegate his/her authority to subordinate, and any instructions issued by such representative shall have the same force and effect as if given by the Public Works Director in person.

4. Owner: Individual, firm, association, or corporation recorded as the legal owner of the property being developed under the "Standard Specifications for Street Construction, City of Carthage, Missouri."

5. ASTM: American Society for Testing Materials.

6. AASHTO: American Association of State Highway and Transportation Officials.

7. MoDOT: Missouri Department of Transportation.

GENERAL 01010

1. GENERAL

1.1 Standard specifications for the work shall consist of the "Standard Street Specifications" of the City of Carthage, and specific sections from the "Standard Specifications for Highway Construction" of the Missouri Highway and Transportation Commission.

1.2 A Performance and Maintenance Bond shall be on file with the Public Work's Department prior to the start of the public improvement construction.

1.2.1 The Performance and Maintenance Bond shall be for the cost of the public improvement construction.

1.2.2 The Performance Bond shall be in effect until project completion. The Maintenance Bond shall be effective for a 12-month period following project completion and acceptance by the City of Carthage.

1.3 No public improvement project construction shall begin until a set of engineering drawings of the proposed construction; sealed by a licensed professional engineer registered in the State of Missouri, is received by the City of Carthage and approved by signature of the Public Works Director or his designee.

1.4 Any public improvement which will be located in a State of Missouri right-of-way shall be permitted first by the Missouri Department of Transportation (MoDOT) before being considered by the City of Carthage. A copy of the MoDOT permit shall be supplied to the City of Carthage.

1.5 All public improvement construction shall be performed in accordance with specifications listed herein and shall be inspected and documented by the City of Carthage Public Works Department.

1.6 If the public improvement construction is required to be done after normal working hours, or on weekends or holidays, all overtime pay for Public Works inspector shall be paid for by the contractor. Failure to pay overtime fees shall result in a claim against the project Performance Bond.

1.7 The contractor or owner will be responsible for the repair/replacement of any City facilities damaged during construction. Failure to repair/replace damaged City facilities will result in a claim against the contractor/owner's liability insurance policy.

1.8 For new construction projects, an emergency contact with a 24-hour telephone numbers must be on file in case of emergency.

2. STREET IMPROVEMENTS

2.1 Streets, curbs and gutters shall be improved to comply with the standards contained herein and all design standards and specifications now or hereafter promulgated by the Public Works Director or adopted by the Council, in accordance with the final construction plans required to be approved prior to final plat approval.

2.2 Responsibility for improvements costs. It is the policy of the City to participate in or contribute to only certain additional costs of construction of major thoroughfares over and above the normal costs of local standard streets, when streets are designated at higher standards by the City. Such participation, and its timing, is not mandated and is solely at the election of the Council, according to the needs of the community.

2.3 Arrangement. All thoroughfares shall be located properly with respect to extending existing and platted streets, to special traffic generators, to population densities, and to the pattern of existing and proposed land uses.

2.3.1 Local streets shall be arranged to discourage use by through traffic, to permit efficient drainage and utility systems, and to require the minimum number of streets necessary to provide convenient and safe access to all properties. The use of curvilinear streets, cul-de-sacs, or U-shaped streets shall be encouraged where such use will result in a more desirable layout.

2.3.2 Where a subdivision abuts or contains an existing arterial street or highway having limited access, the commission may require the arrangement of residential lots with rear yards abutting the major street, or the provision of marginal access roads, or other such treatment as may be necessary in order to provide for adequate protection of residential properties, to afford separation of through and local traffic, and to provide for suitable access to the property involved.

2.3.3 When a new subdivision adjoins un-platted or undeveloped lands, the new streets shall be carried to the boundaries of such land as appropriate. A temporary turnaround approved by the Public Works Director shall be installed at this point, except when the terminus of the street is less than two hundred (200) feet from an intersecting right-of-way.

2.3.4 Private drives may be allowed only to provide internal circulation within a single lot or parcel.

2.4 Blocks. Streets should generally intersect at intervals not exceeding one thousand (1,000) feet or less than four hundred (400) feet. Blocks shall have sufficient depth to provide for two (2) tiers of lots of appropriate depth. Exceptions to this prescribed block depth shall be encouraged in blocks adjacent to major streets, railroads or waterways.

2.5 Curb and Gutter. Curb and gutter shall be considered part of city stormwater conveyance system. Curb and gutter shall be constructed in accordance with plans and specifications and shall be maintained and kept clean throughout construction so as not to allow sediment, trash, oil, or any other debris to enter into storm sewer system.

2.6 Pavement Design. The Developer shall provide with plans submitted for approval, pavement design for proposed streets within a development. Pavement type shall be indicated and shall include thicknesses of materials (concrete, asphalt, bituminous base and aggregate base). Plans shall provide soil compaction parameters. Materials shall be in conformance with applicable sections included in "City of Carthage Standard Specifications for Street Construction." Minimum pavement designs are shown in the following table however the City Engineer may require soils testing for any proposed street in order to verify pavement design.

TYPE OF STREET	AGGREGATE BASE THICKNESS (INCHES)	BITIMINOUS BASE THICKNESS (INCHES)	SURFACE COURSE THICKNESS (INCHES)
Freeway	Submit Design	Submit Design	Submit Design
Arterial, urban	Submit Design	Submit Design	Submit Design
Arterial, rural	Submit Design	Submit Design	Submit Design
Collectors	6	4	2
Local, nonresidential, Central Traffic Zone	6	3	2
Local, nonresidential, all other	6		3
Local, residential	6		3
Cul-de-sacs, residential	6		3
Estate lanes	6		2
Marginal Access roads	6		2

3. STREET WIDTHS

3.1 The right-of-way width required to be dedicated, and the pavement width required to be constructed for streets, according to street classification, shall be:

TYPE OF STREET	MINIMUM FEET RIGHT-OF-WAY	PAVEMENT WIDTH (BACK-TO-BACK OF CURB)	
		MAXIMUM (FEET)	MINIMUM (FEET)
Freeway	Variable	96*	48*
Expressway	Variable	72*	48*
Arterial, urban	80-106	68	120
Arterial, rural	80-106	68	24
Collectors	60	50	
Local, nonresidential, central traffic zone	60		41
Local, nonresidential, all other	60		41
Local, residential	50		30
Cul-de-sacs, residential (stem portion)	50		30
Estate lanes	50		30
Marginal Access roads	30		20

*In addition to road pavement, two (2) paved, ten-foot shoulders are required.
Standard curb and gutter width shall be 2.5 feet for all roadways except 2.0 feet curb and gutter shall be used for Local, residential; Cul-de-sacs, residential; Estate lanes; and Marginal access roads.

NOTE: Where it is impracticable to comply with these standards, a written approval to deviate therefrom must be obtained from the Public Works Director.

4. INTERSECTIONS

4.1 Streets shall intersect one another at as near a ninety-degree angle as possible. No intersection of streets at angles less than sixty (60) degrees shall be approved.

4.2 When streets intersect at a ninety-degree angle or when a street intersects with a cul-de-sac terminal bulb, the intersection right-of-way lines shall be rounded by a curve with a radius of not less than twenty (20) feet for residential streets and not less than (30) feet for non-residential streets.

4.3 When streets intersect at an angle of less than ninety (90) degrees, the Public Works Director may require the intersecting right-of-way lines to be rounded by a curve with a radius greater than required for streets intersecting at a ninety-degree angle.

4.4 The intersection of more than two (2) streets at any one (1) point shall be avoided except where necessary to secure a proper street system.

4.5 Intersecting streets shall have center lines as nearly straight as possible. Streets with center line offsets at intersections shall be offset by less than five (5) feet or more than one hundred twenty-five (125) feet.

5. TERMINAL STREETS

5.1 Permanent terminal streets shall not be longer than seven hundred fifty (750) feet, measured from the center of any cul-de-sac to the right-of-way line of the nearest through street from which it derives.

5.2 Terminal streets shall also have a turnaround at the closed end with an outside roadway diameter of at least seventy-six (76) feet and right-of-way diameter of at least ninety-four (94) feet.

5.3 Residential alleys shall not be permitted in single-family residential areas.

5.4 Non-residential alleys shall be provided in commercial and industrial districts when off-street loading and parking are not otherwise provided.

5.4.1 The right-of-way width of an alley shall be twenty (20) feet.

5.4.2 When alleys intersect, the intersection right-of-way lines shall be rounded by a curve with a radius of five (5) feet in length.

6. TRAFFIC CONTROL

6.1 General. Materials, placement, maintenance, and removal of Traffic Control Devices shall be governed by Part 6 of the "Manual of Uniform Traffic Control Devices," published by the U.S. Department of Transportation of the Federal Highway Administration.

6.2 Maintenance of Access – Construction Sequence. The Contractor shall strictly adhere to the construction sequence outlined on the Construction Phasing Plans.

6.3 Placement of Devices – Approximate Quantities. In order to maintain safe work and travel in the construction zone, the Contractor shall provide and install signs, barriers, and lane channelization for vehicles as shown on the Traffic Control Plan.

7. QUALITY ASSURANCE

7.1 Developer/Contractor shall provide to the City Engineer test reports from independent testing laboratory confirming subgrade, granular stone base, granular stone bedding, and pavement have been constructed in conformance with City of Carthage Standard Street Specifications. Quality assurance tests shall be performed at a minimum in accordance with the schedule indicated below or as determined by the City Engineer or City Inspector. The City Engineer or City Inspector shall be notified at least 24 hours prior to a scheduled inspection or test. Costs for independent testing of streets shall be the responsibility of the developer. Trench backfill and pipe bedding under streets shall be tested and inspected prior to construction of streets. Curb & gutter and street, including crown, shall be checked for grade at intervals of 50 linear feet. Following construction, the project engineer shall provide signed approval stating to City that streets have been constructed in accordance with approved plans and City Street Specifications.

7.2 Maximum thickness, minimum compaction requirement, and minimum testing requirement of each lift are shown below. Compaction tests shall be completed for each lift regardless of lift thickness.

Category	**Max. Lift (inches)**	**Compaction**	**SY/Test**
Sub-grade	6	95	1000
Aggregate Base	6	95	1000
Bituminous Base	3	95	1000
Bituminous Surface	3	95	1000

UNIT PRICES 01151

1. GENERAL

1.1 This section described the methods of measurement and payment for the various items required by the specifications pertaining to contracts with the City of Carthage.

2. MEASURED ITEMS

2.1 The following denote items which will be measured and paid for separately for street construction. All other items as required by the specifications shall NOT be measured and paid for separately but shall be considered incidental to construction. The cost for these items shall be included in the unit price of the item of which they are a part.

2.2 01567 – Pollution Prevention: Measurement and payment shall be lump sum or per the various units noted in the bid schedule.

2.3 02110 - Clearing and Grubbing: Measurement and payment shall be per acre.

2.4 02125 - Removal of Existing Improvements: Measurement and payment will be per lump sum.

2.5 02126 – Cold Milling Bituminous Pavement: Measurement and payment shall be per square yard.

2.6 02200 - Earthwork: Measurement and payment shall be per cubic yard. The quantities of cut shown on the cross sections are from the existing ground to top of structure (i.e., curb, street surface). The quantities of fill shown on the cross sections are from the bottom of the proposed aggregate base to the existing ground elevation.

2.6.1 All earthwork which required filling and shaping shoulders shall be considered incidental to construction.

2.6.2 Soils testing, hauling, materials, equipment, and supervision shall not be measured or paid for separately but shall be considered an obligation incidental to the contract.

2.7 02221 – Trenching, Backfilling and Compacting:

2.7.1 Measurement of various sizes and depths will be in linear feet as listed in the proposal, based on the horizontal length of pipe measured from inside face to inside face of structures along the centerline of pipe. Depth range as listed in the proposal and shown on the plans will not be measured unless field conditions result in a change in the plans by the Owner.

2.7.2 Payment will be made at the contract unit price per linear foot for the applicable size and depth of pipe as listed in the proposal.

2.8 02223 – Granular Stone Base: Shall be measured on a square yard basis of compacted stone of the various thicknesses as noted on the plans. Final measurement of the completed granular stone base will not be made except for authorized changes during construction as approved by the Engineer.

2.9 02240 – Soil Stabilization: Shall be measured and paid for on an installed square yard basis. Material overlap will NOT be measured and paid for separately but shall be included in the installed square yard basis.

2.10 02271 – Rock Ditch Liner: Shall be measured and paid for on a per cubic yard basis for the type as noted on the plans.

2.11 02480 – Surface Restoration: Shall be measured and paid for on a per acre basis for the various types as shown on the plans.

2.12 02513 - Asphaltic Concrete Paving: Shall be measured and paid for at the following types and units.

2.12.1 Base Course: See paragraph 2.6, Granular Stone Base above.

2.12.2 Prime Coat: Measurement and payment shall be per gallon.

2.12.3 Bituminous Base: Measurement and payment shall be per ton.

2.12.4 Tack Coat: Measurement and payment shall be per gallon.

2.12.5 Surface Course: Measurement and payment shall be per ton.

2.12.6 Bituminous base and surface course tonnages listed in the bid schedule are based on an assumed weight of 110 pounds / square yard / inch of thickness. Except for adjustments of areas no additional compensation will be allowed for different weights.

2.13 02530 – Crack Sealing: Shall be measured and paid for on a linear foot basis of placed seal.

2.14 02575 – Roadway Surface and Sidewalk Replacement

2.14.1 Portland Cement Concrete Pavement shall be measured and paid for on a square yard basis.

2.14.2 Asphaltic Concrete Paving shall be measured and paid for on tonnage basis.

2.14.3 Crushed Stone Paving shall be measured and paid for on a square yard basis.

2.14.4 Concrete Sidewalk shall be measured and paid for on either a square foot or square yard basis as noted in the bid schedule.

2.15 02577 – Pavement Marking

2.15.1 Solid striping shall be measured and paid for on a lineal foot basis for the color and width of line specified.

2.15.2 Intermittent striping shall be measured as a solid line on a lineal foot basis for the color and width of line specified and paid for on a 1/3 of total length lineal foot basis.

2.15.3 Directional arrows and miscellaneous symbols shall be measured and paid for on a per basis as noted on the plans or bid schedule.

2.16 02601 – Precast manholes shall be measured and paid for on a per each basis for the size and type of each unit.

2.17 02601 – Precast curb inlets shall be measured and paid for on a per each basis for the size and type of each unit.

2.18 02727 - Storm Sewers:

2.18.1 Pipe: Measurement and payment will be in linear feet for the various sizes and types of pipes noted. Measurements shall be based on the horizontal length of pipe measured along the centerline from inside wall to inside wall of the various structures (i.e., curb inlet, manhole, etc.).

2.18.2 Flared End Section or Beveled Pipe End: Measurement and payment shall be per each of the size and type as noted in the bid schedule.

2.19 Concrete:

2.19.1 Curb and Gutter: Shall be measured and paid for on a lineal foot basis.

2.19.2 Gutter Crossing: Shall be measured and paid for on a square yard basis.

2.19.3 Driveway Entrance: Shall be measured and paid for on a square yard basis as listed in the proposal. Such measurements and payment shall constitute full compensation for all labor, materials, equipment and supervision necessary for the construction of the driveway entrance including excavation, sub-grade preparation, placement and preparation of granular stone base, and placement of the entrance slab.

2.19.4 Sidewalk: Shall be measured and paid for on a square yard basis as listed in the proposal. Such measurement and payment shall constitute full compensation for all labor, materials, equipment and supervision necessary for the construction of the sidewalk including excavation, sub-grade preparation, placement and preparation of granular stone base, and placement of the concrete sidewalk.

2.19.5 Handicap Ramp: Shall be measured and paid for on a per each basis as listed in the proposal. Such measurement and payment shall constitute full compensation for all labor, materials, equipment and supervision necessary for the construction of the handicap ramp including excavation, sub-grade preparation, placement and preparation of granular stone base, and placement of the entrance slab.

2.19.6 Curb Flume: Shall be measured and paid for on a lineal foot basis of curb on each side of flume as listed in the proposal. Such measurement and payment shall constitute full compensation for all labor, materials, equipment and supervision necessary for the construction of the flume including excavation, sub-grade preparation, placement and preparation of granular stone base, and preparation of the embankments to receive rock blankets.

2.19.7 Concrete Headwalls: Shall be measured and paid for on a per each basis complete, in-place unit at each location as shown in the drawings.

2.20 Utility Relocation: Measurement and payment for relocating utilities (water, sewer, telephone, gas, etc.) shall be measured and paid for at the unit price as noted in the bid schedule.

2.21 09614 – Replaceable Warning Surfaces: Shall be measured and paid for on a square foot basis.

POLLUTION PREVENTION.....01567

1. GENERAL

1.1 Description: The work of this section consists of furnishing, installing, maintaining and removing temporary pollution, erosion and sediment control measures; furnishing and placing permanent erosion control features or a combination as shown on the plans or as directed by the engineer.

1.2 Schedule of Work: Prior to beginning any land disturbance activity, the contractor shall submit a schedule for implementation of temporary and placement of permanent erosion control measures.

2. MATERIALS

2.1 Erosion control measures shall comply with the City of Carthage, Missouri Model Best Management Practices (BMP's) for Land Disturbance.

3. EXECUTION

3.1 The contractor shall obtain a copy of the Model Best Management Practices (BMP's) for Land Disturbance and review the various BMP requirements.

3.2 Temporary perimeter BMP's shall be placed as per the contractor's schedule. As work progresses additional temporary or permanent BMP's shall be placed and maintained during construction.

3.3 As work progresses BMP's shall be evaluated. Should any BMP be deemed insufficient, the contractor shall be prepared to place additional BMP's to prevent pollution from the site.

3.4 After construction is completed and all areas stabilized, the contractor shall remove all temporary BMP's.

4. MEASUREMENT AND PAYMENT

4.1 Pollution Prevention shall be measured and paid for at either a lump sum price or at individual unit prices as noted in the bid schedule.

CLEANING.....01710

1. GENERAL

1.1 The work of this section consists of the periodic removal of construction debris from the job site(s) and associated public streets, roads, easements, and right-of-way used during construction. In addition, the final detailed cleaning of the site prior to the Owner's acceptance of the project is included.

2. MATERIALS

2.1 None.

3. METHODS

3.1 General: The Contractor shall keep the construction site sufficiently clean to allow a safe and expeditious construction operation to be implemented. Periodically and upon completion of the work and before acceptance and final payment is made, the Contractor shall clean and remove from the road rights-of-way, easements, public and private property, all surplus, discarded materials, perishable matter, rubbish and temporary structures. He shall restore in an acceptable manner all property, both public and private, which may have been damaged on account of the prosecution of the work, and shall leave the roadway, easements, public and private property neat and presentable.

3.2 Open burning: During each construction project phase, efforts shall be taken to prohibit the open burning of refuse in accordance with laws and regulations of the applicable municipal and state agencies.

3.3 Dust Control: Construction operations may require control measures to prevent the creation of excessive dust, which will be the responsibility of the Contractor.

3.4 Water Pollution Control: The Contractor shall exercise caution to guard against the degradation of the waters of the State of Missouri due to construction related pollutants (silt, debris, and petroleum products) and shall prevent the discharge of sewage involved with this contract into the waters of the State of Missouri.

4. MEASUREMENT AND PAYMENT

4.1 Cleaning is considered incidental to the project and will not be measured or paid for separately.

CLEARING AND GRUBBING.....02110

1. GENERAL

1.1 Description: The work in this section consists of furnishing all labor, materials, equipment, and tools necessary for performing all operations for the proper execution of all clearing and grubbing within the construction areas shown on the drawings and as necessary to complete this section.

1.2 Limits: Unless noted otherwise on the drawings, clearing and grubbing shall be performed within the limits of the "Permanent Easement" as shown on the drawings. Incidental clearing and grubbing shall be performed as necessary within the limits of the "Construction Easement" as shown on the drawings.

2. MATERIALS

2.1 None.

3. EXECUTION

3.1 Clearing:

3.1.1 Clearing shall consist of clearing the surface of the ground in the designated areas of all trees, stumps, roots, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, foundations, debris and rubbish of any nature.

3.1.2 Trees, stumps, roots, brush, and other vegetation in the areas to be cleared shall be cut below the original ground surface.

3.1.3 Trees and vegetation designated in the field by the Owner to remain standing shall be protected from any damage incidental to the clearing, grubbing, and construction operations.

3.2 Grubbing:

3.2.1 Grubbing shall consist of the removal and disposal of stumps, roots larger than two (2) inches in diameter, and matted roots from the areas designated to be grubbed. This material shall be removed to a depth of no less than twelve (12) inches below the original surface of the elevation.

3.2.2 Depressions created by grubbing operations shall be filled with suitable material and compacted.

3.3 Disposal of Materials:

3.3.1 All cleared and grubbed material including trees, stumps, roots, vegetation, organic material, rubbish, and otherwise shall be removed from the project site and disposed of in accordance with federal, state, and local laws.

3.3.2 Limited burning of debris on the site will be permitted if allowed by local, state, and federal law. Any ashes and/or debris left as a result of burning shall be removed from the site and taken to a landfill.

4. MEASUREMENT AND PAYMENT

4.1 Clearing and grubbing will be measured and paid for as noted in Section 01151, paragraph 2.2. and shall include all labor, materials, equipment, and supervision necessary to clear and grub the site except for any individual items addressed in the bid schedule.

REMOVAL OF EXISTING IMPROVEMENTS.....02125

1. GENERAL

1.1 This work shall consist of the removal and disposal of all existing improvements, except those designated or permitted to be left in place or to be removed under other items of work, from the right-of-way and within the limits of the project.

1.2 Removal of existing improvements shall include removing all buildings, drainage structures, pavements, surfacing and base courses of all types, curb, curb and gutter, sidewalks and house walks, steps, retaining walls, foundation walls, columns, footings, floors and any other types of building appurtenances, cisterns, catch basins, manholes, drainage and sewer pipes, water and gas main pipes, other objects or structures including scattered or piled bricks, stones, broken masonry, rubbish, debris, etc. from building demolition work, and other existing improvements. This item shall also include the salvaging of materials as designated in the contract, and the backfilling of the resulting trenches, holes, and pits, and any grading work required to shape, smooth, and finish the disturbed areas.

2. MATERIALS

2.1 None.

3. EXECUTION

3.1 All buildings, disused structures, old pavements, abandoned sewers or pipelines, or other obstructions to the construction of the roadway or within the limits of the right-of-way and not designated or permitted to remain shall be removed or disposed of by the Contractor as required. Existing structures used for handling temporary traffic shall not be removed until the replacement structures are open to traffic. The Contractor may make use of existing structures or portions of them during construction, but no material designated for use elsewhere shall be removed from the project, cut, bent, broken, or otherwise damaged.

3.2 Material designated in the contract to be salvaged from existing structures shall be removed without damage in sections which may be readily handled or transported and shall be piled neatly at an accessible point. Material not designated for salvage will be considered the property of the Contractor unless owned and claimed by any political subdivision or utility company. Salvaged materials becoming the property of the Contractor shall not be stored upon the right-of-way, nor shall any portion of the right-of-way be used by the Contractor as a sales yard. All discarded materials or debris shall be disposed of at locations furnished by the Contractor, or at locations on the right-of-way approved by the Engineer.

3.3 In removing pavement, curb, curb and gutter, gutters, sidewalk, and other similar improvements, and where a portion of such improvements are to be left in place, they shall be removed to an existing joint or to a joint sawed to a minimum depth of one inch with a true line and vertical face. Sufficient removal shall be made to provide for proper grades and connections in the new work regardless of any limits which may be indicated on the plans.

3.4 Removal of concrete pavement or base course and concrete sidewalk may consist either of breaking up and disposing of the broken concrete in embankments or in disposal areas furnished at the Contractor's expense, or of breaking the slab into pieces not exceeding 4 square feet where new embankment over 24 inches high is to be placed over the slab. Existing improvements not removed in their entirety shall be removed to a minimum depth of 12 inches below the finished grading section or natural ground.

3.5 All sewers and drainage pipes which have been or are to be abandoned shall be permanently sealed at the ends with bulkheads constructed of Class B Concrete, concrete of a commercial mixture or brick masonry, having a minimum thickness of 8 inches. The use of salvaged bricks will be permitted for constructing bulkheads provided the bricks are clean and sound. No direct payment will be made for blocking abandoned sewers, drainage pipes, or floor drains.

3.6 All trenches, holes, and pits resulting from the removal of existing improvements shall be filled with earth. The material shall be placed in the same manner and compacted to approximately the same density as that required in adjoining areas.

3.7 Removing and disposing of abandoned fences will be considered as included in final cleaning up of the right-of-way and no direct payment will be made for such work.

4. MEASUREMENT AND PAYMENT

4.1 Removal of existing improvements shall be measured and paid for as noted in Section 01151, paragraph 2.3 and shall include the removal of all items, whether in view or hidden underneath the surface of the ground, regardless of whether shown on the plans or encountered during construction.

COLDMILLING BITUMINOUS PAVEMENT.....02126

1. GENERAL

1.1 The work of this section consists of the removal and disposal of a portion of the existing asphalt pavement. The pavement shall be removed to the depth and profile as shown on the drawings.

2. MATERIALS

2.1 None.

3. EQUIPMENT

3.1 Equipment for profiling and removing bituminous pavement surface shall be a power operated, self-propelled planing machine or grinder. The machine shall be capable of removing a 2" thickness or specified depth, 54" minimum width, and provide a uniform profile and cross slope.

3.2 The equipment shall be self-propelled with sufficient power, traction, and stability (rigid suspension, non-pneumatic tire) to maintain accurate depth of cut and slope.

3.3 The equipment shall be capable of accurately, and automatically, establishing profile grades within ± 1/8-inch along each edge of the machine. Grade referencing shall be from the existing pavement, by means of a ski or matching shoe, or from an independent grade control. The equipment shall be controlled by an automatic system for controlling grade elevation and cross slope at a given rate.

3.4 The machine shall be equipped with water spray to control dust and other particulate matter created by the cutting action.

3.5 The machine shall have an effective means of removing cuttings from the pavement and discharging them into a hauling unit, all in one operation as the pavement is milled.

4. EXECUTION

4.1 Setup signage and other safety and traffic control devices.

4.2 Cold milling shall only begin when the contractor is ready to immediately follow up with the resurfacing operation.

4.3 Do not expose the milled surface to traffic for an extended period before resurfacing. If the milled surface begins to ravel under traffic, or other problems resulting from the milling occur, the Owner's Representative may restrict the time the milled area is open.

4.4 The pavement surface shall be removed to the 2" depth or as noted on the drawings. The width, grade and cross section shall conform with the drawings, or as approved by the Owner's Representative.

4.5 Automatically control grade leveling and slope. Provide control to produce a uniform surface to the established grade and a cross slope conforming to the requirements of the typical section.

4.6 Remove and plane asphalt surface around and over manholes, utility valves and drainage appurtenances.

4.6.1 Damage to manholes, valves, or drainage appurtenances by the removal and planing operation shall be the responsibility of the Contractor to correct.

4.6.2 Place a temporary wedge of bituminous material at a slope no steeper than one inch in 4 feet around manholes, utility valves, and other appurtenances in the driving lanes.

4.6.3 Remove bituminous wedges prior to resurfacing.

4.7 Exercise care not to damage existing concrete curbs, drives, etc.

4.8 Immediately sweep and pick up loose material on roadway surface not picked up by the milling machine.

4.8.1 In areas with earth or stabilized aggregate shoulders, the Contractor may sweep small amounts of loose material onto the shoulders.

4.8.2 Remove loose material on bridge decks not picked up by the milling machine immediately behind the milling operation.

4.9 Milled material is to be disposed of offsite unless provided otherwise in the contract.

5. FIELD QUALITY CONTROL

5.1 For roadway surfaces, the surface of each layer shall be substantially free of waves or irregularities.

5.2 The final surface, including pavement repair limits, shall not vary from a 10-foot straightedge applied parallel to the centerline, by more than 1/8 inch.

5.3 Repair spalled areas using an approved plant mix bituminous pavement commercial mix.

5.4 The texture produced for the finished pavement shall be a grid surface with discontinuous longitudinal striations.

6. MEASUREMENT AND PAYMENT

6.1 Cold Milling Bituminous Pavement shall be measured and paid for as noted in Section 01151, paragraph 2.4 and shall include all equipment, labor, supervision and incidentals necessary to complete the milling operation as shown on the plans.

EARTHWORK.....02200

1. GENERAL

1.1 The work of this section consists of performing all excavating, filling, rough grading, finish grading, and trenching as shown on the drawings and providing proper drainage, as follows:

1.1.1 Perform general excavation for structures to grades, lines, and levels as indicated for miscellaneous drainage structures.

1.1.2 Perform general exterior grading, cutting, and filling required to transform existing grades shown on drawings.

1.1.3 Perform filling of embankment and backfilling for all work as required to conform to the lines, grades, thicknesses, and typical cross shown on plans. Material used for fill and backfill shall be taken from the existing right-of-ways, or from a designated borrow area.

1.1.4 Cut ditches to divert water around streets, parking area and drives as shown on drawings.

1.1.5 Perform fine grading using four (4) inches topsoil free of rocks. Set all grade stakes, and place topsoil after rough grading has been approved by the Engineer. All finish grading shall be hand raked and shall be left ready for the sowing of grass seed. Limits of fine grading shall be within the project limits.

1.1.6 Water shall be diverted or pumped out of the excavations until completion of the work for which the excavations were made.

1.1.7 All excess material shall be spread on other parts of the property or disposed of by the Contractor when so directed.

1.1.8 All material excavated shall be considered as unclassified excavation which shall consist of all material of whatever character encountered in the work, including soil, solid rock, fragmented rock, water, or other.

1.1.9 All excess suitable excavation shall be placed and compacted in the waste fill area designated on the plans. The waste area shall be stripped of topsoil (min. depth-18 inches) prior to placing excavation. The excavation or fill material shall be compacted as designated by the Engineer. The area shall slope from north to south. Excavated topsoil should be stockpiled at a location designated by the Engineer.

2. ROCK EXCAVATION

2.1 Any solid or fragmented rock over six (6) inches in diameter encountered during excavation of the project site or borrow shall be removed and disposed of by the Contractor unless designated by the Engineer. No direct compensation will be included for rock excavation.

3. EXCAVATION

3.1 Crushed Stone and Paved Areas:

3.1.1 In all areas which are to receive crushed stone paving, curb and gutter, and concrete or asphalt paving the finished sub-grade shall be excavated to the bottom of the granular stone base to allow for construction of curb and gutter, aggregate base, and paving

3.1.2 In all areas which are to receive crushed stone paving, curb and gutter and concrete or asphalt paving, the sub-grade shall be scarified and compacted in accordance with Section 02210 - SUBGRADE COMPACTION and Section 02230 - SOIL COMPACTION CONTROL.

4. EMBANKMENT

4.1 Complete all cutting, filling, compacting of fills, and rough grading required to bring the entire project area to sub-grades for all surfaced and planted areas. Remove topsoil to its entire depth from the areas within line five (5) feet outside areas to be occupied by roads, walks, and other surfaces. Pile topsoil in approved locations where it will not interfere with building or utility operations. Areas to be stripped as designated by the plans shall first be scraped clean, cleared, and grubbed of all brush, weeds, grass, and roots. Topsoil shall be reasonably free from subsoil, debris and stones larger than two (2) inches in diameter. All finish grading in areas designated to be fine graded shall be done with satisfactory topsoil and in such manner as will permit the sowing of grass seed with no further work necessary. All rough grading of areas to be fine graded shall be done to a level of four (4) inches below elevations shown to allow placement of topsoil. The in-slopes shall not require topsoil but shall require seeding and mulching.

4.2 Rough grading of areas beyond limits of fine grading shall be done with machine and shall be as smooth and free of rocks as can be obtained under machine conditions. Grades shall be accurately cut to elevations shown on elevations and cross sections.

4.3 All ditches, swales and gutters shall be finished to drain readily.

4.4 Material for fill shall be free of roots, wood, or other organic material and shall be taken from the project site and borrow area. Remove all debris subject to termite attach, rot, or corrosion, and all other deleterious materials from areas to be filled. Prior to placing fill material, the surface of the ground shall be scarified to a depth of twelve (12) inches, and the moisture content of the loosened material shall be such that it will readily bond with the first layer of fill material. Place fill in layers not exceeding six (6) inches or eight (8) inches loose material.

4.5 Compact each layer of fill by rolling or tamping to ninety-five (95) percent of maximum density at optimum moisture content. The degree of compaction shall be determined and controlled in accordance with the current AASHTO “Standard Method of Test for the Compaction and Density of Soil.” Compaction shall be accomplished using power rollers, machine tampers, or other mechanical equipment approved by the Engineer. If necessary, soil shall be moistened or allowed to dry to the correct moisture content before compaction. Do not deposit any fill on a sub-grade that is muddy, frozen, or that contains frost.

5. TESTS

5.1 The Contractor shall provide, at his cost, a compaction test for each 1000 square feet of fill for each 6-inch lift and/or as required by Section 02230 - SOIL COMPACTION CONTROL. Where tests indicate that fill does not conform to the compaction density specified, the fill shall be removed and replaced with conforming material without additional cost to the Owner. The name of the testing company shall be submitted to the Engineer for approval and copies of each test report shall be furnished to the Engineer.

6. MEASUREMENT AND PAYMENT

6.1 Earthwork shall be measured and paid for as noted in Section 01151, paragraph 2.5 and shall include all materials, equipment, labor and supervision necessary to complete the earthwork as shown on the plans.

SUBGRADE COMPACTION 02210

1. GENERAL

1.1 Description: The work of this section shall consist of compacting the earth sub-grade on roadbed of a previously graded or excavated roadway. This work shall be performed prior to the placement of granular stone base on widened roadways or areas which require the removal of the existing roadway.

1.2 The contractor shall perform this work on the sub-grade at all locations beneath the aggregate stone base.

2. MATERIALS

2.1 None.

3. EXECUTION

3.1 The sub-grade for the full width of the roadbed shall be scarified to a depth of at least 6 inches, and the scarified material brought to a uniform moisture content either by drying or by adding water and manipulating with suitable equipment. At the Contractor's option, the upper 6 inches of soil may be removed and replaced with satisfactory material or removed and manipulated with suitable equipment before replacing. The material shall be compacted to produce a sub-grade having a density not less than the density required and within the moisture contents specified under Section 02230 using approved equipment producing satisfactory results.

3.2 If the required sub-grade density cannot be obtained by moisture control and compaction of the upper 6 inches, the unsuitable material shall be excavated and replaced with satisfactory fill material compacted in layers not to exceed 6 inches. Each 6-inch layer shall be processed, wetted, or dried as necessary, and compacted to the required density. No extra compensation will be made for removal of unsuitable material, and the work shall be considered incidental to the contract.

4. MEASUREMENT AND PAYMENT

4.1 Sub-grade compaction shall not be measured or paid for separately but shall be included and considered incidental to the placement of granular stone base.

TRENCHING, BACKFILLING, AND COMPACTING.....02221

1. GENERAL

1.1 Description: The work of this section consists of excavation for trenches relating to the construction of underground piping. There will be no distinction made in any definition or classification of excavation covered by this section between wet or dry materials below the surface of the earth. Trench excavation shall be considered as unclassified, which shall consist of all materials of whatever character encountered in the work, including soil, solid rock, fragmented rock, water, or other. Work under this section shall also include:

1.1.1 All sheeting, shoring, bracing, protection of adjacent property, preparation of all sub-grades, storage of excavated materials, backfilling, tamping, grading, and surfacing.

1.1.2 Diversion of surface water, and all pumping, draining, or other means of dewatering excavations.

1.1.3 All subsequent handling and disposal of excavated material, together with the preparation of all trench sub-grade.

1.2 Protection of Adjacent Property: The Contractor shall protect all excavations and trenches from settlement or displacement by approved means of bracing and shoring. All existing underground utilities and structures as well as all surface improvements and structures shall be protected and their functional purpose preserved.

2. CLASSIFICATION OF EXCAVATION

2.1 All excavation shall be considered unclassified.

3. TRENCHING

3.1 Lines and Grades: The Contractor shall furnish and set all stakes to establish and maintain the lines and grades as shown on the drawings including all grade boards, uprights, and accessory materials required. Line and grade shall be maintained either by grade boards with string or laser beam.

3.1.1 Grade boards shall be installed across the trench at intervals not to exceed 25 feet. The Contractor shall be held responsible for verification of lines and grades as established and shown on the drawings. The Owner may check the line and grade at any given point before backfilling has been started, and if there is a variation of more than two-hundredths (0.02) of a foot from the true grade, the same shall be raised or lowered as required.

3.1.2 In the event a laser beam is used to set line and grade for the pipe laying operation, grade stakes shall be set at each structure (i.e. catch basin, drop inlet, manhole, etc.) and at 25 feet, 50 feet, 100 feet, and then 100-foot increments thereafter, upgrade of the structure. The laser must be checked at the beginning of each day and at each grade stake to ensure the proper line and grade of the pipe.

3.2 Excavation: All excavation for trenches shall be made with sufficient working space to permit the placement, inspection, and completion of all work contemplated in the contract. Excavated material that is unsuitable for backfill, and all boulders exposed by grading shall be removed from the work area. Trenches shall be excavated in accordance with the drawings for trench width relative to trench depths.

3.2.1 Trenches shall be excavated to six inches below the bottom of the pipe when set to established flow lines. Should the trench be excavated more than six inches below the bottom of the pipe, the Contractor shall use only granular stone bedding material to establish flow line grade.

3.2.2 Trench excavation shall, in all cases, be made continuously from the ground surface to the established trench depth. Materials excavated shall be stockpiled at the sides of the trench and within established area limits to minimize inconvenience to the public, and damage to vegetation and structures in the area.

3.2.3 Trenching, shoring, bracing, and shields shall be placed by the Contractor whenever necessary for the proper preservation of any excavation, embankment, or structure. Where the ground is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final excavation as may be directed. The Contractor shall be held responsible for the sufficiency of all sheeting and bracing used, and for any and all people injured, or property damaged as the result of improper quality, strength, placement, maintenance, or removal of the same. No extra compensation will be made for sheeting and bracing, whether left in place or not. The Contractor shall, at his own expense, shore up, protect, and insure from injury all building, retaining walls, piers, and footing, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees, or other property liable to be injured during the process of the work, and he will be held responsible for all damage which may occur by reason of prosecution of the work. Sheeting, shoring, and bracing shall be provided, installed, and maintained to protect the excavation, ensure the safety of workmen, and as required by applicable federal, state, and local laws, rules, and regulations.

3.2.4 Trench width from six inches below the bottom of the pipe to six inches above the pipe bell shall be held to 1.4 times the outside diameter of the pipe plus twelve inches. Trench width above these levels may be wider to accommodate shoring, bracing, and shields, but shall be kept within practical limits. Contractor shall not receive additional payment for extra trench width.

3.3 Removal of Water: The Contractor shall furnish and operate sufficient pumps and appliances, and shall provide all material, labor, etc. required to prevent interference with any work by water, ice, or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper conduct of the work shall be made good by the Contractor at his own expense. No structure or pipe shall be placed in water and water shall not be allowed to run into or cover any concrete work or pipe, or into or through any pipe, unless by special permission given by the Owner in writing.

3.4 Record Drawings: Even though all excavation shall be considered unclassified for pay purposes, the Contractor shall clearly indicate on the Record Drawings (which he shall submit to the Owner) the elevations and extent of all solid rock encountered during construction of the project.

4. BACKFILLING AND COMPACTING

4.1 Material used for backfilling of trenches shall be free from perishable matter and from other material liable to become unstable when saturated with water after having been compacted. No frozen material shall be used in backfill. No large stones or organic matter shall be placed within two feet of the top of the sewer pipe. Care shall be taken to prevent damage to the pipe and structures. Special precautions shall be taken in backfilling over pipes. No backfill shall be placed over any portion of pipes and/or joints not inspected by the Owner. The granular stone bedding material shall be brought to a depth of at least six inches over the top of the pipe bell, with this material carefully deposited in uniform layers not exceeding six inches in depth, and each layer carefully and solidly tamped with mechanical tampers in such a manner as to avoid damage to pipe or disturbing completed work. Unless noted otherwise on the drawings, backfilling for the remainder of the trench shall be previously excavated gravel, sand, or earth, and shall contain no stone over three inches in its largest dimensions. Stones smaller than that size may be used in proportion not exceeding one part of stone and three parts of earth in any place. This backfilling shall be deposited and spread in layers and solidly tamped. As the trenches are backfilled, the Contractor shall remove all surplus material and re-grade the surface, leaving it in good order. The trenches shall be filled to the ground surface elevation which previously existed, unless shown otherwise on the drawings.

4.1.1 The Contractor may be required to settle certain backfill material with water, in addition to other backfilling procedures. The water will be furnished by the Contractor without cost to the Owner. Methods and procedures in using the water shall be approved by the Owner prior to carrying out the operation.

4.1.2 Whenever, in the opinion of the Owner, the excavated material is not suitable for backfilling the trench, or there is a deficiency of material, the Contractor shall, at his own expense, provide suitable material.

4.1.3 All excess excavation materials shall be cleaned up by the Contractor as directed. All backfilled trenches shall be maintained by the Contractor for a period of one year after Final Acceptance of the work by the Owner.

4.1.4 Roadway Crossings: At all open-cut roadway crossings, and as noted elsewhere, the trench shall be backfilled to grade with granular stone meeting the requirements of Section 02222 - GRANULAR STONE BEDDING AND BACKFILL. For roadway surface replacement, see Section 02575 - ROADWAY SURFACE AND SIDEWALK REPLACEMENT.

4.1.5 Private Drives, Field Entrances, etc.: At all open-cut crossings of private drives, field entrances, and the like, the trench backfill shall be deposited and spread in layers and solidly tamped to Range "B" compaction requirements set forth in Section 02250 - COMPACTION CONTROL AND TESTING. Private drives, etc. shall be backfilled "immediately" upon completion of the pipe laying across the drive. The driving surface shall be restored to its original condition immediately following proper compaction of the backfill.

5. MEASUREMENT AND PAYMENT

5.1 Trenching, Backfilling and Compacting shall be measured and paid for as noted in Section 01151, Paragraph 2.6. Such payment and price shall constitute full compensation for all the labor, materials, equipment, and for the performance of all work necessary to complete the sewer, including excavation, sheeting and shoring, dewatering, placement of stone bedding, installation of pipe, backfilling, and disposal of excess material.

GRANULAR STONE BEDDING AND BACKFILL 02222

1. GENERAL

1.1 Description: The work in this section shall consist of furnishing, hauling, placing, and compacting granular stone for bedding underground utility piping, and for granular stone backfill at street crossings and other locations shown on the drawings.

2. MATERIALS

2.1 Pipe Bedding: Embedment for pipe in ordinary trench conditions with or without high groundwater and with or without a hydraulic gradient shall be ASTM D2487 Class IB dense graded, clean, manufactured, and processed aggregates described as angular crushed stone, crushed rock, or crushed gravel and crushed stone/sand mixtures containing little or no fines with gradations selected to minimize migration of adjacent soils. Class IB aggregates must be compacted to 85% standard proctor density and tested to ensure proper compaction. Sieve requirements for Class IB aggregates for various nominal diameters are shown below.

2.2 Embedment for pipe in ordinary trench conditions without high groundwater and without a hydraulic gradient when ASTM D2487 Class IB aggregate is not used, shall be ASTM D2487 Class IA open graded, clean, manufactured aggregates described as angular crushed stone, crushed rock or crushed gravel with large void content containing little or no fines. Class IA aggregates must be compacted. Sieve requirements for Class IA aggregates for various nominal diameters are shown below.

Nominal pipe diameter (inch)	Bedding material ASTM D2487 Class	Amounts Finer Than Each Laboratory Sieve (Square Openings) Mass Percent					
		Sieve Size					
		1 ½ inch (37.5 mm)	¾ inch (19mm)	½ inch (12.5mm)	3/8 inch (9.75mm)	No. 4 (4.75mm)	No. 200 (0.075 mm)
4	IA				100%	≤10%	≤5%
4	IB				100%	≤50%	≤5%
6	IA			100%		≤10%	≤5%
6	IB			100%		≤50%	≤5%
8 to 15	IA		100%			≤10%	≤5%
8 to 15	IB		100%			≤50%	≤5%
≥16	IA	100%				≤10%	≤5%
≥16	IB	100%				≤50%	≤5%

2.3 High strength embedment (steel reinforced concrete low cradle, steel reinforced concrete high cradle, steel reinforced concrete encasement, or steel reinforced concrete arch constructed to ASTM C12 (standards for Class A embedment) shall be used for problem soil conditions, near Karst features including caves and sink holes, for road crossings, for stream crossings, for water main/sewer main crossings, and for sewer main/stormwater conduit crossings.

2.4 Pipe Backfill: When granular stone backfill is required, the aggregate shall be identical to the pipe bedding material specified in paragraph 2.1.

3. EXECUTION

3.1 Pipe Bedding: Granular stone shall be placed in the trench and shaped to provide uniform support for the bottom quadrant of the pipe barrel. The bedding shall be not less than six (6) inches in thickness. Following the placement of the pipe, the trench shall be filled with granular stone bedding material to a minimum compacted depth of six (6) inches above the pipe bell. Bedding installation in trench shall be to the widths and depths as shown on the drawings.

3.2 Pipe Backfill: When granular stone backfill is required, it shall be of the specified graduation and shall be placed in the trench in maximum 24-inch-thick layers and compacted to 80% of maximum density.

4. MEASUREMENT AND PAYMENT

4.1 Pipe Bedding and Backfill: Granular stone bedding and backfill shall not be measured or paid for separately but shall be included in the unit price of the storm sewer pipe.

GRANULAR STONE BASE 02223

1. GENERAL

1.1 The work shall consist of furnishing and placing one or more courses of aggregate on a prepared sub-grade in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans.

2. MATERIALS

2.1 Granular stone base shall consist of MoDOT Type 1 or MoDOT Type 5 aggregate.

2.1.1 Type 1 aggregate shall be essentially limestone or dolomite. The aggregate shall not contain more than 15 percent deleterious rock and shale. Sand may be added only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt, and clay, and any deleterious rock and shall be uniformly distributed throughout the mass. The fraction passing the No. 40 sieve shall have a maximum plasticity index of six. The aggregates shall conform to the following gradation requirements:

Percentage by Weight Passing Each Sieve:

1 Inch Sieve	100%
½ Inch Sieve	60-90%
No. 4	35-60%
No. 40	10-35%

2.1.2 Type 5 aggregate shall consist of crushed stone or sand or gravel. The aggregate shall not contain more than 15 percent deleterious rock and shale. If crushed stone is used, sand may be added only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt, and clay, and any deleterious rock shall be uniformly distributed throughout the mass. The fraction passing the No. 40 sieve shall have a maximum plasticity index of six. When sand and gravel aggregate are used, the fraction passing the No. 200 sieve shall be less than one half of that fraction passing the No. 30 sieve. The aggregates shall conform to the following gradation requirements:

Percentage by Weight Passing Each Sieve:

1 Inch Sieve	100%
½ Inch Sieve	60-90%
No. 4	35-60%
No. 30	10-35%
No. 200	0-15%

2.2 Material shall be delivered with sufficient moisture content to provide specified densities when compacted.

3. METHODS

3.1 Sub-grade: All work on that portion of the sub-grade on which the base is to be constructed shall be completed in accordance with the requirements of these specifications prior to the placing of any base material on that portion. Aggregate base shall not be placed on a frozen sub-grade.

3.2 Placing: The maximum compacted thickness of any one layer shall not exceed six (6) inches. When the specified compacted depth of the base course exceeds six (6) inches, the base shall be constructed in two or more layers of approximately equal thickness. The compacted depth of a single layer of the base course may be increased to eight (8) inches for shoulders and lightly traveled areas. After preliminary

compaction has been secured, finish compaction shall be carried to completion by means of self-propelled steel-wheeled rollers weighing not less than ten (10) tons. Shaping and compacting shall be carried on until a true, even, uniform base course of proper grade, cross section and density is obtained. Proper moisture content shall be maintained by wetting the surface or allowing it to dry as required during shaping and compacting operations. The use of excess water, resulting in run-off or in the formation of slurry on the surface, shall be avoided. The stone base shall be compacted to not less than ninety-five (95) percent of the maximum density at optimum moisture content.

3.3 Testing: The compacted base shall be tested for in place density by ASTM Method 2950, latest revision, at the rate of one (1) determination for each 1000 square yards of base surface, or as required by the Engineer.

3.4 Tolerance: The compacted base shall be brought to within a tolerance of ½" or less below design grade.

3.4.1 The compacted aggregate base thickness shall not be deficient more than ½ inch from the plan thickness. Thickness measurement shall be taken and determined for each 1500 square yards of base surface or as designated by the Engineer.

4. MEASUREMENT AND PAYMENT

4.1 Measurement: Granular stone base shall be measured and paid for as noted in Section 01151, paragraph 2.7 and shall constitute full compensation for all labor, material, equipment, manipulation, compaction, testing, and incidentals necessary to complete the granular stone base.

SOIL STABILIZATION 02240

1. GENERAL

1.1 Description: The work of this section consists of furnishing and installing a manufactured grid structure to provide soil stabilization for new roadways and shall include all materials, labor, equipment, supervision and incidentals.

1.2 Where required: The grid structure shall be installed beneath all new roadways. This requirement may be waived by the City Engineer providing the developer/contractor can demonstrate the supporting soils are satisfactory for the proposed pavement design.

2. MATERIALS

2.1 The grid structure shall be manufactured from a punched polypropylene sheet which is then oriented in three substantially equilateral directions so that the resulting ribs shall have a high degree of molecular orientation, which continues at least in part through the mass of the integral node.

2.2 The geogrid shall be manufactured to the following characteristics:

Index Properties	Longitudinal	Diagonal	Transverse	General
♦ Rib Pitch[2]	1.60”	1.60”	-	
♦ Mid-rib depth	-	0.06”	0.06”	
♦ Mid-rib width	-	0.04”	0.05”	
♦ Rib shape				Rectangular
♦ Aperture shape				Triangular
Structural Integrity				
♦ Junction efficiency[3], %				93
♦ Radial stiffness at low strain[4], lb/ft @ 0.5% strain				20,580
Durability				
♦ Resistance to chemical degradation[5]				100%
♦ Resistance to ultra-violet light and weathering				70%

3. EXECUTION

3.1 The structural geogrid shall be placed on a relatively smooth, graded surface free of all protruding objects (i.e. tree stumps, branches, large boulders, etc.).

3.2 The geogrid shall be installed per the manufacturer’s recommendations with a minimum overlap of adjacent grids of one to three feet.

3.3 After the geogrid is properly placed and secured, the granular stone base material shall be placed and compacted as specified in Section 02232, Granular Stone Base.

4. MANUFACTURER

4.1 The structural geogrid shall be TriAx TX160 as manufactured by Tensar International Corporation or approved equal.

5. MEASUREMENT AND PAYMENT

5.1 Soil stabilization shall be measured and paid for as noted in Section 01151, paragraph 2.8 and shall include all materials, equipment, labor, supervision and incidentals necessary to properly place the soil stabilization material.

6. NOTES

1) Values shown are minimum average of each roll as determined in accordance with ASTM D4759-02.
2) Nominal dimensions
3) Load transfer capability determined in accordance with ASTM D6637-10 and ASTM D7737-11.
4) Radial stiffness is determined from tensile stiffness measured in any in-plane axis from testing in accordance with ASTM D6637-10.
5) Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.
6) Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultra-violet light and aggressive weathering in accordance with ASTM D4355-05.
7) If soil tests are conducted, the material recommendations of the testing laboratory shall take precedence over the above specification.

COMPACTION CONTROL AND TESTING.....02250

1. GENERAL

1.1 Description: The work of this section consists of furnishing all equipment, labor, materials, and incidentals to compact the various fill areas. Also, the Contractor shall provide the necessary on-site testing facilities and equipment.

2. MATERIALS

2.1 None.

3. EXECUTION

3.1 Maximum Density: The maximum density of the fill material shall be determined according to ASTM D698, "Standard Proctor Method". If more than one type of fill material is used, the maximum density for each type will be determined. Determination of the maximum densities shall be the Contractor's responsibility. The Owner shall be provided with one copy of each maximum density test result, which shall include the maximum density and the optimum moisture content.

3.2 Compaction Operations: See Section 02221 - TRENCHING, BACKFILLING, AND COMPACTING.

3.3 Compaction Requirements: Compaction requirements for soils as controlled by methods of testing described herein are as follows:

3.3.1 Range A - In place compacted density of soil shall be equal to or greater than one hundred (100) percent of the maximum density at optimum moisture content.

3.3.2 Range B - In place compacted density shall be equal to or greater than ninety-five (95) percent of the maximum density at optimum moisture control.

3.3.3 Range C - In place compacted density shall be equal to or greater than eighty (80) percent of the maximum density at optimum moisture.

3.4 Density range for compaction shall be as stated on the drawings or as specified herein. Compaction requirements for granular stone or sand, as controlled by methods of testing described herein, shall be to a density of not less than ninety-five (95) percent of the referenced density.

3.4.1 Range B Compaction shall be used for all compacted fill.

3.5 Compaction Operations:

3.5.1 Trenches & Adjacent to Structures - Compaction shall be achieved using manually operated mechanical tampers or towed and self-propelled drum and vibrator tampers.

3.5.2 Roadways & Fills: Compaction shall be achieved using rollers, vibrators, compactors, or mechanical tampers.

3.5.3 Variances: The use of water jetting or similar techniques of compaction is prohibited as the sole means for compaction.

3.6 Moisture Content & Control:

3.6.1 Content: The moisture content requirements as determined under the methods of testing described herein are as follows:

a. Range A Compaction: The moisture content of the soil at the time of compaction shall be uniform and shall be not higher than five (5) percentage points above the optimum nor lower than the optimum of the soil involved.

b. Range B Compaction: The moisture content of the soil at the time of compaction shall be uniform and shall not be lower than three (3) percentage points below the optimum moisture content of the soil involved.

c. Range C Compaction: The moisture content of the soil at the time of compaction shall not be lower than five (5) percentage points below the optimum moisture content of the soil involved.

d. Compaction of Granular Stone or Sand: The moisture content shall be not less than ten (10) percentage points below the optimum content at the time of compaction.

3.6.2 Control:

a. Water Application: The moisture content of the soil at the time of compaction shall be within the moisture range designated. When the natural moisture content of the embankment soil does not fall within the required moisture range, water shall be added or the material shall be aerated, whichever is needed to adjust the soil to the proper moisture content. Water may be transported or distributed from calibrated tank trucks, or the water may be added to the soil in the borrow and cut areas before hauling, as long as the moisture content of the soil at the time of compaction is uniform and within the designated moisture range.

b. Testing: No water shall be added without the consent of the Resident Project Representative and without providing him or her with an adequate opportunity to measure the quantities used. The amount of water to be added shall be only that amount that will, as determined by the field moisture tests, provide a moisture content in the soil to be within the required range plus a reasonable amount to compensate for evaporation and other unavoidable losses. Satisfactory methods and sufficient equipment shall be used for the furnishing and handling of the water so there will be no undue loss due to evaporation. If water is added to cut areas or borrow pits, the surfaces of the areas or pits shall be maintained in such a manner that will prevent undue loss of moisture.

c. Visual Control: From other than the results of the moisture content test, the moisture content of the soil being compacted shall be considered as being too high to ensure compaction when after repeated rolling with the sheepsfoot roller, the roller continues to pick up excessive amounts of soil and refuses to “build up” so that the tamping feet eventually ride the compacted surface.

3.7 Compacting Equipment:

3.7.1 Sheepsfoot Rollers: Tamping or sheepsfoot rollers shall consist of metal rollers, drums, or shells, surmounted by metal studs with tamping feet projecting not less than six and one-half (6 ½) inches from the surface of the rollers, drum or shell. Tamping feet shall be spaced not less than six (6) inches, nor more than twelve (12) inches measured diagonally from center to center; and the cross-section area of each tamper foot, measured perpendicularly to the axis of the stud, shall not be less than four (4) nor more than twelve (12) square inches. The weight of tamping rollers shall be such that, when fully loaded, the load on each tamper foot shall not be less than two hundred (200) pounds per square inch of cross-sectional area. The load per tamper foot will be determined by dividing the total weight of the roller (loaded) by the number of tamper feet in one (1) row parallel to the axis of the roller.

3.7.2 Pull-Type Steel Rollers: Pull-type steel rollers shall not have less than forty-eight (48) inches effective width of roll and shall be designed and constructed so that the weight per lineal inch of roll can be varied from two hundred (200) to at least three hundred (300) pounds.

3.7.3 Trench Rollers, Self-Propelling: The trench roller shall be an approved type and shall not weigh less than three hundred (300) pounds per inch of width.

3.7.4 Manually Operated Compactors: Equipment shall be in good mechanical condition and shall be capable of transmitting forceful vibrations or impacts to the various materials placed in construction.

4. SOIL TESTING

4.1 Testing Methods: Density tests, as prescribed in these specifications, will be made on the soil to be used in the construction of the project to determine a reference density, optimum moisture content, and the moisture range applicable to the soil required to attain specified compaction. The field density and actual moisture content of the compacted material shall also be determined as prescribed previously herein.

4.1.1 Reference Density: The density as determined by the specified compaction test shall be the density to which the field density is referred for comparison or percentage for each type of soil used in the work.

4.1.2 Optimum: The optimum shall be the moisture content corresponding to the reference density on the specified compaction test curve.

4.1.3 Moisture Range: The moisture range shall be the limits of moisture content of the soil with the optimum as a reference.

4.1.4 Field Density: The field density shall be the density of the compacted material determined by the field density test. If an in-field density test shows results below the minimum requirements, the lift or area in question shall be retested after additional compaction efforts are performed. If the original in-field density test results are more than two percentage points below minimum requirements, additional tests are required, and the area in question shall be scarified and re-compacted, if so, designated by the Engineer. Additional testing and scarification shall be performed by the Contractor without any additional payment and shall be considered incidental to the completion of the project.

4.1.5 Moisture Content: The moisture content shall be the actual moisture content of the soil in the compacted embankment or fill at the time of compaction.

4.2 Scope of Tests:

4.2.1 Borrow Areas: All areas selected to supply backfill and area fill materials requiring a specified density shall have moisture-density relationships determined by ASTM Designation D-698, when the soil is initially excavated. In place density of compacted soil shall be tested in accordance with ASTM Designation D2167-63T or D2922, latest revision, to determine compliance with specifications. Specific testing locations will be determined by the Engineer.

4.2.2 Granular Stone & Sand: Granular stone and sand shall have moisture-density relationships determined by ASTM Designation D2049. In place density shall be determined by ASTM Designation D2167, ASTM D698, or D2922.

4.2.3 Compacted Soil Sub-Base Supporting Concrete, Steel, or Masonry Structures: Density shall be determined by a minimum of three samples and/or tests per structure, or two samples and/or tests per 1000 S.F. of area, for each two lifts of fill by ASTM Test Designation D2167-63T, or D2922.

4.2.4 Compacted Soil Sub-Base Supporting Rigid & Flexible Pavements & Crushed Stone Surfacing: Density shall be determined by a minimum of three samples and/or tests, or two samples and tests per 500 S.Y. of area, for each 6 inches of fill.

4.2.5 Compacted Granular Stone or Sand Supporting Concrete, Steel, Masonry Structures, Rigid and Flexible Pavements: Density shall be determined by a minimum of three samples and/or tests, or one sample and/or test per 100 S.Y. of area, whichever is greater.

5. MEASUREMENT AND PAYMENT

5.1 Measurement: Compaction of materials and testing thereof will not be measured or paid for separately but will be considered incidental with the compacted fill, backfill, grading, and hauling requirements. Additional testing, if required by the Engineer for further verification of the embankment or fill compaction, will be considered incidental to the completion of the project and no additional payment will be made.

FINISH GRADING 02260

I.GENERAL

1.1 Description: The work of this section consists of bringing to finish grade all areas on the site and furnishing all labor, materials, tools, and equipment necessary to complete this section.

2.EXECUTION

2.1 The Contractor shall grade the earth as indicated on the drawings.

2.2 In those areas noted on the drawings to receive seeding and mulching, the top six inches of all excavated areas shall consist of topsoil. Topsoil shall not be placed until the area has been shaped, trimmed, and smoothed, and, if the existing surface has become hardened or crusted, it shall be disked or raked so as to provide a bond with the layer of topsoil. The surface of the topsoil shall be free from lumps, clods, rocks, and shall conform to the lines and grades shown on the drawings.

2.3 Areas within the construction limits, regardless of whether or not they are to be seeded and mulched, shall be graded smooth and left with a neat and sightly appearance. The final grade around all structures shall be pitched to drain water away from the structures, and toward the roadside ditches, and natural drainage way. The finished grade shall be free of any and all projections which could interfere with mowing of the site.

ROCK DITCH LINER 02271

1. GENERAL

1.1 Description: The work of this section consists of furnishing and placing rock blankets at the locations shown on the plans.

2. MATERIALS

2.1 Material for rock blanket shall be Type 1 or Type 2 Rock Blanket conforming to MoDOT 609.60

2.1.1 Type 1 Rock Ditch Liner shall consist of material with a predominant rock size of 3 inches, a maximum rock size of 6 inches and a gradation such that no more than 15 percent will be less than one inch.

2.1.2 Type 2 Rock Ditch Liner shall consist of material with a predominant rock size of 6 inches, a maximum rock size of 10 inches and a gradation such that no more than 15 percent will be less than 3 inches.

2.1.3 Type 3 Rock Ditch Liner shall consist of material with a predominant rock size of 12 inches, a maximum rock size of 20 inches and a gradation such that no more than 15 percent will be less than 4 inches.

2.1.4 Bedding material consisting of crushed stone or gravel with a gradation consisting of 100 percent passing the 3-inch sieve, 30 to 70 percent passing the 1 1/2-inch sieve and 0 to 15 percent passing the No. 4 sieve. shall be used under Type 3 Rock Ditch Liner.

2.2 Acceptance of quality and size of material may be made by visual inspection at the job site.

3. EXECUTION

3.1 Rock ditch liner shall be placed to the approximate shape and thickness shown on the plans for the specified ditch or as directed by the engineer. The rock shall be dumped on a subgrade of reasonably uniform density and left in a rough condition meeting the approval from the engineer.

4. MEASUREMENT AND PAYMENT

4.1 Rock Ditch Liner: Shall be measured and paid for as noted in Section 01151, paragraph 2.9. Such payment shall include all materials, equipment, labor, supervision, and incidentals necessary to construct rock ditch liners.

SURFACE RESTORATION.....02480

1. GENERAL

1.1 Description: The work of this section consists of furnishing all labor, materials, tools, and incidentals necessary to restore the surface of all areas affected by construction, including finish grading and landscaping as required herein, replacement of fences, stone-lined ditches, walls and embankments, and restoration of miscellaneous structures (mailboxes, street signs, etc.). The minimum requirement for surface restoration shall be Type B.

1.1.1 Type A Surface Restoration: Regardless of the site's previous condition, restoration consists of furnishing and placing topsoil (which may need to be hauled in), liming, seeding, mulching, laying netting as required, and otherwise preparing and establishing a uniformly grassed area as specified herein. Areas requiring Type A surface restoration shall be so designated on the drawings.

1.1.2 Type B Surface Restoration: Consists of furnishing and placing all the necessary materials to restore areas affected by construction to a condition equal to that which existed prior to construction.

1.1.3 Pavement Repair and Replacement shall conform to Section 02575 - ROADWAY SURFACE REPLACEMENT.

2. MATERIALS

2.1 Topsoil Stripped and Stored: Topsoil stripped, stored, and placed shall be fertile, friable, with liberal content of humus, and capable of sustaining vigorous plant growth.

2.2 Topsoil to be furnished: If the stripped topsoil is not adequate to complete the work, sufficient topsoil shall be furnished and shall be a natural, fertile, friable soil, possessing characteristics representative of productive soils in the vicinity. It shall be obtained from naturally well-drained areas. It shall not be excessively acid or alkaline (except for those planes requiring acid soil) nor contain toxic admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stumps, roots, or similar substances, debris, or other objects which might be a hindrance to planting operations.

2.3 Lime: Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such a fineness that 50% will pass through a 100-mesh sieve and 90% will pass through a 20-mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately based on quantities passing the 100-mesh sieve.

2.4 Fertilizer: Commercial fertilizer shall be formula 12-12-12 and shall conform to the applicable state fertilizer laws. It shall be uniform in composition, dry, and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

2.5 Herbicide: Herbicide shall be a pre-emergence type for mixing with soil designed to eliminate noxious weeds without harming landscaped plants.

2.6 Lawn Materials: Grass seed shall be mixed and certified by the dealer and shall be a blend of K-31 fescue and Lespedeza, acceptable to the landowner. The seed shall be uniformly sown.

2.7 Water: The Contractor shall make, at his expense, whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs of this contract. He shall also furnish all necessary hose, equipment, attachments, and accessories for the adequate watering of plants as may be required to complete the work as specified.

2.8 Netting: Netting shall be a uniform, open, plain weave mesh of single jute yarn or 25-to-35-pound, natural, unbleached kraft paper. Minimum width of netting fabric shall be 42 inches. Jute netting shall have 76 warp ends per 48-inch width and 41 weft ends per yard, minimum. Kraft paper netting shall have 5.5 warp yarns by 3.5 filling yarns per inch. Staples for anchoring netting shall be No. 11 gauge steel wire, six (6) inches long.

2.9 Mulch: Vegetative mulch shall be the shredded cereal straw from stalks of oats, rye, wheat, or barley. The straw shall be free of prohibited weed seeds as stated in the State Seed Law; shall be relatively free of all other noxious and undesirable seeds; and shall be clean, bright, and dry enough to spread properly. A binder emulsion shall be applied to prevent straw from blowing.

3. EXECUTION

3.1 Areas within the construction limits, regardless of whether they are to be seeded and mulched, shall be graded smoothly and left with a neat and sightly appearance. The final grade around all structures shall be pitched to drain water away from the structures, and toward the roadside ditches, and natural drainageway. The finished grade shall be free of all projections which could interfere with mowing of the site.

3.2 All areas within the limits of fine grading are not required to be developed otherwise they shall be planted with grass.

3.3 Soils Test: The Contractor shall, at his own expense, contact the County Extension Agent and secure a soil test of the topsoil. If recommended by this test, the topsoil shall be limed in quantity recommended by the Extension Agent. (Generally, a soil pH of 6.0 to 6.5 is desirable.) Three copies of the soil test shall be sent to the Owner along with recommendations on lime use. Estimates of lime requirements are as follows:

POUNDS OF GROUND LIMESTONE PER 1,000 SQUARE FEET

pH	Light Sandy Soil-Pounds	Medium Sandy Soil-Pounds	Loam & Silty Loam-Pounds	Clay Loam Pounds
4.0	90	120	172	217
4.5	82	112	157	202
5.0	67	90	127	150
5.5	52	67	97	120
6.0	None	None	None	None

3.4 Time of Planting for Lawns: The Contractor shall coordinate the work so that lawn areas will be topsoiled and graded to meet the planting schedule as follows:

3.4.1 Preferred Time of Planting: February 1 to April 20.

3.4.2 Alternative time of Planting: September 1 to October 30. For this time of planting, the Contractor shall keep the lawn well watered through the summer, or until the project is accepted by the Owner.

3.5 The Owner is aware that in some cases, it would create a hardship to maintain the above schedule. If the Contractor wishes to make recommendations on other times when seeding could be done, the Owner will consider these recommendations. However, methods or time of planting shall be agreed to, in writing, before commencing this portion of the work or the above schedule shall be followed.

3.6 Preparation of Topsoil: The topsoil shall be graded and uniformly compacted according to Section 02260 - FINISH GRADING.

3.7 Sulphur: If the addition of sulphur is necessary, it shall be applied at a rate of two pounds per 1000 square feet.

3.8 Applying Fertilizer: Commercial fertilizer shall be applied at the rate of 20 pounds per 1,000 square feet to the lawn areas being prepared for planting. Fertilizer may be applied with seed, however, application after sprouting of the lawn seed is preferred.

3.9 Sowing of Seed: Immediately before any seed is to be sown, the ground shall be scarified as necessary and shall be raked until the surface is smooth, friable, and of uniformly fine texture. Lawn areas shall be seeded evenly at the rate of 100 pounds per acre, lightly raked, and watered with a fine spray. The method of seeding may be varied at the discretion of the Contractor on his own responsibility to establish a smooth, uniformly grassed lawn.

3.10 Mulching: Within 24 hours after seeding, mulch with binder emulsion shall be spread evenly over the entire area at the rate of 2 1/2 tons per acre.

3.11 Optional Establishment of Lawns: At the option of the Contractor, sod may be used for establishing all or part of grass lawn areas. Sod on slopes shall be held in place by wooden pins about one inch square and six inches long driven through the sod into the soil until they are flush with the top of the sod. Before any sod is laid, all soft spots and inequalities in ground shall be corrected. Fertilizer spread shall be raked in. Sod shall be laid so that no voids occur and shall be tamped or rolled. The complete sodded surface shall be true to finish grade, even, and firm at all points. Sod shall be placed so that the surface of the compacted sod will be slightly below the surrounding surface soil. All soils tests and pH adjustment specified previously shall be undertaken prior to sodding.

3.12 Clean-up: Any soil, manure, peat or similar material which has been brought onto paved areas by hauling operations, or otherwise, shall be removed promptly, keeping these areas clean at all times. Upon completion of the planting, all excess soil, stones, and debris which has not previously been cleaned up shall be removed from the site or disposed of. All lawns and planting areas shall be prepared for final inspection.

3.13 Maintenance: Maintenance shall begin immediately after planting and shall continue in accordance with the following requirements:

3.13.1 Repairs: Repairs to lawns or replacement of plants necessary during the maintenance period due to removal, vandalism, or acts of neglect on the part of others may be done on request by the Owner and will be done at the expense of the Owner.

3.13.2 Maintenance: Lawns shall be protected and maintained by the Contractor by water, mowing, and replanting as necessary for at least thirty (30) days and as much longer as is necessary to establish a uniform stand of the specified grasses, and until acceptance by the Owner.

3.14 Inspection: Inspections of the work to determine completion of contract work exclusive of possible replacement, will be made by the Owner at the conclusion of the maintenance period upon written notice requesting such inspection submitted by the Contractor at least 10 days prior to the anticipated date. The condition of lawns will be noted and determination made by the Owner as to whether maintenance shall continue in any part. After inspection, the Contractor will be notified in writing by the Owner of acceptance of seeding work exclusive of the possible replacement.

3.15 Guaranty and Replacement: Lawns and planting shall be guaranteed for a maximum of one year after the conclusion of the maintenance period, or for the duration of one full growing season, after planting, whichever is longer, and shall be alive, and in satisfactory growth at the end of the guaranty period, subject to normal care as recommended by this Contractor after acceptance of the work. At the end of

the guaranty period, inspection will be made by the Owner upon written notice requesting such inspection submitted under this contract that is dead or not in satisfactory growth, as determined by the Owner, shall be removed from the site. These shall be replaced as soon as conditions permit, but during the normal planting season.

4. MEASUREMENT AND PAYMENT

4.1 Surface restoration shall be measured and paid for as noted in Section 01151, paragraph 2.9 and shall include all materials, equipment, labor, supervision and incidentals to provide a surface as specified.

ASPHALTIC CONCRETE PAVING 02513

1. GENERAL

1.1 Description: The work of this section consists of furnishing all labor, materials, equipment, and tools for construction of asphaltic concrete paving for streets and drives. The asphaltic concrete shall be placed in one or more courses on a prepared stone base or underlying course in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans, or as designated by the Engineer.

2. MATERIALS

2.1 Aggregate Base: Shall conform to specification Section 02232 - GRANULAR STONE BASE.

2.2 Prime Coat: The prime coat shall be medium-curing, cut back (MC-30) asphalt and shall conform to AASHTO M-82.

2.3 Tack Coat: The tack coat shall be an emulsified asphalt (SS-1) and shall conform to ASTM 977.

2.4 Asphaltic Concrete Base: Asphaltic concrete base shall comply with MoDOT Type SP190 or Type SP250 as described in Division 400 of MoDOT standard specifications.

2.5 Asphaltic Concrete Surface: The asphaltic concrete surface course shall comply with MoDOT Type SP125 as described in Division 400 of MoDOT standard specifications.

2.6 Asphalt Cement: Shall be AC-10, AC-20, AC-30 asphalt cement, or approved by Engineer homogenous and free of water and shall not, in heating, foam below 232 degrees centigrade. Asphalt cement shall be prepared by refining crude petroleum by suitable methods and shall conform to the requirements of Section 1015 of the Missouri Standard Specifications for Highway Construction.

2.7 Samples: At least 15 days prior to preparing any of the mixtures on the project, the contractor shall obtain in the presence of the Engineer, representative samples of the asphalt cement and mineral aggregate for tests. The samples of materials shall be of the size specified by the Engineer and the contractor shall submit the samples to a qualified laboratory for testing. The contractor shall also submit for the Engineer's approval, a job-mix formula for each mixture to be supplied for the project. No mixture will be accepted for use until the job-mix formula for the project is approved by the Engineer.

2.8 Design Level: Prior to completion of mix design, the project engineer shall obtain traffic count information from the City Engineer and shall utilize a mix design base on the applicable equivalent single axle load (ESAL) level. For roadways with no traffic count available, design level E shall be utilized.

3. EXECUTION

3.1 Existing Roadway (if applicable): The existing roadway surfacing shall be removed to the depth cross sections shown on the plans.

3.2 Sub-grade Preparation (if applicable): Shall be as described in specifications Section 02200 - EARTHWORK.

3.3 Base Course:

3.3.1 Contractor shall furnish, place, and compact the thickness of base course as specified on the plans of crusher run limestone on a prepared sub-grade, as described in Section 02232 - GRANULAR STONE BASE.

3.3.2 In no case shall the Contractor be permitted to place the granular base or manipulate it on muddy or frozen sub-grade. Any mixture containing frost or frozen particles shall not be placed on the sub-grade or compacted.

3.3.3 The granular base shall be handles in such manner as to avoid undue segregation. If segregation occurs or if the mixture becomes contaminated, such segregation or contaminated material shall be removed and replaced with material of suitable quality and gradation. Segregated or contaminated materials ordered removed by the Engineer shall be replaced at the sole expense of the Contractor.

3.3.4 Preliminary compaction shall be performed by means of pneumatic-tired rollers. After preliminary compaction has been secured, finish compaction shall be carried to completion by means of self-propelled steel-wheeled rollers weighing not less than ten tons. Shaping and compacting shall be carried on until a true, even, uniform base course of proper grade, cross-section, and density is obtained. Proper moisture content shall be maintained by wetting the surface or allowing it to dry as required during shaping and compacting operations. The use of excess water resulting in run-off or in the formation of slurry on the surface shall be avoided. The stone base shall be compacted to not less than 95 percent of the maximum density of optimum moisture content as determined by Mod AASHTO T-99.

3.4 Prime Coat: The prime coat shall be placed only on a dry or slightly damp, clean base free from loose or foreign material when atmospheric temperature is above 50°F. The rate of application shall be from 0.2 to 0.5 gallons per square yard, depending upon the surface texture. Temperature of the prime coat at the time of application shall not be less than 100°F, or more than 180°F. Any prime coat overspray on adjacent concrete surfaces shall be removed to the Owner's satisfaction.

The prime coat shall be allowed to cure a minimum of 24 hours before application of the surface course.

3.5 Tack Coat: The tack coat shall be placed on an existing asphaltic surface which is free of all dust, loose material, grease, or other foreign materials when atmospheric temperature is above 40°F. The asphalt emulsion shall be applied uniformly with a pressure distributor at a rate of application from 0.02 to 0.10 gallons per square yard. Water may be added to the asphalt emulsion and mixed therewith in such proportion that the resulting mixture will not contain more than 50 percent of added water. The application of the resulting mixture shall be such that the original emulsion will be spread at the specified rate. Temperature of the tack coat at the time of application shall not be less than 75°F or more than 130°F.

3.5.1 The tack coat shall be allowed to properly cure, and the tacked surface shall be cleaned of all dirt and surplus sand before the next course is placed.

3.5.2 The tack coat shall be applied in such a manner as to cause the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the asphalt emulsion.

3.6 Surface and Bituminous Base Course: The asphalt concrete surface course shall be a hot plant-mix of specified thickness suitable placed and compacted and shall be placed in layers not exceeding three inches in compacted thickness. The asphaltic concrete shall be delivered to the work area in dump trucks properly lubricated to prevent sticking. The asphaltic concrete shall be covered during transit, and shall arrive at the job site at not less than 275°F. Placing of asphaltic concrete shall be as follows:

3.6.1 The asphaltic concrete shall not be placed, when either the air temperature or temperature of the surface on which the mixture is to be placed is below 50°F for the surface course or 40°F for the bituminous base course, or on any wet or frozen surface, or when weather conditions prevent the proper handling or finishing of the mixture, or when authorized by the Engineer.

3.6.2 The asphaltic concrete surface shall be compacted while the mixture is hot with power roller equipment as specified. Rolling shall continue until a uniform, even textured surface of the thickness specified is produced. Rolling shall begin at the outer edge and continue toward the center. Each pass shall overlap the preceding one by at least one-half of the rear roller width. Delays in rolling freshly spread mixture will not be tolerated. Traffic shall not be permitted on the finished pavement until it has cooled to atmospheric temperature. Final rolling shall be done with either a two or three-wheel tandem-type roller weighing not less than 10 tons.

3.6.3 Around areas not accessible to power rollers, compaction shall be secured by hand tamping, and all joints must be effectively sealed.

3.6.4 The finished surface shall be rolled until it is free from waves and irregularities. All surplus material shall be removed prior to final acceptance.

3.6.5 If the asphaltic concrete construction consists of more than a single layer, each layer shall be compacted as specified and allowed to cool to the ambient temperature before the next layer is placed.

3.6.6 The contractor shall provide a leveling course at areas and at a thickness necessary to obtain the elevation and cross sections as shown on the plans, prior to placing the surface course. The areas of existing asphaltic pavement which require an overlay of asphaltic concrete shall be as specified on the plans. The finished surface course as placed shall be performed in such a manner as to provide the smoothest possible riding surface.

3.7 Equipment: All equipment, tools, and machines used in the performance of the work shall be subject to the approval of the Engineer and shall be maintained in satisfactory working condition at all times.

3.7.1 The Asphalt Distributor: Shall be a machine manufactured for the specific purpose of applying heated asphaltic materials by pressure spray application. The Distributor shall be designed to permit the application of the heated asphalt material in a uniform spray without atomization and at the rate, temperature, and pressure specified by the Asphalt Institute. The Distributor shall be equipped for circulation and agitation of the bituminous material during the heating process.

3.7.2 The Power Roller: Shall be a self-propelled type weighing at least eight tons and shall be suitable for rolling bituminous pavements. A five-ton roller may be used around radii and driveways where rolling with an eight-ton roller is not feasible. The roller shall be equipped with adjustable wheel scrapers and a sprinkling system which will uniformly wet the wheels to prevent adherence of bituminous material to them. Rubber tired rollers may be used after initial rolling with an eight-ton roller.

3.7.3 Mechanical Spreaders and Finishers: Shall be adjustable and capable of spreading upon the prepared surface a tamped, screeded and finished wearing surface of asphalt concrete of the specified thickness.

3.7.4 Broom Drag and Power Brooms: Shall be of the type suitable for effectively cleaning the surface to be treated.

3.7.5 Automatic Screed Control: The use of automatic screed control devices will be required except for paving small irregular areas, shoulders, entrances, and side road connections. The screed of the mechanical spreading and finishing machine shall be regulated by an automatically controlled grade leveling and slope control device approved by the Engineer. The device shall be of a standard commercial quality adapted to the type of paver used and shall provide control for producing a uniform surface to the established grade, and a cross slope conforming to the requirements of the typical section.

The initial pass of the paver, when placing the first continuous layer, shall be made with the sensor following a traveling reference plane not less than 30 feet in length that is an integral part of the paver. An established grade reference is required by the contract; the contractor will establish the grade and will furnish variable thickness values at intervals along the center line of the roadbed for the use in setting a grade reference. Regardless of the method used for placing the first continuous layer, all other layers shall be placed by using a shoe-type sensor or indicator, the traveling reference plane, or by additional use of the established grade reference.

3.8 Compaction and Testing:

3.8.1 After final rolling, the finished course shall at no point have a density less than ninety-five (95%) percent of the laboratory compacted density. Field determination of the density shall be the responsibility of the Contractor and considered incidental to the paving operations. Contractor shall provide access to the Engineer and his representatives for all testing of asphaltic concrete paving.

3.8.2 Testing Pavement: The finished courses shall have the minimum thickness shown on the plans. Tests will be made to ensure that each course is being constructed of proper thickness, composition, and density. The Contractor shall cut samples from any layer of the compacted mixture at locations designated by the Engineer and shall deliver them to the testing laboratory in good conditions. Samples may be obtained by either sawing with a power saw or by drilling 4-inch diameter cores. Each sawed sample shall consist of a single piece of the pavement of the size designated by the Engineer, but not larger than 12 inches square.

3.8.3 Density Samples: Each sample for laboratory density determination shall consist of four cores. All samples, whether sawed or cored, shall consist of an undisturbed portion of the compacted mixture removed for the full depth of the layer or course to be tested.

3.8.4 Thickness Samples: Each sample taken for course thickness shall consist of one 4-inch diameter core taken for the full depth of the course. Each sample taken for total compacted thickness shall consist of one 4-inch diameter core taken for the full depth of bituminous construction. Total thickness samples shall be obtained after all bituminous construction is completed on the project and shall be taken at locations designated by the Engineer.

3.8.5 Surface Restoration: The surface from which samples have been taken shall be restored by the Contractor with the mixture then being produced not later than the next day of plant operation, if construction is still in progress. If bituminous construction has been completed, the surface from which samples have been taken shall be restored within 48 hours with hot mix asphalt acceptable to the Engineer.

3.8.6 Grade and Surface Smoothness Requirements: The finished surface of the bituminous courses shall conform to the grade lines and elevations shown on the plans. The grade and crown slopes shall not deviate more than 0.05 feet from the plan grades. The surface shall not vary more than ¼ inch when a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from the crown to pavement edge.

3.8.7 Quality of Samples & Tests: The Contractor shall provide as an obligation incidental to the performance of the contract, with the following minimum quantity of samples and tests.

a. From the paving spreader, not less than one (1) composite sample for each 1000 square yards or less of surfacing to be constructed. This sample shall be tested for asphaltic cement content, aggregation gradation and content, and attainable density.

b. From the compacted surfacing, not less than one (1) core sample for each 2500 square yards of asphalt surfacing applicable for thickness determination and laboratory tests. On the compacted

surface, not less than one (1) in place density test for each 300 square yards of asphalt surfacing applied.

3.8.8 Test Designation:

a. Asphaltic Cement Content: Compacted and uncompacted samples shall be tested by procedures established by ASTM D2172, latest revision, to determine asphalt cement content.

b. Aggregate Gradation: Coarse and fine aggregate from asphaltic concrete samples shall be tested for gradation by ASTM Test Method C136, latest revision. Mineral filler content shall be determined by ASTM Test Method C117, latest revision.

c. Density: In place density shall be determined by ASTM Test Method D2950. Reference density shall be determined by ASTM D1188, or ASTM D2726 procedures and ASTM procedures D2041.

4. REMEDY AND CORRECTION OF DEFICIENCY

4.1 The Contractor shall provide, at no cost to the Owner, remedy and correction of deficiencies in the asphaltic surfacing, in the following specified form and procedures:

4.1.1 Deficiency in Asphalt Cement: Should tests on uncompacted samples or core samples indicate the asphalt content is below the specified amount, the Contractor shall provide additional asphaltic concrete overlays to the entire surfacing area for which the tests indicated an asphalt cement deficiency. One (1) inch of compacted asphaltic concrete overlay shall be added for each one-tenth percent asphalt cement content falls below specified minimum. The percent deficiency shall be determined from the average of the percentage asphalt cement content from five samples.

4.1.2 Deficiency in In-Place Density: Should tests on core samples or in-place density tests indicate density of the asphaltic concrete to be below the specified minimum density, the basis of payment for deficiency in in-place densities for any one day's run of asphaltic concrete shall be determined as follows:

Average Density (%) as determined from 4 in-place density tests or total tests performed during each day's run of asphalt	Percent of Payment
95-100	100.0
94.9	100.0
94.8	99.9
94.7	99.8
94.6	99.6
94.5	99.4
94.4	99.1
94.3	98.7
94.2	98.3
94.1	97.8
94.0	97.3
93.9	96.3
93.8	94.1
93.7	92.2
93.6	90.3
93.5	87.9
93.4	85.7
93.3	83.3

93.2	80.6
93.1	78.0
93.0	75.0
below 93.0	Reject

4.1.3 Deficiency in Surface Limit: Surface finish shall be provided such that surface water drains to ditches and guttering. Depressions in the surface, which are exhibited by ponding of water, shall be remedied by the addition of an overlay of asphaltic concrete to eliminate the depression.

4.1.4 Deficiency in course and total thickness: Should tests on core samples indicate the thickness is less than the design thickness, the Contractor shall provide additional asphaltic concrete overlay to the entire surfacing area for which the tests indicated a thickness deficiency. One inch minimum of compacted asphaltic concrete overlay shall be added to those deficient areas. The areas which are found to be deficient shall first be cold milled ½ inch minimum over the entire deficient area, then overlaid with a thickness sufficient to bring the area up to the design thickness and grade. The deficient area shall be determined in accordance with 3.6.7.2 and/or from core samples taken at a minimum distance of 200 feet between cores, or as approved by the Engineer.

5. MEASUREMENT AND PAYMENT

5.1 Asphaltic concrete paving shall be measured and paid for at the various component units as noted in Section 01151, paragraph 2.10 and shall include all materials, equipment, labor, supervision and incidentals necessary to provide a complete asphaltic concrete surface.

CRACK SEALING 02530

1. GENERAL

1.1 Description: The work of this section consists of providing and installing a resilient and adhesive crack sealant capable of effectively sealing cracks in pavements.

2. MATERIALS

2.1 Crack Sealant: Joint sealant materials shall meet the requirements of ASTM-D3405 and AASHTO-M301. Sealant shall be suitable for sealing joints and crack in Portland cement concrete pavements and flexible asphaltic concrete pavements. Sealant shall be flexible to a temperature of –20 F. Each lot of sealing compound shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch, or lot number, and the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the compound meets the requirements of this specification.

3. EXECUTION

3.1 Preparation of Cracks: Immediately before sealing, the cracks shall be thoroughly cleaned of all laitance or other foreign material. Cleaning shall be accomplished by blowing cracks with compressed air. The crack faces shall be surface dry when the seal is applied. Only air compressors with operable moisture removal devices shall be used to prepare the cracks for sealing.

3.2 Sealants shall be installed in accordance with the following requirements:

3.2.1 Hot Poured Sealants: The crack sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall be heated to the safe heating temperature as obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the crack shall be provided. Any sealant spilled on the surface of the pavement shall be removed immediately.

4. MEASUREMENT AND PAYMENT

4.1 Crack Sealing shall be measured and paid for as noted in Section 01151, paragraph 2.11 and shall include furnishing all materials, preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

ROADWAY SURFACE AND SIDEWALK REPLACEMENT 02575

1. GENERAL

1.1 Description: The work of this section shall consist of furnishing all labor, materials, tools, equipment, and incidentals necessary to replace all roadway surfaces and sidewalks removed during utility construction. This section shall include, but not be limited to, vehicular and pedestrian pavements, and surfaces of stone, gravel, asphalt, and Portland cement concrete, in addition to parking areas.

2. MATERIALS

2.1 Portland Cement Concrete: Shall conform to Section 03300 - CAST-IN-PLACE CONCRETE.

2.2 Hot-Mix Asphaltic Concrete: Shall conform to Section 02513 – ASPHALTIC CONCRETE PAVING.

2.3 Crushed Stone: Shall conform to Type 1 aggregate as specified in Section 02223 – CRUSHED STONE BASE.

3. EXECUTION

3.1 General: Existing paving shall be cut vertically and horizontally to straight lines. The trench shall be backfilled with full-depth granular stone bedding beneath all roadways or controlled backfill material beneath sidewalks compacted to Range B compaction requirements (see Section 02250 - COMPACTION CONTROL AND TESTING) to within eight inches of the final roadway surface. The top eight inches shall be backfilled with crushed stone base compacted level with the existing riding surface of the roadway. This level shall be maintained by the Contractor until all secondary settling has occurred. Any crushed stone required to maintain the trenches in a suitable condition for traffic during this period shall be furnished at the Contractor's expense. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, roadway surfacing shall be applied according to this specification. At the time of final repairs, the Contractor shall remove sufficient material to allow placement of roadway surfacing to the thicknesses specified as follows.

3.2 Roadway Surface Replacement:

3.2.1 Portland Cement Concrete: Edges of existing pavement at the trench shall be trimmed vertically to produce a neat even edge. A minimum 7-inch-thick concrete slab shall be placed to match the elevation of the existing pavement, as shown on the drawings.

3.2.2 Hot-Mix Asphaltic Concrete: Edges of existing pavement at the trench shall be trimmed vertically to produce a neat, even edge. A minimum of 3 inches of hot-mix asphaltic concrete shall be placed to match the elevation of the existing pavement. Asphalt to be placed per Specification 02513.

3.2.3 Crushed Stone: Trenches along or across unpaved roadways, including country roads, and city streets, as well as on dirt, or gravel shoulders of paved streets, roads, or highways, shall be backfilled in compliance with these specifications. The trench shall be backfilled to a level with the existing riding surface of the roadway. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, the backfill shall be removed as necessary for crushed stone surfacing. The crushed stone shall be rolled and thoroughly compacted in layers to a minimum finished thickness of six inches.

3.2.4 Sidewalk Replacement: The existing concrete sidewalk and base material shall be removed for a distance equal to trench width plus two feet as shown on the drawings. The trench shall be backfilled to a height that will allow the placement of four inches of crushed stone and a 4-inch-thick concrete walk above. The elevation of the top of the new sidewalk section shall match that of the existing walk.

4. MEASUREMENT AND PAYMENT

4.1 Roadway and Sidewalk Replacement shall be measured and paid for as noted in Section 01151, paragraph 2.12 and shall include all materials, equipment, labor, supervision and incidentals necessary to replace the affected surface.

PAVEMENT MARKING 02577

1. GENERAL

1.1 The work of this section consists of furnishing all materials, equipment, tools, labor and supervision necessary for completing pavement marking as shown on the drawings and specified herein.

1.2 All work shall be completed in accordance with the applicable sections of the Manual on Uniform Traffic Control Devices and the Missouri Standard Specifications for Highway Construction.

2. MATERIALS

2.1 Pavement marking shall be an Acrylic Waterborne marking paint capable of receiving and holding glass beads for producing reflective pavement marking. The finished paint shall be formulated and manufactured from quality materials and shall be a fast-drying, water-based, acrylic resin-type paint capable of withstanding air and roadway temperatures without bleeding, staining, discoloring, or deforming. The dried paint film shall be capable of maintaining original dimensions and placement without chipping, spalling or cracking. The dry paint shall not deteriorate from contact with normal roadway chemicals or materials.

2.2 The paint shall contain no more than 3200 ppm lead or more than 800 ppm chromium, based on dry weights. The volatile content of the finished paint shall contain less than 150 grams of volatile organic matter per liter in accordance with ASTM D 3960.

2.3 Pavement marking paints shall have the following physical properties:

Viscosity, 77F (25 C), KU	83 – 98
Grind (Hegman Gage), minimum	3
Laboratory Dry Time, ASTM D 711, minutes, max.	10
Dry Through Time, minutes, max.	150

2.4 Color: Paint shall be either white or yellow as shown on the plans. White shall match Color Chip 37925 and yellow shall match Color Chip 33538 of Federal Standard 595b.

2.5 The paint shall conform to Federal Specification TT-P-1952B. The paint shall show no cracking or flaking, coagulation or change in consistency greater than 10 Kreb units when tested per FS TT-P-1952B for flexibility, water resistance, freeze-thaw stability and heat stability.

2.6 Reflectance: The daylight directional reflectance of a 15-mil with film, applied to a 2A or 5C Leneta Chart and dried for a minimum of 24 hours shall be no less than 84 percent for white paint and no less than 50 percent for yellow paint.

3. EXECUTION

3.1 Equipment: Application equipment for pavement marking paint shall be specifically designed for such use, shall be properly maintained and shall be in such condition as to evenly apply marking paint.

3.2 The surface on which paint is to be applied shall be clean and dry. Paint shall not be applied in damp conditions or if there is any evidence of surface moisture on the pavement.

3.3 Weather limitations: The pavement surface temperature and air temperature shall be determined before the start of each day of marking operation and at any other time deemed necessary by the engineer. The pavement surface temperature and ambient air temperature shall be above 50° F before beginning paint application. Paint shall not be applied if the forecast conditions for the eight hours immediately following final application include precipitation or temperatures below 50° F.

3.4 Application: Paint shall be applied using spray guns designed and adjusted to apply paint at the required thickness and width. If there is any evidence of gun clogging, splattering, or uneven paint distribution, painting operations shall cease until the equipment is restored to proper operation.

3.4.1 Painting of stop lines, arrows, words and symbols may be applied by hand using paint spray equipment. Equipment shall be capable of applying paint evenly to the required thickness.

3.5 Paint shall be applied to a minimum wet thickness of 15 mils.

3.6 Finished markings shall have well-defined edges and lateral deviation shall not exceed one inch in one hundred feet.

3.7 Intermittent markings shall be placed with the length of the painted mark being equal to one-third of the length of the gap (i.e., painted mark = 10', gap length = 30'). The following table denotes mark length and gap length for common speed limits within the city.

Speed (MPH)	Mark Length (Ft.)	Gap Length (Ft.)
25	8	24
30	10	30
35	12	36

4. MEASUREMENT AND PAYMENT

4.1 Pavement marking shall be measured and paid for as noted in Section 01151, paragraph 2.13 and shall include preliminary layout, materials, equipment, labor, supervision and incidentals necessary to provide complete pavement marking as shown on the plans. Any markings deemed unacceptable by the Owner will be removed and replaced by the contractor at no additional charge.

PRECAST MANHOLES AND CURB INLETS 02601

1. GENERAL

1.1 Description: The work of this section shall consist of furnishing, hauling, and placing all precast concrete manholes and catch basins as shown on the drawings and as required for sewer line construction.

1.2 Precast concrete manholes shall be of the type, size, and configuration shown on the drawings, and all manholes shall be provided by one sole manufacturer.

1.3 Precast catch basins shall be of the type, size, and configuration shown on the drawings, and all basins shall be provided by one sole manufacturer.

2. MATERIALS

2.1 Portland Cement: Shall conform to ASTM C150, latest revision, Type I, II, or V.

2.2 Concrete Reinforcement: Shall be as specified in Section 03200 - CONCRETE REINFORCEMENT.

2.3 Aggregate: Shall conform to ASTM C33, latest revision, for coarse and fine aggregate.

2.4 Mortar: Shall conform to ASTM C270, latest revision, Type M.

2.5 Water: Mixing water shall be clean and potable.

2.6 Dampproofing: Shall conform to Koppers Specifications for Coal Tar Bitumastic Super Service Black or an approved alternate.

2.7 Joint Sealant: Shall meet AASHTO Specification M-198 and shall be suitable for application in vertical and horizontal joints. Sealant shall be as manufactured by Hamilton-Kent, Ram-Nek, or approved equal.

2.8 Joint Wrap: Shall be a stretchable, self-shrinking, intra-curing halogenated based rubber meeting the requirements of ASTM C923 and shall have a minimum thickness of 30 mils.

2.8.1 Adhesive: The joint wrap shall be secured with a cross-linked reinforced butyl adhesive. The adhesive shall be a not-hardening sealant with a minimum thickness of 30 mils.

2.9 Grout: Shall be a pre-mixed, packaged, non-ferrous, aggregate non-shrink grout.

2.10 Castings: All castings shall be made of clean, even grain, tough gray cast iron. The casting shall be smooth, true to pattern, and free from projections, sand holes, warp and other defects which would interfere with the use of or impair the serviceability of the casting. All castings shall be well cleaned before enamel coating is applied. The iron used for these castings shall conform to ASTM A48, latest revision, for Class 30 gray iron. The “B” test bar (1.2” diameter by 21” long) shall be used to prove the quality of iron used. Frame and cover shall have machined horizontal bearing surfaces.

2.10.1 Manhole castings shall be Neenah R-1769-A, Deeter 1048 or approved equal. Minimum clear opening of the access shall be 24 inches.

2.10.2 Curb Inlet Castings: Shall conform to the dimensions, tolerances and specifications of Deeter Foundry No. 1157 manhole ring and cover or approved equal.

2.10.3 Manhole Steps: Shall be cast iron, copolymer polypropylene, or polyethylene.

2.10.4 Cast iron steps shall conform to the dimensions, weights, and tolerances of Neenah R-1980-C, Deeter 1600, or approved equal.

2.10.5 Copolymer polypropylene plastic steps shall be M.A. Industries, Inc., Model PSI-PF with ½ inch grade-60 steel reinforcement or approved equal.

2.10.6 Polyethylene steps shall be MSU Mississauga Ltd., Model 360 with ¾ inch O.D. 6351 - T6 aluminum tubing or approved equal.

2.11 Chimney Seal: Shall be a continuous seamless band of EPDM rubber having a minimum thickness of 65 mils. A preformed "L" shaped corner shall be molded into the top of the seal. A 2" to 3" by 1/8" thick strip of non-hardening butyl mastic shall be attached to the underside of the top section.

3. EXECUTION

3.1 Manhole Fabrication and Manufacturing: Precast reinforced concrete manholes shall be manufactured to requirements of ASTM C478, latest revision and shall be of the type, size, and configuration shown on the drawings. Manhole tops shall be of the eccentric type. The minimum allowable wall thickness shall be determined by the manhole depth as below:

Depth	Wall Thickness
0 to 16 feet	1/12 of internal diameter
16 feet or greater	1/12 of internal diameter + 1"

Minimum internal diameter of any manhole section shall be 4 feet. Damp proofing shall be applied on all interior and exterior surfaces except to the interior surface of the bottom section. Dampproofing shall be field applied to the interior surface of the bottom section after base and fillet have been placed. Damp proofing systems shall be a polyamide epoxy-coal tar coating such as Tnemec Series 46H-413 Tneme-Tar or an approved equal. Two coats, each with a minimum of 8 mils, dry thickness shall be applied. A 75-volt maximum wet sponge detector shall be employed to check for holidays in the dried finished film.

3.2 Construction:

3.2.1 Manhole Base: The manhole base shall be of either cast-in-place reinforced concrete or a precast concrete unit with the precast unit being the preferred method on all new installations.

a. Precast manhole bases shall consist of either a precast unit with integral invert or a precast base with field constructed invert. Either type of precast unit shall be set on a minimum of 6" of compacted crushed stone. The unit shall be set plumb and to the elevation as shown on the plans.

b. Cast-in-place concrete bases shall be constructed of 3,500 min. psi concrete, 4-inch max. slump concrete with #4 steel reinforcing bars at 12-inch on center each way. The bottom section of the precast unit shall be set into the base a minimum of 12 inches. The base shall extend not less than 6 inches beyond the outside manhole wall.

3.2.2 Precast riser sections shall be set plumb and oriented with manhole steps and access opening to match the detailed drawings designations. Each section of the precast concrete manhole shall be set in a pre-molded mastic material or a rubber gasket. Joint wrap shall also be applied to the exterior of manhole at each joint to produce an absolutely watertight joint under full hydrostatic head conditions. The joint wrap shall be installed per the manufacturer's requirements and recommendations.

3.2.3 Openings for storm sewer pipe in manhole sections shall be formed at the factory, either cast-in-place gasket or cut out opening. The minimum opening for cutouts shall be equal to outside

diameter of pipe plus four inches and maximum opening shall be equal to outside diameter of pipe plus six inches.

3.2.4 Flexible watertight cast-in-place gaskets shall be used and shall be A-LOK or approved equal.

3.2.5 Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent pipeline sections with change in flow direction made by a smooth curve of as large a radius as the manhole size will permit, and changes in the size and grade of the channels being made gradually and evenly. Manhole floor shall rise a minimum of 1 inch per foot from side of channel to wall.

3.2.6 All castings, frames, and covers shall be set true to line and to correct elevation upon a mastic gasket. Manhole frames shall be attached to manholes with anchor bolts. Frames and covers shall have true common bearing surfaces, such that the covers will seat firmly without rocking or shifting. A chimney seal shall be installed per the manufacturer's requirements and recommendations to provide a watertight seal between the manhole frame, adjustment rings and the cone section of the manhole.

3.2.7 Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections and shall extend six inches beyond the inside surface of the wall. The new manhole shall be cleaned of silt, debris, or other foreign matter prior to acceptance.

3.2.8 All lifting holes shall be thoroughly wet and filled with non-shrinking grout to form a watertight seal.

3.3 New Manhole Over an Existing Line: Manholes to be located over an existing storm sewer line shall be built so that all the manhole inverts will be smooth and continuous after the sewer tile is broken open.

3.4 Connections to Existing Manholes: Existing manholes used for connecting new storm sewer lines to the existing storm sewer system shall have the new sewer line connected by core boring a hole in the side of the existing manhole at the new flowline elevation. The bore hole shall be of sufficient diameter to allow for the insertion of an A-lok gasket or equal such to provide a flexible watertight connection. The new sewer pipe shall then be inserted into the gasket and invert grouted.

3.5 Curb Inlet Fabrication and Manufacturing: Precast reinforced concrete curb inlets shall be of the type, size, and configuration shown on the drawings. The minimum allowable wall thickness shall be 6 inches.

3.6 Construction:

3.6.1 Curb Inlet Base: The inlet base shall be of either cast-in-place reinforced concrete or a precast concrete unit with the precast unit being the preferred method on all new installations.

a. Precast inlet bases shall consist of either a precast unit with integral invert or a precast base with field constructed invert. Either type of precast unit shall be set on a minimum of 6" of compacted crushed stone. The unit shall be set plumb and to the elevation as shown on the plans.

b. Cast-in-place concrete base shall be constructed of 3,500 min. psi concrete, 4-inch max. slump concrete with #4 steel reinforcing bars at 12-inch on center each way. The bottom section of the precast unit shall be set into the base a minimum of 6 inches. The base shall extend not less than 6 inches beyond the outside manhole wall.

3.6.2 Precast riser sections shall be set plumb, and each section of the precast box shall be set in a pre-molded mastic material or a rubber gasket.

3.6.3 Openings for storm sewer pipe in manhole sections shall be formed at the factory, either cast-in-place gasket or cut out opening. The minimum opening for cutouts shall be equal to outside diameter of pipe plus four inches and maximum opening shall be equal to outside diameter of pipe plus six inches.

3.6.4 Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent pipeline sections with change in flow direction made by a smooth curve of as large a radius as the inlet box size will permit, and changes in the size and grade of the channels being made gradually and evenly. Inlet floor shall rise a minimum of 1 inch per foot from side of channel to wall.

3.6.5 Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections and shall extend 2 inches beyond the inside surface of the wall. The new inlet shall be cleaned of silt, debris, or other foreign matters prior to acceptance.

3.6.6 All lifting holes shall be thoroughly wet and completely filled with non-shrink grout to form a watertight seal.

4. MEASUREMENT AND PAYMENT

4.1 Precast manholes shall be measured and paid for as noted in Section 01151, paragraph 2.15. Such payment shall be for all materials, equipment, labor, supervision, testing and incidentals necessary to complete the installation of precast manholes.

4.2 Precast curb inlets shall be measured and paid for as noted in Section 01151, paragraph 2.15. Such payment shall be for all materials, equipment, labor, supervision, testing and incidentals necessary to complete the installation of precast manholes.

REINFORCED CONCRETE PIPE.....02612

1. GENERAL

1.1 Description: This section specifies the furnishing and installation of Reinforced Concrete Pipe for storm sewers as shown on the drawings and specified herein.

2. MATERIALS

2.1 Pipe: Reinforced concrete pipe shall be designed and manufactured to meet ASTM C76, latest revision for Class III pipe with Wall B thickness. Pipe sections shall be full length except for short sections for closure lengths. At manholes or curb inlets where pipe sections connect thereto, sections shall be four (4) feet maximum length to place a joint within four (4) feet of the inside face of the manhole. Certification of pipe shall include assurance that absorption does not exceed six (6) percent when tested per ASTM C497, latest revisions.

2.2 Joints: Pipe shall be provided with joints designed to conform to Section 5.7.1 and 5.7.1.1 of ASTM C361, latest revision, and shall be designed to withstand, without cracking, the gasket compression plus a differential load across the joint equal to 4000 pounds per foot of internal diameter.

2.3 Flexible Gaskets: Shall be circular cross section, confined O-Ring gaskets, conforming to ASTM C443, latest revision, or approved mastic joint filler material. Gasket shall serve as sole means of sealing the joint.

3. SUBMITTALS

3.1 The Contractor shall provide to the Engineer digital Letter of Certification from the manufacturer of Reinforced Concrete Pipe certifying the materials provided were manufactured in accordance with prevailing specifications and that all materials and manufacturing provided will meet or exceed standards of quality set forth in those specifications.

4. EXECUTION

4.1 Reinforced Concrete Pipe shall be installed, measured and paid for as specified in Section 02721 – Storm Sewer Systems.

DUCTILE IRON PIPE AND FITTINGS 02615

1. GENERAL

1.1 Description: The work in this section consists of furnishing, hauling, placing, and backfilling as necessary the ductile iron pipe, fittings, and fitting restraints in the designated locations and to the lines and grades as shown on the drawings.

2. MATERIALS

2.1 Ductile Iron Pipe: Unless otherwise specified or shown on the drawings, ductile iron pipe shall be Wall Thickness Class 52 and shall conform to the latest revision of ANSI A21.51 – (AWWA C151) Standard for Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids. The pipe shall be standard asphaltic varnish coated on the outside. Pipe shall be cement mortar lined in conformance with ANSI A21.4-80 – (AWWA C104) unless specified otherwise.

2.2 Fittings: The fittings to be used with ductile iron pipe may be with gray iron or ductile iron and shall conform to the requirements of ANSI/AWWA C110-77. All fittings shall be coated and lined in the same manner as the pipe. All fittings up to and including 12 inches shall be Class 350, with all larger fittings of Class 250. Flanged fittings shall be Class 125 unless noted otherwise on the drawings. Mechanical joint and push-on joint fittings shall meet all applicable requirements of ANSI 21.11-79 – (AWWA C111).

2.3 Joints: Unless specifically noted otherwise, joints for ductile iron pipe that is to be buried shall be either a push-on type or a mechanical joint. Unless noted otherwise, joints for pipe used inside buildings or structures shall be either flanged or a lock coupling for grooved-end pipe.

2.3.1 Push-on Type Joint: The push-on type joints consisting of a single neoprene gasket which are acceptable are “Tyton” as manufactured and licensed by the U.S. Pipe and Foundry Company; “Fastite” as manufactured and licensed by the American Cast Iron Pipe Company and “Bell-Tite” as manufactured and licensed by James B. Clow and Son, Inc. All required joint materials including the neoprene gasket and the lubricant shall be furnished with the pipe.

2.3.2 Mechanical Joint: Mechanical joint ends shall comply with the requirements of ANSI A21.11-79 - (AWWA C111). All required joint materials including neoprene gasket, gland, bolts, and nuts shall be included with the pipe.

2.3.3 Flanged Joint: The flanged joint shall be integrally cast and shall conform to the requirements of ANSI Specification B16.1 for Class 125. Screw-on flanges will be acceptable, but any required threading of pipe barrel shall be done by the factory in conformance with AWWA C115 utilizing Class 53 pipe. Flanges shall be ductile iron. The pipe barrel and flange shall not be field assembled. The flanges shall be furnished with factory purchased full face gaskets 1/8-inch thick of SBR rubber per ANSI/AWWA C111/A21.11.

3. EXECUTION

3.1 Cutting, Cleaning, and Inspecting: All cutting of ductile iron pipe shall be done by a means of mechanical cutter. Wheel cutters shall be used whenever practical. After cutting, the interior of the pipe shall be thoroughly swabbed or cleaned of all foreign matter before being installed into the system and shall be kept clean during and after installation. Before installation of any pipe or fitting, each piece shall be inspected for defects and shall be rung with a light hammer to detect any cracks. All defective, damaged, or unsound pipe or fittings shall be rejected.

3.2 Installation:

3.2.1 Mechanical Joint: The last eight inches outside of the spigot and the inside of the bell of the mechanical joint of push-on fittings shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint, and then coated with a soap solution. The ductile iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket or bell end. The rubber gasket shall be coated with soap solution and placed on the spigot end in the bell. The gasket shall then be pressed into place with the bell. Care shall be taken to locate the gasket evenly around the entire joint. The ductile iron gland shall be moved into position for bolting. Nuts spaced 180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland.

3.2.2 Flanged Joint: When assembling the flange joint, the Contractor shall insure that the ring gasket is properly located and placed flat against the face of the flange. Flanges shall be assembled by alternately tightening bolts spaced 180 degrees apart to produce equal pressure on all parts of the gland.

3.2.3 Restrained Joint: Installation of restrained joint fittings shall be in strict accordance with the manufacturer's printed literature.

4. MEASUREMENT AND PAYMENT

4.1 Ductile iron pipe (as used in these specifications) shall only be used to complete a relocation of potable water piping as necessary for the installation of storm sewers. Pipe will not be measured directly but shall be measured and paid for as Utility Relocation as noted in Section 01151, paragraph 2.19.

STEEL PIPE.....02617

1. GENERAL

1.1 Description: This section specifies the furnishing and installation Steel Pipe for storm sewers as shown on the drawings and specified herein. Materials for steel encasement are also included in this specification.

2. MATERIALS

2.1 Corrugated Steel Pipe w/Fiber Bonded, Smooth Lined, Bituminous Coating:

2.1.1 The materials used in the fabrication of smooth lined asbestos-bonded corrugated steel pipe shall conform to the requirements of ASTM Designation A569 with 0.20% minimum copper added. In addition, the metal sheets shall be coated on both sides with a layer of fibers, applied in a sheet form by pressing it into a molten metallic bonding medium. Immediately after the metallic bond has solidified, the fibers shall be thoroughly saturated with a bituminous saturant. The finished sheets shall be of first-class commercial quality, free from blisters and unsaturated spots.

2.1.2 Except as modified herein, the finished pipe shall conform to the requirements of AASHTO Designation M-36. In addition, the pipe shall be coated as required in AASHTO Designation M-190, Type A, and shall be lined on the inside of the pipe so that a smooth surface will be formed by centrifugally filling the corrugations to a minimum thickness of 1/8 inch above the crests. The interior lining shall be applied by a centrifugal or other approved method and shall be free from sags and runs. The lining material shall meet the requirements of AASHTO Designation M-190. Pipe shall be fabricated with riveted, lap joint construction and shall have the rivets located in the inside valleys of the corrugations. In addition, all pipe seams shall be made watertight using a suitable seam sealant.

2.1.3 Joints: Each section of pipe shall be joined by connecting bands conforming to the requirements outlined in ASTM Designation A-444 for chemistry, weight of galvanizing and permissible variations in dimensions. In addition, bands shall be .064" thick minimum, 10 ½" wide minimum, and shall be drawn together by two ½" bolts using a bar and strap suitably welded to the band. The pipe shall have at least two annular corrugations rolled into each end; the band shall engage each pipe end with one matching annular corrugation. Bands shall be of bituminous coated material only.

Gasket: The end corrugation shall contain a 3/8" O-Ring gasket. The gasket shall be in accordance with ASTM C-361. Butyl sealant tape shall be used to connect the band lap.

2.1.4 Corrugated metal pipe and pipe arch shall be of 2-2/3" x 1/2" corrugations for pipe 12 through 30 inches in diameter and 3" x 1" for pipe 36 through 120 inches in diameter.

2.1.5 Welded Steel Encasement Pipe: Shall be smooth wall, welded steel pipe with a minimum wall thickness as specified in American Petroleum Institute Code No. 1102. The provision of this code is listed as follows:

Nominal Diameter	Nominal Wall Thickness (Uncoated)
Under 12-3/4"	0.188" Min.
12-3/4"	0.282" Min.
14" and 16"	0.313" Min.
18"	0.344" Min.
20"	0.375" Min.
22"	0.407" Min.
24" and 26"	0.438" Min.

Nominal Diameter	Nominal Wall Thickness (Uncoated)
28”	0.469” Min.
30”	0.501” Min.
32” and 34”	0.563” Min.
36”, 38” and 40”	0.626” Min.
42”	0.688” Min.

3. EXECUTION

3.1 Steel pipe for storm sewers shall be installed as specified in Section 02721 – Storm Sewer Systems.

4. MEASUREMENT AND PAYMENT

4.1 Steel pipe shall be measured and paid for as noted in Section 01151, Paragraph 2.17.1 and shall include all materials, equipment, labor, supervision and incidentals necessary to install the steel pipe.

PLASTIC PIPE 02622

1. GENERAL

1.1 Description: This section specifies the furnishing and installation of Plastic Pipe for storm sewers.

2. MATERIALS

2.1 Polyvinyl Chloride (PVC) Pipe and Fittings (12" - 36")

2.1.1 PVC pipe shall be manufactured with a corrugated exterior, smooth interior and meet the requirements of ASTM F949 and F794. Pipe shall be made of a PVC compound having a minimum cell classification of 12454B as defined in ASTM D1784. Pipe shall be homogeneous throughout and free from visible cracks, holes foreign inclusions or other injurious defects.

2.1.2 Pipe shall be manufactured with one end to serve as a spigot end and the other as a bell end. A gasket meeting the requirements of ASTM F477 shall be installed in each joint. The gasketed pipe joint shall show no leakage when tested in accordance with the requirements of ASTM D3212.

2.1.3 Pipe shall be manufactured to 46 PSI stiffness when tested in accordance with ASTM D2412, latest revision.

2.1.4 There shall be no evidence of splitting, cracking, or breaking when the pipe is tested per ASTM Test Method D2412 in accordance with ASTM F949, Section 7.5 and ASTM F794, Section 8.5

2.1.5 Fittings for PVC corrugated sewer pipe with a smooth interior shall be of the same material and configuration as the pipe and shall conform to ASTM F949, Section 5.2.3 or F794, Section 7.2.4.

2.2 High Density Polyethylene (HDPE) Pipe and Fittings (4” – 60”)

2.2.1 HDPE pipe shall be manufactured with a corrugated exterior and smooth interior. Virgin material for pipe and fitting production shall be high density polyethylene conforming the with minimum requirements of cell classification 424420C for 4” through 10” and 435400C for 12” through 60” as described in ASTM 3350, latest revision, except the carbon black content shall not exceed 5%.

2.2.2 Pipe shall be manufactured with one end to serve as a spigot end and the other as a bell end. A gasket meeting the requirements of ASTM F477 shall be installed in each joint. The gaskets shall be installed by the pipe manufacturer and covered with a removable wrap.

2.2.3 Four-inch (4”) through ten-inch shall meet the requirements of AASHTO M252, Type S. Twelve-inch (12”) through sixty-inch (60”) shall meet AASHTO M294, Type S or ASTM F2306.

2.2.4 Fittings shall conform to AASHTO M252, AASHTO 294 or ASTM F2306.

2.3 Polypropylene (PP) Pipe and Fittings (4” – 60”)

2.3.1 PP pipe, 12” – 30” inclusive, shall be manufactured with a corrugated exterior and smooth interior. PP pipe, >30” – 60” shall be manufactured with a smooth exterior and interior surface and annular inner corrugations.

2.3.2 Pipe and fittings shall be manufactured from a modified copolymer meeting the material requirements of ASTM F2764.

2.3.3 Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F2764. Pipe shall be watertight according to the requirements of ASTM D3212, with the addition of a 15-psi pressure requirement.

a. Spigot shall have two gaskets meeting the requirements of ASTM F477, be installed by the pipe manufacturer, and covered with a removable, protective wrap to ensure the gaskets are free from debris.

b. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

c. Pipe shall have a reinforced bell with a polymer composite band installed by the manufacturer.

2.3.4 Fittings and connections shall provide a watertight connection as per the requirements of ASTM D3212.

2.4 Pipe Anchors

2.4.1 Pipe anchors shall be required for all plastic pipe where bedding/backfill is not of sufficient depth to prevent pipe flotation. Flotation shall be determined utilizing the following criteria/assumptions:

a. Pipe is empty
b. The maximum outside diameter of pipe is used to determine water and soil displacement.
c. The water table is assumed to be 12" below ground surface
d. Soil density is 110 pcf
e. A safety factor of 1.5 shall be provided

2.4.2 The contractor shall provide a plan sheet showing calculated pipe uplift, weight of bedding/backfill, location of additional anchors (if required), and resistance or weight of each anchor.

2.4.3 Anchors may be concrete "dead-men" with stainless steel strap, concrete collars, screw anchors with stainless steel strap or other methods recommended by the pipe manufacturer.

3. EXECUTION

3.1 Plastic pipe for storm sewers shall be installed as specified in Section 02721 – Storm Sewer Systems.

4. MEASUREMENT AND PAYMENT

4.1 Plastic pipe shall be measured and paid for as noted in Section 01151, Paragraph 2.17.1 and shall include all materials, equipment, labor, supervision and incidentals necessary to install the plastic pipe.

STORM SEWER SYSTEMS 02721

1. GENERAL

1.1 Description: This section specifies the furnishing and installation of all storm sewer pipe shown on the drawings and as specified herein.

2. MATERIALS

2.1 Storm sewers shall be constructed of one of the following types of pipes:

2.1.1 Reinforced Concrete Pipe as specified in Section 02612.

2.1.2 Steel Pipe as specified in Section 02617.

2.1.3 Plastic Pipe as specified in Section 02622.

3. SUBMITTALS

3.1 The Contractor shall provide to the Engineer six (6) copies of Letters of Certification from the manufacturer of steel reinforcing bars, pipe, fittings, gaskets, ferrous metal castings, and incidental elements of materials certifying that materials provided were manufactured in accordance with prevailing specifications and that all materials and manufacturing provided will meet or exceed standards of quality set forth in those specifications.

4. EXECUTION

4.1 Laying Storm Sewer Pipe:

4.1.1 Pipe shall be laid using a laser beam or a grade rod that has an iron heel for the invert and notches for the grade line stretched over the sewer.

4.1.2 The alignment of all pipelines between adjacent manholes shall be true to line and grade. The pipeline from manhole to manhole shall reflect the full bore of the pipe. The pipe section shall be truly centered into the adjacent pipe section at each joint.

4.1.3 At all pipe joints, the bedding shall be excavated sufficiently so that the pipe bell will not rest on the bedding material, but all the weight of the pipe shall be evenly distributed along the entire length of the barrel of the pipe.

4.1.4 The flow lines shown on the profile drawings are the internal inverts of the sewer pipelines. The pipes and special fittings shall be laid to true line and grade throughout and all junctions, curves, branches, and other pieces required shall be properly excavated for and laid as shown on the drawings and as directed by the Engineer.

4.1.5 The sewer shall be constructed watertight at all points. Any leaks or other defects discovered at any time shall be immediately repaired, or that portion of the sewer shall be rebuilt, if necessary. In all cases, full length joints of pipe shall be used, except in making closures.

4.1.6 In laying the pipe, water shall be removed from the trench to an elevation below flowline while the pipe is being laid. No pipe shall be laid on frozen bedding materials.

4.1.7 The pipe shall not be rolled or dragged across the ground, truck bed, or other length of pipe. No weight should be placed on the pipe joint when the pipe is hauled, handled or stored.

4.1.8 Care shall be taken to ensure that the joints of the pipe are clean and free of any foreign material and be made properly using the specified jointing materials.

4.1.9 The interior of the pipe shall be kept free of superfluous material during construction and flushed out after completion.

4.1.10 At the close of each day's work, or when pipe is not being laid, the end of pipe shall be stopped to prevent access into the pipe.

4.1.11 Any pipe which settles, or which is not in true alignment shall, upon orders from the Engineer, be taken up and re-laid by the Contractor without cost to the Owner.

4.1.12 Infiltration: Materials used for sewer pipe joints shall have satisfactory records for preventing infiltration and the entrance of roots. Leakage or infiltration in the case of wet trenches shall not be permitted to exceed 200 gallons per inch of pipe diameter per mile per day for any section of the system as determined by flow measurement in the pipe.

4.1.13 Testing: Hydrostatic testing will not be required. However, the Contractor shall use materials specified herein and use good construction methods and workmanship for an in-place storm sewer that functions as intended.

4.1.14 Pavement replacement: Asphaltic pavement shall be replaced according to the plans and in accordance with Section 02513 - ASPHALTIC CONCRETE PAVING. Concrete pavement replacement shall be in accordance with Section 03300 – Cast-in-Place Concrete.

5. MEASUREMENT AND PAYMENT

5.1 No direct measurement and payment for installation of storm sewers will be made. See Section 01151 for measurement and payment of the various items.

CONCRETE FORMWORK.....03100

1. GENERAL

1.1 Description: The work of this section consists of furnishing all materials, labor, tools and equipment necessary to construct all required form work to the lines and grades shown on the plans.

2. MATERIALS

2.1 All forms for exposed surfaces shall be built of sound plywood or other materials approved by the Engineer, closely fitted to provide the best surface possible without special lining.

2.2 Forms for surfaces not exposed may be built of sound lumber free from loose knots.

2.3 Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured type. The portion remaining within the concrete shall leave no metal within one inch of any surface which will be exposed to view.

3. EXECUTION

3.1 Forms: Forms shall conform to the shape, lines and dimensions of the concrete as shown on the Plans. Forms shall be provided for all vertical surfaces. The materials, design, and construction of formwork shall conform to the applicable portions of the American Concrete Institute Standard "Recommended Practice for Concrete Formwork" (ACI 347) and to these specifications.

3.2 Design: The design of the formwork shall be the responsibility of the Contractor.

3.3 Construction: Forms shall be built true to line and shall be mortar-tight and sufficiently rigid to prevent displacement or bulging between supports. Bends, chamfers and other offsets shall be provided when the forms are built. Joints shall be kept to a minimum and all joints shall be solidly backed by framing.

3.4 Preparation of Surfaces: Before forms are placed, material to form exposed surfaces shall be oiled thoroughly, and for unexposed concrete, forms may be oiled at the Contractor's option. All forms that are not oiled shall be wet immediately before placing concrete. All formwork shall be cleaned free of dirt and construction debris before placing concrete and points at which water has gathered within the forms due to wetting shall be drained.

3.5 Removal of Forms: Formwork for walls, sides of slabs and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

3.6 Embedded Items, Opening, and Recesses:

3.6.1 General: All sleeves, inserts, grooves, anchors, recesses, and other items required for adjoining work or for its support shall be placed or formed prior to placing the concrete.

3.6.2 Related Trades: All various trades shall be given ample opportunity to furnish for installation all hangers, anchors, inserts, sleeves, frames and other items to be built into the concrete as shown on the Plans or the various manufacturers' drawings or specified herein.

3.6.3 Placing Embedded Items: Expansion joint material, waterstops and all other embedded items shall be positioned accurately and supported securely against displacement before placing concrete.

3.6.4 Formed Holes: Formed holes shall be formed with non-ferrous material which shall be removed after the concrete has hardened.

3.7 Formwork for beams, slabs and other parts that support the weight of concrete and construction live loads shall remain in place until the concrete has reached its specified 28-day strength. Formwork that supports the weight of concrete only, and no construction live loads, or other loads, shall remain in place for not less than seven (7) days or until the concrete has reached 75 percent of its specified 28-day strength. The concrete shall be presumed to have reached its strength when either of the following conditions has been met.

3.7.1 When test cylinders, field cured under the most unfavorable conditions prevailing for any portion of the concrete represented, have reached the required strength. Except for field curing and age at test, the test cylinders shall be taken and tested as specified herein.

3.7.2 When the concrete has been cured as specified herein for the same length of time as the age at test of laboratory-cured cylinders which reached the required strength. The length of time the concrete has been cured in the field shall be determined by the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of air in contact with the concrete is above 50°F, and the concrete has been damp or thoroughly sealed from evaporating and loss of moisture.

3.8 Contractor's Responsibility: In all cases, the Contractor shall be solely responsible for adequate support of the forms to safely carry the load of concrete without undue deflection. The Contractor shall be liable for injury or damage resulting from inadequate forms, falsework or from premature removal of same.

4. MEASUREMENT AND PAYMENT

4.1 Concrete formwork shall be considered incidental to construction of the various items for which it is used and therefore will not be measured or paid for separately.

CONCRETE REINFORCEMENT.....03200

1. GENERAL

1.1 Description: This work of this section consists of furnishing, hauling all reinforcement materials and all tools, labor, equipment and incidentals necessary to complete this section.

2. MATERIALS

2.1 Reinforcing Steel: Reinforcing bars shall conform to the "Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A615 or to the "Standard Specifications for Axle-Steel Deformed Bars for Concrete Reinforcement", ASTM A617 and shall be Grade 40, as designated on the plans.

2.2 Reinforcing Glass Fiber Polymer Bars: Reinforcing bars shall conform to the "Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement", ASTM D7957_D7957M-17, as designated on the plans.

2.3 Welded Wire Fabric: Welded wire fabric shall conform to "Standard Specifications for Welded Steel Sire Fabric for Concrete Reinforcement", ASTM A185.

2.4 Metal Supports: Metal chairs used to support tie bars or reinforcing bars shall be channel shaped pressed out of sheet steel of not less than twelve (12) gauge (U.S. Standard) metal and conforming to details shown on the plans.

2.5 Expansion Tubes: Metal dowel caps or tubes shall be manufactured from thirty-two (32) gauge sheet metal, shall be indented to provide a limiting stop for the dowel bar, and shall provide unobstructed expansion space of not less than one (1) inch to permit movement of the dowel bar. They shall be of proper size to fit the specified bars tightly and the closed end shall be watertight.

2.6 Fiber Mesh: Shall be 100% virgin homopolymer polypropylene multifilament fibers. Mesh shall be graded and shall have a diameter between .0012" & .002" and a length between 0.5" & 0.75".

3. EXECUTION

3.1 General: Unless otherwise indicated on the Plans or specified herein, all cutting and bending or reinforcement bars shall be done at the mill or ship prior to shipment. Cutting and bending in the field will be permitted only where shown on the plans or to correct errors, damage by handling and shipping, and minor omissions in shop bending when authorized by the Resident Project Representative.

3.2 Storing and Cleaning:

3.2.1 All reinforcement shall be stored above ground on skids, pallets or other supports and shall be protected from mechanical injury and from deterioration by exposure.

3.2.2 When placed in the work, reinforcement shall be free from dirt, detrimental scale, concrete, paint, oil or other foreign materials. Tight, thin rust is not considered detrimental and will not require cleaning.

3.3 Placing: Except as shown on the Plans or specified herein, all placement of reinforcing bars, welded wire fabric and bar supports shall conform to the latest editions of "Placing Reinforcing Bars, CRSI-WCRSI Recommended Practices", published by the Concrete Reinforcing Steel Institute. Bars may be moved as necessary to avoid interference with other reinforcing steel, pipes and other embedded items. If bars are moved more than the specified placing tolerances, the resulting arrangement shall be approved by the Project Representative.

3.4 Splices: When splices other than those shown on the plans become necessary, they shall be located at areas of low stress and shall be subject to approval by the Project Representative.

3.5 Fiber mesh: Dosage rate for fiber mesh shall be between 0.75 and 1.5 pounds per cubic yard of concrete. Actual dosage rate shall be as per mesh manufacturer's recommendation for the intended use.

3.5.1 Mesh shall be added directly to the concrete mixing system after the batching of other ingredients and mixed as per the manufacturer's recommendations.

4. MEASUREMENT AND PAYMENT

4.1.1 Measurement and payment of reinforcing will not be measured and paid for separately but considered incidental to the placement of concrete items unless specifically noted otherwise in the bid schedule.

4.1.2 If noted measurement and payment will be at the unit listed in the bid schedule.

CAST-IN-PLACE CONCRETE 03300

1. GENERAL

1.1 Description: The work of this section shall include the furnishing, hauling, placing, curing, and testing of all Portland Cement Concrete required by the Construction Drawings and herein specified.

2. MATERIALS

2.1 Portland Cement: Portland cement shall conform to "Standard Specifications for Portland Cement: ASTM C150 Type 1 or Type 1A when specified. One sack of cement shall be considered as one cubic foot of volume or 94 pounds by weight.

2.2 Aggregates: Fine and coarse aggregates shall conform to "Standard Specifications for Concrete Aggregates", ASTM C33. The nominal maximum size of the coarse aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms, one-third the depth of the labs, nor three-fourths of the minimum clear distance between reinforcing bars or between bars and forms, whichever is lest. Coarse aggregate gradation shall conform to ASTM C33 Size 67 for class B.

2.3 Admixtures: Air-entrained admixtures shall conform to "Standard Specifications for Air-Entraining Admixtures for Concrete", ASTM C260. The Contractor shall submit a manufacturer's certification and guarantee to the Engineer showing the brand name and designation, the composition or description of the air-entraining agent will conform the requirements of these specifications. Water-reducing, retarding, or accelerating admixtures, if permitted by the Resident Project Representative, shall conform to "Standard Specifications for Chemical Admixtures for Concrete", ASTM 494. The use of calcium chloride in concrete mixtures will not be permitted.

2.4 Mixing Water: Mixing water for concrete shall be fresh, clean and potable. Non-potable water may be used only if it produces mortar cubes having 7- and 28- day strengths equal to the strength of similar specimens made with distilled water, when tested in accordance with "Method of Test for Compressive Strength of Hydraulic Cement Mortars", ASTM C109.

2.5 Curing Compounds: All curing compounds shall conform to specifications for liquid membrane forming compounds for curing concrete ASTM C309 for Type 1-D clear or translucent with fugitive dye or Type 2 white pigmented and shall be applied in accordance with manufacturer's recommendations.

2.6 Reinforcement: Reinforcing steel shall conform with Section 03200.

3. PROPORTIONING CONCRETE

3.1 General: Proportions of aggregate to cement and water shall be such to provide a concrete mix which will work readily into corners and angles for forms and around reinforcement and other embedded items without causing segregation of materials.

3.2 Proportioning Ingredients: All ingredients shall be proportioned in order to obtain the following:

Class of Concrete	Type of Concrete	Min. 28-Day Com. Strength	Water-Cement Ratio (maximum)	Maximum Slump (inches)
B-1	Structural	4,000 psi	5.25 gal/sack	4 (see note)
Pavement	Structural	4,000 psi	6.0 gal/sack	3.5

Note: Slump may be adjusted to 7" maximum for slabs receiving Replaceable Detectable/Tactile Warning Surface.

Air Entrainment

4% to 7% by volume of air-entrainment for all classes of concrete.

3.2.1 In no case shall be amount of fine aggregate be more than the amount of coarse aggregate (measured by weight) nor shall the amount of coarse aggregate be such as to produce honeycombing.

3.2.2 Portland cement concrete shall be proportioned and placed to provide an average compressive strength sufficiently high to minimize the number of compressive strength tests falling below the specified compressive strength for the concrete structure. Portions of concrete ingredients, including water-cement ratios, shall be established based on laboratory trial batches to provide conformance with compressive strength requirements, workability, and consistency. When different materials are used for different portions of the project, each combination shall be evaluated separately. Strength tests shall be conducted on test specimens in accordance with ASTM C39 and ASTM C192, from the trial batches using different water-cement ratios. Tabular data showing the compressive strength of the concrete proportions with various water-cement ratios shall be provided to the Engineer prior to placing concrete on the jobsite.

3.2.3 Concrete shall be provided to develop a minimum 28-day compressive strength for field cured cylinders for each class of concrete indicated. Concrete that, after curing, will be subjected to freezing temperatures while wet shall contain entrained air from 4.0 to 7.0 percent by volume. Concrete that is intended to be water-tight shall have a maximum water-cement ratio of 0.48 by weight.

3.3 Moisture: Moisture in the aggregate shall be measured, and the quantity must be included in the water-cement ration specified above.

3.4 Air-Entrainment: Air-entrainment shall be accomplished by the use of Type 1 Portland Cement with the addition of an approved air-entrainment admixture or by the use of Type 1A Portland Cement, as specified herein.

3.5 Trial Batches: Full sized trial batches shall be made in the laboratory using the aggregates selected for the job to establish the correct proportions to give proper workability, strength, and texture with the water-cement ration specified. The combinations of fine and coarse aggregates shall be adjusted within limits specified in ASTM C33 until the mix meets approval of the Engineer.

3.6 Water-Reducing, Retarding & Accelerating Admixtures: Such admixtures may be used when such use is requested by the Contractor subject to review and approval by the Engineer. For certain uses the Engineer reserves the right to require the use of a retardant or other admixtures for specific uses such as a retardant in extensive wall pours to assure elimination of cold joints or for other such purposes. No additional compensation will be allowed when such admixtures are used either at the Contractor's request or at the request of the Engineer. However, when certain such admixtures are used, it will be allowable to reduce the cement content of the mix to a minimum of 5 ½ bags of cement per cubic yard of concrete subject to the following conditions: A trial batch and test cylinders taken therefrom demonstrate that the mix will meet the strength, workability, slump and durability requirements of the specified mix previously herein stated. The strength shall be determined from seven-day test cylinders from a trial batch utilizing the admixture and made using the aggregates selected from the job, to establish the correct proportions to give proper workability with the water-cement ratio specified. The combination of fine and coarse aggregates shall be adjusted within limits specified to equal 95 percent of the specified minimum 28-day strength.

4. MIXING CONCRETE

4.1 Ready-Mixed Concrete: Ready-mixed concrete will be permitted provided it conforms to the "Standard Specification for Ready-Mixed Concrete", ASTM C94 and to the applicable portions of these

Specifications. The Contractor shall make all arrangements to satisfy the Engineer that materials used comply with specification requirements.

4.1.1 The Engineer shall have free access to the mixing plant at all times when work is performed for this project for sampling and testing materials. Such privilege shall not relieve the Contractor of his responsibility for compliance with contract requirements.

4.2 Batch Mixing at Site:

4.2.1 The concrete shall be mixed in a batch mixer, conforming to the requirements of the Mixer Manufacturer's Bureau of the Associated General Contractors of America. The mixer shall bear a manufacturer's rating plate indicating the rated capacity and the recommended revolution per minute and shall be operated in accordance with these recommendations. It shall be equipped with a suitable charging hopper, water storage tank, and a water-measuring device and shall be capable of thoroughly mixing aggregates, cement and water into a uniform mass within the specified mixing time and discharging the mix without segregation.

4.2.2 The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. Controls shall be provided to ensure that no additional water may be added during mixing. The entire batch shall be discharged before the mixer is recharged.

4.2.3 Each batch of two cubic yards or less shall be mixed for not less than 1 ½ minutes. The minimum mixing time shall be increased by 15 seconds for each additional cubic yard or fraction thereof.

4.3 The mixer shall be clean, and the pick-up and throw-over blades shall be replaced when they have lost 10 percent of their original depth.

4.4 Admixtures:

4.4.1 Air-entraining and chemical admixtures shall be charged into the mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powered admixtures shall be weighted or measured by an admixture shall be with +/- three percent.

4.4.2 Two or more admixtures may be used in the same concrete, provided such admixtures are added separately during the batching sequence and provided further that the admixtures used in that combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

4.4.3 Addition of retarding admixtures shall not be significantly delayed after the addition of the cement.

4.5 Retempering: Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered but shall be discarded.

4.6 Indiscriminate addition of water to increase slump or workability shall be prohibited. When concrete arrives at the project with slump below that suitable for placing, water may be added only if neither the maximum permissible water-cement ration nor the maximum slump is exceeded. The water must be incorporated by additional mixing equal to at least half of the total mixing required. Any addition of water above that permitted by the limitation on water-cement ration must be accompanied by a quantity of cement sufficient to maintain the proper water-cement ration. Such addition must be approved by the Engineer.

4.7 Weather Conditions:

4.7.1 Cold Weather: To maintain the temperature of the concrete above the minimum placing temperature required herein, the as-mixed temperature shall not be less than 55°F. when the mean temperature falls below 40°F.

4.7.2 If the water or aggregate has been heated, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be added to the mixtures of water and aggregate when the temperature of the mixture is greater than 100°F.

4.7.3 Hot Weather: The ingredients shall be cooled before mixing if necessary to maintain the temperature of the concrete below the maximum placing temperature required herein.

5. CONCRETE PLACEMENT

5.1 Preparation Before Placing: Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.

5.2 Formwork shall be completed; reinforcement shall be secured in place; expansion joint material, waterstops, anchors, pipe sleeves, and other embedded items shall be positioned; and the entire preparation shall be approved by the Resident Project Representative before any concrete is placed. Subgrades shall be sprinkled sufficiently to eliminate absorption of water from the concrete before any concrete is placed.

5.3 Conveying: Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients and is a manner which will ensure that the required quality of the concrete is obtained.

5.4 Conveying equipment shall be of size and design to ensure a continuous flow of concrete at the delivery end and shall be approved by the Resident Project Representative. Conveying equipment and operations shall conform to the following requirements:

5.4.1 Truck mixers, agitators, and non-agitating units and their manner of operation shall conform to the applicable requirements of “Specifications for Ready-Mixed Concrete”, ASTM C94.

5.4.2 Belt conveyors shall be horizontal or at a slope which will not cause segregation or loss. An approved arrangement shall be used at the discharge end to prevent separation. Long runs shall be discharged without separation into a hopper.

5.4.3 Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontals. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

5.4.4 Pumping or pneumatic conveying equipment shall be without “Y” sections, and with adequate pumping capacity. The equipment shall be cleaned at the end of each operation. Pneumatic placement shall be controlled so that separation is not apparent in the discharged concrete. The maximum loss of slump in pumping or pneumatic conveying equipment shall be 1 ½ inches.

5.5 Depositing: Concrete shall be deposited continuously or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or plans of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved by the Resident Project Representative. Placing shall be carried on at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by foreign materials shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation, rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

5.5.1 Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic.

5.5.2 Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to flowing or rehandling and shall drop vertically into the center of the forms. In no case shall concrete be allowed to fall more than five feet or at other times when required by the Resident Project Representative drop chutes or other approved devices shall be used.

5.6 Where surface mortar is to be the basis of the finish, the coarse aggregate shall be worked back from the forms with a suitable tool to bring a full surface of mortar against the form without the formation of excessive surface voids. All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting or plans of weakness. Mechanical vibrators shall have a minimum frequency of 7,000 revolutions per minute and shall be operated by competent workmen. Overvibrating and use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at many points, from 18 to 30 inches apart. At each insertion the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds duration. A spare vibrator shall be kept on the job site during all concrete placing operation.

5.7 Weather Conditions:

5.7.1 Unless adequate protection is provided and approved by the Engineer, concrete shall not be placed in rain, sleet, or snow. Rainwater shall not be allowed to increase the mixing water nor to damage the surface finish.

5.7.2 When the mean daily temperature falls below 40°F., the minimum temperature of concrete as place shall be 50°F.

5.7.3 Concrete deposited in hot weather shall have a placing temperature which will not cause difficulty from loss of slump, flash set or cold joints (usually somewhat less than 90°F.).

5.8 Concreting Under Water: No concrete shall be placed under water without the approval of the Engineer.

6. JOINTS

6.1 Longitudinal and transverse joints shall be constructed as shown on the plans.

6.2 Longitudinal joints are those joints parallel to the lane of construction. They may be either intermediate center joints or the construction joints between construction lanes.

6.3 Transverse joints shall be contraction joints or construction joints. Construction joints are put in transversely whenever construction operations require them.

6.4 Expansion joints may be either longitudinal or transverse. They are used only where specifically shown on the plans.

6.5 The edges of the pavement and those joints where such edging is shown on the plans shall be rounded with an edger having a radius of not larger than one-eighth (1/8) inch. Transverse joints, except keyed and tied construction joints, shall be continuous across the entire paved area including the curb.

6.6 Transverse Joints: Transverse joints shall be contraction, expansion or construction joints. Contraction and expansion joints shall be placed as indicated on the plans and construction joints wherever construction may require them. They shall make a right angle with the centerline of the pavement and with the surface of the sub-grade.

6.6.1 Transverse Expansion Joints: Expansion joints, where shown on the plans, shall extend the entire width of the pavement and from the sub-grade to one (1) inch below the surface of the pavement. They shall be of the dimensions and spacing as shown on the plans. The filler shall be held accurately in place during the placing and finishing of the concrete by a bulkhead, a metal channel cap or other approved method. Under no circumstances shall any concrete be left above the expansion material or across the joint at any point. Any concrete spanning the ends of the joint next to the forms shall be carefully cut away after the forms are removed. Before the pavement is opened to traffic, the groove above the filler shall be cleaned and sealed with specified joint sealing material covered under 6.10 entitled “Joint Sealer”.

6.6.2 Transverse Contraction Joints: Transverse contraction joints shall be of the sawed, formed dummy groove or pre-molded strip type, one quarter the thickness of concrete unless otherwise shown on the plans.

6.6.3 Transverse Sawed Contraction Joints: When transverse contraction joints are to be formed by sawing, care must be taken to saw the grooves soon after placing to prevent the formation of cracks due to contraction of the slab. All transverse joints shall be sawed at least one-fourth (1/4) of the slab depth. Any procedure for sawing joints that results in premature and uncontrolled cracking shall be revised immediately by adjusting the time interval between the placing of the concrete and the cuffing of the joints.

6.6.4 Transverse Formed Dummy Groove Joints: Transverse dummy groove joints shall be formed by a groove or cleft in the top of the slab of the dimensions shown on the plans. The groove made in the plastic concrete by a suitable tooling device shall extend vertically downward one-fourth (1/4) of the slab depth from the surface and shall be true to line.

6.6.5 Transverse Pre-Molded Strip Joints: Transverse pre-molded strip joints shall be of the proper dimensions as shown on the plans. The pre-molded filler is placed in a vertical groove formed to receive it. The top of the filler shall be flush with the pavement surface.

6.7 Transverse Construction Joints: Transverse construction joints of the type shown on the plans shall be placed wherever the placing of the concrete is suspended for more than 30 minutes. A butt type joint with dowels shall be used if the joint occurs at the location of a construction joint. Keyed joints with tie bars are used if the joint occurs at any other location.

6.7.1 If joints are to be equipped with dowels, they shall be of the dimension and at the spacing and location indicated on the plans. They shall be firmly supported in place, accurately aligned parallel to the pavement grade and the centerline of the pavement by means of a dowel support that will remain in the pavement and will ensure that the dowels are not displaced during construction. One-half of each dowel shall be painted and greased and in an expansion joint, one end shall be equipped with a tight-fitting sleeve of the dimensions shown on the plans conforming to Section 03200, paragraph, 2.1 entitled “Expansion Tubes”.

6.8 Longitudinal Joints: Longitudinal joints shall be placed as shown on the plans. They shall be of the sawed, dummy groove, pre-molded strip, or the keyed construction type, unless otherwise shown on the plans. Joints between construction lanes shall be the keyed construction type, unless otherwise shown on the plans.

6.8.1 Longitudinal Center Joint: Longitudinal center joints shall be of the sawed or pre-molded strip type, unless otherwise shown on the plans.

6.8.2 Sawed Longitudinal Center Joints: Sawed longitudinal center joints shall be sawed grooves made with a concrete saw after the concrete has hardened. The saw cut shall be at least one-fourth (1/4) of the slab depth. The joint may be sawed at any time prior to the time the pavement is open to traffic. These joints are otherwise formed in the same manner as the transverse sawed joints in paragraph 6.7 entitled “Transverse Contraction Joints”.

6.8.3 Longitudinal pre-molded strip joints: Longitudinal pre-molded strip joints are formed in the same manner described for transverse pre-molded strip joints in paragraph 6.8.3 entitled "Transverse Pre-Molded Strip Joints".

6.8.4 Longitudinal Construction Joints: Longitudinal construction joints (i.e., joints between construction lanes) shall be of the dimensions shown on the plans. The key shall be constructed by placing an approved key against the form when the first slab adjacent to the joint is placed. When placing the second slab, care must be taken that no concrete is left to overhang the lip formed in the first slab by the edging tool.

6.9 Tie bars: When shown on the plans, it shall be deformed steel and of the dimensions and of the spacing specified. Tie bars shall be firmly supported by sub-grade chairs or so installed as not to be displaced during construction operation.

6.10 Joint Sealer: After the curing period, all sawed and dummy groove joints in the pavement shall be cleaned and sealed with material meeting the requirements in Section 3100.3.22 entitled "Joint Sealing Compounds". All foreign materials, joint sawing residue, dirt and curing membrane shall be removed. Joints shall be lightly underfilled (about 1/4 inch) to prevent extrusion of sealer. Any excess material should be removed from the pavement surface as soon after sealing as possible.

6.11 Integral Curb Joints: In the construction of transverse joints of concrete integral curb pavement, special care must be taken to see that all transverse joints extend continuously through the pavement and curb.

6.12 Water Stops: Each piece of thermoplastic elastomeric rubber water stop shall be of maximum practicable length in order that the number of splices be held to a minimum. Joints at intersections and at ends of pieces shall be made according to the manufacturer's recommendations and shall develop watertightness fully equal to that of the continuous water stop material. Care shall be taken during installation of the waterstops so that no leakage will occur across the joint.

6.13 Joint Sealer:

6.13.1 Horizontal joints shall be sealed with a two-part, cold-applied urethane joint sealant. Sealant shall be self-leveling and shall conform to Federal Specification TT-S-00227E, Type I, Class A. Joint sealant shall be SEALTIGHT POURTHANE as manufactured by W.R. Meadows, Inc., or approved equal.

6.13.2 Vertical joints shall be sealed with a two-component, gun-grade, non-sag urethane joint sealant. Sealant shall conform to Federal Specification TT-S-00227E, Type II, Class A. Joint sealant shall be SEALTIGHT Dualthane, as manufactured by W.R. Meadows, Inc., or approved equal.

7. FINISHES

7.1 General: After removal of forms the concrete shall be given one or more of the finishes specified herein.

7.2 All necessary patching shall have been done immediately after forms have been removed and rubbing shall be completed not later than the following day. Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until a uniform color and texture are produced. No cement grout or slush shall be used other than the cement paste drawn from the green concrete itself during the rubbing process.

7.3 Related Uniformed Surfaces: Tops of walls and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

7.4 Sidewalk slabs shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface. This operation shall follow immediately after floating.

8. PATCHING

8.1 General: All tie holes and all repairable defective areas shall be patched immediately after form removal.

8.2 Defective Areas: All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and an area at least six inches wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately one part cement to one-part fine sand passing a No. 30 mesh sieve, shall be mixed to the consistency of thick cream and shall then be well brushed into the surface.

8.3 The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 1 ½ parts sand by damp loose volume. White portland cement shall be substituted for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete as determined by a trial patch.

8.4 The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel without addition of water until it has reached the stiffest consistency that will permit placing.

8.5 After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be kept damp for seven days. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

8.6 Tie Holes: After being cleaned and thoroughly dampened, the tie holds shall be filled solid with patching mortar.

8.7 Proprietary Materials: If desired by the Contractor, proprietary compound for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations and shall be Standard Dry Wall products or approved equal.

9. CURING AND PROTECTION

9.1 General: Exposed surfaces of concrete shall be protected from premature drying and excessively hot or cold temperatures for the period of time necessary for the hydration of the cement and proper hardening of the concrete.

9.2 Curing: Initial curing shall immediately follow the finishing operation. Concrete shall be kept continuously moist for at least for 24 hours by one of the following materials or methods:

9.2.1 Ponding or continuously sprinkling.

9.2.2 Absorptive mat or fabric kept continuously wet.

9.2.3 Sand or other covering kept continuously wet.

Whichever of the above materials or methods is chosen shall be approved by the Engineer.

9.3 Immediately following the initial curing and before the concrete has dried, final curing shall be accomplished by one of the following materials or methods:

9.3.1 Continuation of method used for initial curing.

9.3.2 Waterproof paper conforming to "Specifications for Waterproof Paper for Curing Concrete", ASTM C171.

9.3.3 Other moisture retaining coverings as approved by the Engineer.

9.4 The final curing shall continue for a cumulative number of seven days, not necessarily consecutive, during which the temperature of air in contact with the concrete is above 50°F. If high-early-strength cement has been used, the final curing shall continue for a total of three days. When the mean daily temperature of the atmosphere is less than 40°F., the temperature of the concrete shall be maintained between 50°F. and 70°F. for the required curing period. When necessary, arrangements for heating, covering, insulating or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature and moisture conditions without injury due to concentration of heat or carbon dioxide build up.

9.5 During hot weather, arrangements for installation of windbreaks, shading, spraying, sprinkling, ponding or wet covering shall be made in advance of placement and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

9.6 Changes in temperature of the concrete shall be as uniform as possible and shall not exceed 5°F. in any one hour or 50°F. in any 24-hour period.

9.7 Protection From Mechanical Injury: During curing the concrete shall be protected from damaging mechanical disturbance, heavy shock or excessive vibration. All finished surfaces shall be protected from damage caused by construction equipment, materials or methods and rain or running water.

9.8 Temperature & Shrinkage Cracks: Temperature and shrinkage cracks which develop prior to the final acceptance of the plant by the Owner shall be repaired and waterproofed as specified herein and other applicable parts of the Specifications.

10. TESTING

10.1 General: The Contractor shall keep a log identifying the exact locations of poured concrete represented by each test cylinder and shall furnish two copies of the test reports and logs to the Engineer as they become available.

10.2 All strength tests shall be performed by a reputable testing laboratory hired by the Contractor at his expense and approved by the Engineer. The costs of performing all strength tests as specified herein shall be borne by the Contractor and no extra compensation will be allowed.

10.3 Slump Tests: Slump tests will be performed when requested by the Resident Project Representative and shall conform to "Standard Method of Test for Slump of Portland Cement Concrete", ASTM C143.

10.4 Strength Tests: Test cylinders shall be taken by the Contractor as directed by the Resident Project Representative and shall be cured and tested in accordance with the "Standard Method of Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field", ASTM C31. Not less than three specimens shall be made for each 20 cubic yards of concrete or fraction thereof in each day's pour, except that in no case shall a given mix design be represented by less than five tests. In the event that three test cylinders are not considered sufficient to represent the work done, the Engineer may direct extra cylinders be made. The standard age of test shall be 28 days, but 7-day tests and 14-day tests may be used provided that the relation between the 7-day, 14-day and 28-day strengths of the concrete is established in advance by test for the materials and proportions used and approved by the Engineer. If the Contractor desires, extra cylinders may be made and tested for the purpose of indicating sufficient concrete strength for form removal or other purposes. If the average of the strengths of the test cylinders fail to obtain the specified strength so as to justify doubt as to the quality of the concrete, further tests shall be made at the Contractor's expense, of the concrete in place to determine its fitness to remain in the structure. These tests shall be performed in accordance with the "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete", ASTM C42. The strength level of the concrete

will be considered acceptable if the average of three, 28-day test strength results equal or exceed the specified compressive strength and no individual tests fall below the specified compressive strength by more than 200 psi.

10.5 Air Content Tests: Air content tests may be requested by the Resident Project Representative at his discretion and shall conform to the "Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method", ASTM C173 or the "Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method", ASTM C231. The Contractor shall provide all necessary equipment, materials, sampling, and testing.

11. CONCRETE CURB AND GUTTER / CURB FLUME

11.1 Concrete curb and gutter or concrete curb flume shall be poured on a base of aggregate, contiguous with the base for street paving. Forms shall be metal or sound, dressed lumber, straight, free from warp, of sufficient strength to resist springing during construction, and of a height equal to the full depth of the item to be constructed. The forms shall be thoroughly cleaned, well oiled, securely staked, braced, and held to the required line and grade. A template shall be used to achieve the proper curb and gutter cross section.

11.2 In lieu of the forming requirements specified in Paragraph 11.1, slip form methods may be used for placement of concrete curb, concrete gutter, curb and gutter, and paved ditch providing proper lines, grades, and typical sections are maintained.

11.3 Required reinforcement and tie bars shall be held in the designated position during the placing of concrete by bar chairs or other approved devices. Joints shall be constructed at intervals and locations shown on the plans or as directed by the Engineer.

11.4 Concrete shall be placed on the prepared and sprinkled subgrade, compacted and struck off to the required thickness. Concrete shall be tamped or vibrated sufficiently to eliminate all voids and to bring mortar to the top, after which the surface shall be finished smooth and even. All edges shall be rounded with an edging tool. Faces of curbs shall be rounded at the top and bottom, by means of an approved tool, to the radius shown. All curb and gutter will be given a light broom finish and shall be sprayed with a liquid membrane-forming compound or as specified by the Engineer.

11.5 After the concrete has set sufficiently, the forms shall be removed, and where necessary, the contractor shall backfill adjacent to the concrete with suitable material, compacted and finished in a satisfactory manner.

11.6 Crack Control Joints: When the concrete curb and gutter have cured sufficiently to allow saw cuts to be made without raveling, the contractor shall saw crack control joints. These shall be cut at intervals at 20 feet, or as directed by the Engineer. Sawing of the joints shall be considered as a part of the curb and gutter construction with no extra compensation provided. All sawed joints shall be sealed as specified above.

12. CONCRETE SIDEWALK

12.1 Design. Sidewalks are required on at least one side of residential streets and both sides of collector and arterial streets (see Subdivision Regulations).

12.2 The thickness of the sidewalks shall be a minimum of four inches and placed on a minimum of 4-inch aggregate base.

12.3 Sidewalks across drives shall be constructed with a seven-inch thickness. The additional thickness at driveways shall extend a minimum of 18 inches beyond the drive and curb tapers.

12.4 All new sidewalks shall meet the requirements of the most current ADA Standards for Accessible Design and Public Right of Way Accessibility Guidelines and city standards. Variance from the requirements in this section shall require a written design exception.

12.5 Location. The outside edge of sidewalk shall be placed a minimum of one foot inside the street right of way line.

12.6 Width. Sidewalks shall be a minimum width of five feet. Should conditions require the sidewalk to be closer to the street than standard design the width will be adjusted as follows:

12.6.1 Five feet when offset from the back of curb by a minimum of one foot.

12.6.2 Six feet when immediately adjacent to the back of curb.

12.7 Sidewalk Cross-Section Grade. The minimum cross slope for sidewalks shall be 1% and the maximum cross slope shall be 2%. Driveway grades shall be adjusted to meet this maximum. Written design exceptions for a lesser width will be considered in some situations. Joint lines shall delineate the portion of the sidewalk that crosses the driveway, so it is clear where the sidewalk crosses the entrance.

12.8 Longitudinal Grade. The longitudinal grade of the sidewalk shall not exceed the grade of the adjacent roadway within the right of way. For sidewalks and trails not built adjacent to a street the maximum grade is 5%.

12.9 Drainage. Drainage from properties adjacent to the sidewalk shall not drain across the surface of the sidewalk nor shall the grade of the sidewalk be constructed that water would pond on the surface of the sidewalk.

12.10 Obstructions. All obstructions shall be removed or relocated off the sidewalk.

12.11 Grade Breaks. Grade breaks shall not be permitted across curb ramps, landings or gutter areas within the pedestrian access route.

12.12 Expansion Joints: Expansion joints shall be constructed at 100 feet intervals or as shown on the plans and shall be formed one-half (1/2) inches wide and extend the full depth of the slab. In addition to the 100 feet intervals, expansion joints shall be placed on each side of driveways, and between the sidewalk and all structures within the limits of the sidewalk such as light standards, traffic light standards, traffic poles, and columns or shown on the plans. The expansion joint shall be constructed by installing ½ inch thick bituminous material for the full depth of the concrete slab to within 1/4 of an inch of the surface of the sidewalk slab. Edges of the slab shall be edged with an edging tool that has a 1/4-inch radius. The top ¼ inch of the joint shall be filled with flowable sealer to the level of the adjacent concrete surface. The sealer shall be applied per the manufacturer's instructions utilizing equipment suitable for this purpose.

12.13 Contraction Joints: The sidewalk surface shall be marked off into square stones by contraction joints as shown on the plans. The joints shall be one-eighth (1/8) inches wide by depth of one quarter the thickness of the concrete and may be formed either by inserting a fiber strip, tooling, or by use of a concrete saw. The maximum distance between contraction joints shall be six feet and a minimum of four feet unless otherwise approved by the Engineer.

12.14 Curb Ramps. Curb ramps shall be installed at all intersections with streets, alleys, and mid-block pedestrian crossings in accordance with ADA Standards for Accessible Design and Public Right of Way Accessibility Guidelines. The running slope shall be 12:1 maximum except that the length of the curb ramp shall not exceed fifteen feet. The cross slope shall be two percent maximum. A minimum landing of five feet by five feet shall be provided at the top and bottom of the curb.

12.15 Replaceable Detectable/Tactile Warning Surface. Surfaces as specified in Section 09614 shall be placed prior to the intersection of the sidewalk and a public street or alley.

12.16 Required reinforcement and tie bars shall be held in the designated position during the placing of concrete by bar chairs or other approved devices. Expansion joints shall be constructed at intervals and locations shown on the plans or as directed by the Engineer.

12.17 Placement and Finishing: Concrete shall be placed on the prepared and sprinkled base, compacted and struck off to the required thickness. Concrete shall be tamped or vibrated sufficiently to eliminate all voids and to bring mortar to the top, after which the surface shall be finished smooth and even. Concrete sidewalks shall be given a light broom finish and shall be sprayed with a liquid membrane-forming compound or as specified by the Engineer.

12.17.1 All edges shall be rounded with an edging tool.

12.17.2 Contraction joints shall be placed at intervals as noted above.

12.17.3 Contraction joints may be placed with a joint tool or by cutting with a concrete saw.

12.18 After the concrete has set sufficiently, the forms shall be removed, and where necessary, the contractor shall backfill adjacent to the concrete with suitable material, compacted and finished in a satisfactory manner. All joints shall be filled with as specified above.

13. DRIVEWAYS

13.1 General: Driveway approaches are located to serve the operation of automobiles and other vehicles from the street pavement to the garage, parking area, building entrance, structure, or other approved use located on the property.

13.2 Design: Driveway approaches shall be constructed using Class B1 Portland Cement Concrete with a minimum 28-day compressive strength of 3500-psi in accordance with Section 3 of this specification.

13.2.1 All driveway pavement shall be constructed on a minimum of 4” inches of base rock.

13.2.2 When a driveway approach intersects an existing 4-inch-thick sidewalk, the area of the sidewalk within the driveway and both sides of the sidewalk transition sections to meet the drive elevation or 18 inches, whichever is greater, shall be removed and reconstructed with 7-inch-thick concrete.

13.2.3 The cross slope of the sidewalk area shall not to exceed 1:50 (2%). The grade of the driveway approach from the gutter line shall rise on a constant grade to the front edge (side street) of the sidewalk area. The algebraic difference of longitudinal grade changes of the driveway approach shall not exceed 13%. The maximum grade for a driveway shall be 15%.

13.2.4 The width of residential driveway approaches shall not exceed 36 feet without permission from the City Engineer and shall not be less than 11 feet for new construction. The width of a driveway is measured at the Right-of- Way line.

13.3 Approach Location: Driveway spacing is restricted by the city Subdivision Regulations and the City Code. Zoning cases, planned developments and subdivisions are subject to the access restrictions set forth in the city Subdivision Regulations and city Code.

13.3.1 No driveway approach shall be permitted which will interfere with any existing parking meters, signs, traffic control devices, planting, cables, poles, guys, water mains, gas mains, or other public utilities.

13.3.2 No part of any driveway approach shall be located within 4 feet of a drop inlet or other drainage structure of pedestrian ramp.

13.4 Shared Driveways: Shared driveway approaches shall be permitted only if there is a perpetual mutual access agreement approved by the City Attorney and filed on record in the Jasper County Recorder's Office.

13.4.1 Edges of the driveway approach may be skewed so that the angle between the street right-of-way line and the edge of the driveway approach is not less than 60 degrees.

13.5 Concrete shall be placed in accordance with the provisions of Section 5 of this specification.

14. GROUT

14.1 General: This item includes furnishing, placing and finishing the grout at the various locations as required.

14.2 Materials: Materials are specified herein.

14.3 Proportioning & Mixing: Grout shall consist of a mixture of 1part portland cement and 2 parts fine aggregate with a slump of three inches to five inches. The water-cement ratio shall be maintained at not more than 4½ gallons per bag of cement. The ingredients shall be mixed in accordance with the applicable portions of this Specification so as to produce a uniform mass of material.

14.4 Placing: Before placing grout, the concrete shall be thoroughly cleaned of all dust, dirt or other deleterious material and then shall be thoroughly wet. Grout shall be placed in one continuous operation to the thickness shown on the plans with no construction joints allowed.

14.5 After the grout is placed, it shall be given a floated finish as specified in this Specification and shall be cured as specified under Section 9 of this Specification.

15. MEASUREMENT AND PAYMENT

15.1 Concrete items shall be measured and paid for at the various units as noted in Section 01151.

CONCRETE ADMIXTURES 03301

1. GENERAL

1.1 Description: The work of this section consists of furnishing and using materials and procedures for air-entrainment of and/or addition of chemical admixtures to concrete.

2. MATERIALS

2.1 Air-entrainment Admixtures: Air-entrainment shall be accomplished using Type 1 Portland cement with the addition of an approved air-entrainment admixture or using Type 1A Portland cement. Air-entrainment admixtures shall conform to "Standard Specifications for Air-Entraining Admixtures for Concrete", ASTM C260.

2.2 Water Reducing, Retarding, and Accelerating Admixtures: Water reducing, retarding, or accelerating admixtures, if permitted by the Owner, shall conform to "Standard Specifications for Chemical Admixtures for Concrete", ASTM C494.

2.3 Fly Ash: Fly ash may be allowed as an admixture in the concrete mix concrete mix provided the following requirements are satisfactorily addressed.

2.3.1 Its use is in strict accordance with ASTM C618, latest revision.

2.3.2 Fly ash shall be sampled and tested in accordance with ASTM C311, latest revision.

2.3.3 Prior to being approved for use, fly ash shall be tested in combination with the cement and aggregates proposed for use to ascertain its suitability with regard to water requirements, strength development, shrinkage, heat of hydration, and durability.

3. EXECUTION

3.1 Water Reducing, Retarding, and Accelerating Admixtures: Such admixtures may be used when such use is requested by the Contractor subject to review and approval by the Owner. For certain uses, the Owner reserves the right to require the use of a retardant or other admixtures for specific uses such as a retardant in extensive wall pours to assure elimination of cold joints or for other such purposes. No additional compensation will be allowed when such admixtures are used. However, when certain such admixtures are used, it will be allowable to reduce the cement content of the mix to a minimum of 5 ½ bags of cement per cubic yard of concrete, subject to the following conditions: A trial batch and test cylinders taken therefrom demonstrate that the mix will meet the strength, workability, slump, and durability requirements of the specified mix previously herein stated. The strength shall be determined from seven-day test cylinders from a trial batch utilizing the admixture and made using the aggregates selected for the job, to establish the correct proportions to give proper workability with the water-cement ratio specified. The seven-day test strength shall equal 95 percent of the specified minimum 28-day strength.

3.2 Air-entraining and chemical admixtures shall be charged into the mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighed or measured by volume as recommended by the manufacturer. The accuracy of measurement by any admixture shall be within ± three percent.

3.3 Two or more admixtures may be used in the same concrete, provided such admixtures are added separately during the batching sequence and provided further that the admixtures used in that combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Addition of retarding admixtures shall not be significantly delayed after the addition of the cement.

3.4 The addition of calcium chloride to the mix will not be allowed.

4. MEASUREMENT AND PAYMENT

4.1 Concrete admixtures shall not be measured and paid for separately but shall be considered incidental to the various concrete items.

REPLACEABLE DETECTABLE/TACTILE WARNING SURFACES.....09614

1. GENERAL

1.1 Description: The work of this section consists of furnishing all materials, tools, labor, supervision and incidentals necessary for installing replaceable cast-in-place detectable/tactile warning surfaces.

1.2 Locations: Warning surfaces shall be installed in all curb ramps and at other locations as shown and noted on the drawings.

2. MATERIALS

2.1 The warning surface shall consist of replaceable tiles manufactured from an epoxy polymer composition with an ultraviolet stabilization coating. Each tile shall be a minimum of 24" by width shown or noted by a depth of 0.5". Tile face thickness shall be a minimum of 0.1875".

2.2 The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2" height, 0.9" base diameter and 0.45" top diameter. The domes shall be spaced 3.4" center to center as measured on a diagonal and 2.35" as measured side by side.

2.3 The field area shall consist of a non-slip surface with a minimum of 40, 90° raised points, 0.045" high per square inch.

2.4 The entire surface of each tile shall be colored Brick Red conforming to Federal Color No. 22144.

2.5 Tiles shall be anchored with tamper resistant, flat-head, hex socket, stainless steel screws secured to hexagonal embedment anchors.

3. EXECUTION

3.1 All manufacturers' recommendations and requirements shall be followed and strictly adhered to.

3.2 The physical characteristics of the concrete shall be in accordance with the specifications however the concrete to receive the tiles shall be placed with a 4" to 7" slump. This slump will allow the solid placement of the tile.

3.3 Concrete shall be placed and finished true and smooth to the required dimensions and slope prior to the tile placement. Immediately after finishing the concrete, the tile shall be placed true and square to the curb edge and shall be tamped or vibrated into the fresh concrete. The tile shall be placed such that the field level of the tile (base of truncated domes) is flush to the adjacent concrete surface to permit proper drainage and eliminate tripping hazards between adjacent finishes.

3.4 A 1/8" radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile's perimeter.

3.5 Following placement of the tile, a weight of 10 to 25 pounds may be placed on each tile to ensure solid contact of the underside of the tile with the concrete. No traffic, foot or vehicular, shall be allowed on the tile until the concrete has been cured for a minimum of 48 hours.

3.6 Once the concrete has cured the protective tile covering shall be removed and the tile surface shall be cleaned to remove any concrete residue.

4. MANUFACTURER

4.1 Replaceable cast-in-place detectable/tactile warning surfaces shall be as manufactured by Engineered Plastics Inc or approved equal.

5. MEASUREMENT AND PAYMENT

5.1 Replaceable cast-in-place detectable/tactile warning surfaces shall be measured and paid for as noted in Section 01151, paragraph 2.20. Such payment shall include all materials, equipment, labor, supervision and incidentals necessary to provide and install the warning surfaces.

CONCRETE REINFORCEMENT.....03200

1. GENERAL

1.1 Description: The work of this section consists of furnishing, hauling all reinforcement materials and all tools, labor, equipment and incidentals necessary to complete this section.

2. MATERIALS

2.1 Reinforcing Steel: Reinforcing bars shall conform to the "Standard Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A615 or to the "Standard Specifications for Axle-Steel Deformed Bars for Concrete Reinforcement", ASTM A617 and shall be Grade 40, as designated on the plans.

2.2 Welded Wire Fabric: Welded wire fabric shall conform to "Standard Specifications for Welded Steel Sire Fabric for Concrete Reinforcement", ASTM A185.

2.3 Metal Supports: Metal chairs used to support tie bars or reinforcing bars shall be channel shaped pressed out of sheet steel of not less than twelve (12) gauge (U.S. Standard) metal and conforming to details shown on the plans.

2.4 Expansion Tubes: Metal dowel caps or tubes shall be manufactured from thirty-two (32) gauge sheet metal, shall be indented to provide a limiting stop for the dowel bar, and shall provide unobstructed expansion space of not less than one (1) inch to permit movement of the dowel bar. They shall be of proper size to fit the specified bars tightly and the closed end shall be watertight.

3. EXECUTION

3.1 General: Unless otherwise indicated on the Plans or specified herein, all cutting and bending or reinforcement bars shall be done at the mill or ship prior to shipment. Cutting and bending in the field will be permitted only where shown on the plans or to correct errors, damage by handling and shipping, and minor omissions in shop bending when authorized by the Resident Project Representative.

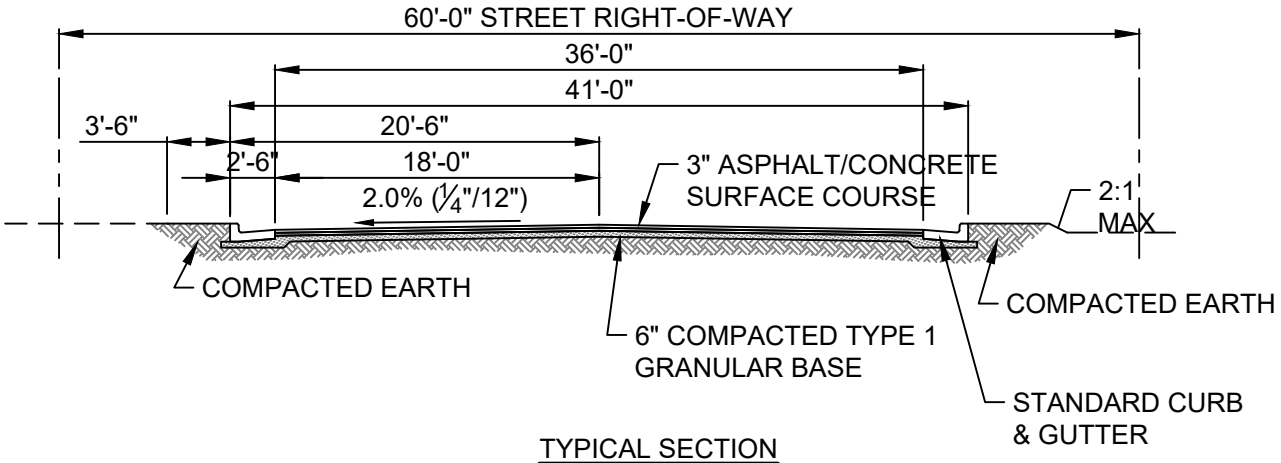
3.2 Storing and Cleaning:

3.2.1 All reinforcement shall be stored above ground on skids, pallets or other supports and shall be protected from mechanical injury and from deterioration by exposure.

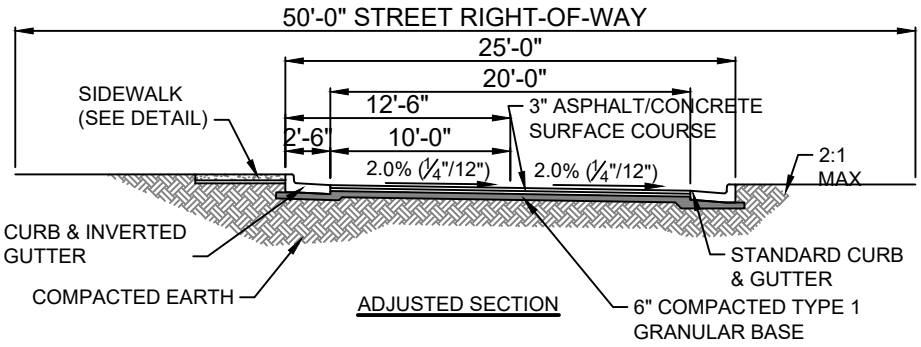
3.2.2 When placed in work, reinforcement shall be free from dirt, detrimental scale, concrete, paint, oil or other foreign materials. Tight, thin rust is not considered detrimental and will not require cleaning.

3.3 Placing: Except as shown on the Plans or specified herein, all placement of reinforcing bars, welded wire fabric and bar supports shall conform to the latest editions of "Placing Reinforcing Bars, CRSI-WCRSI Recommended Practices", published by the Concrete Reinforcing Steel Institute. Bars may be moved as necessary to avoid interference with other reinforcing steel, pipes and other embedded items. If bars are moved more than the specified tolerances, the resulting arrangement shall be approved by the Resident Project Representative.

3.4 Splices: When splices other than those shown on the plans become necessary, they shall be located at areas of low stress and shall be subject to approval by the Resident Project Representative.



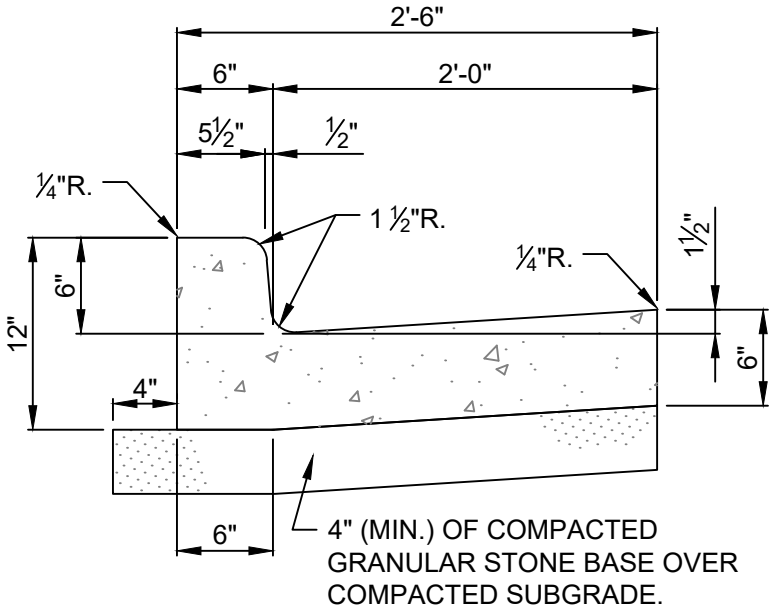
TYPICAL SECTION



ADJUSTED SECTION

ST-1

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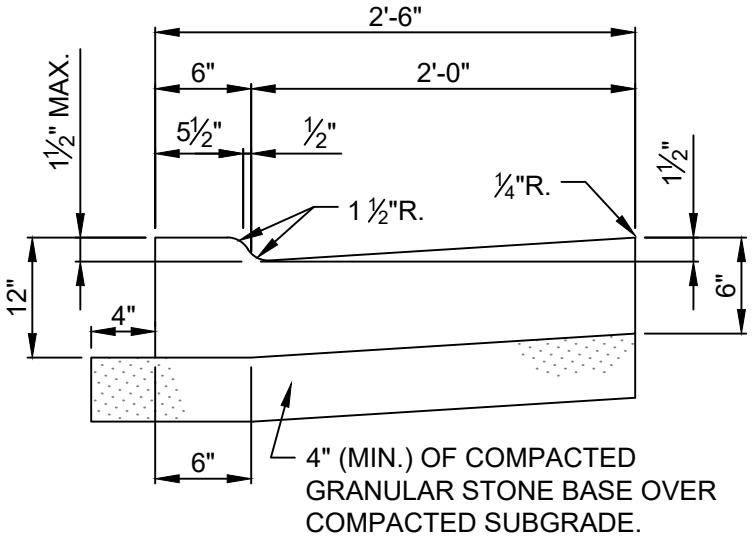


STANDARD CURB & GUTTER

1" = 1'-0"

ST-2

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DEPRESSED CURB & GUTTER

1" = 1'-0"

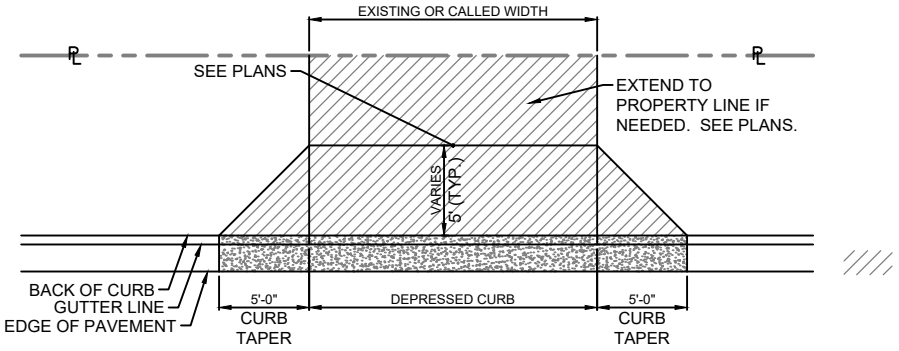
ST-3

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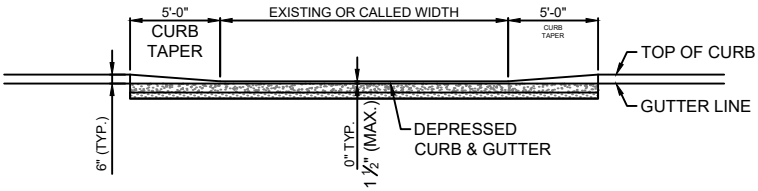
NOTES:

1. ALL POURED CONCRETE SHALL BE PAVEMENT CLASS.
2. STEEL REINFORCEMENT IS NOT ALLOWED.
3. BID PRICE FOR ALL DRIVES SHALL INCLUDE ALL EXCAVATION, LABOR, & MATERIALS REQUIRED TO CONSTRUCT DRIVE.
4. MAXIMUM DRIVE GRADE SHALL NOT EXCEED 15%.
5. ALGEBRAIC DIFFERENCE AT GRADE CHANGES, NOT TO EXCEED 13%.

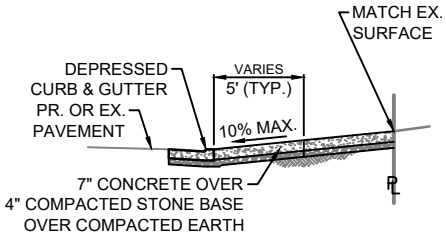
PAY LIMITS FOR ENTRANCES



PLAN



ELEVATION AT GUTTER LINE

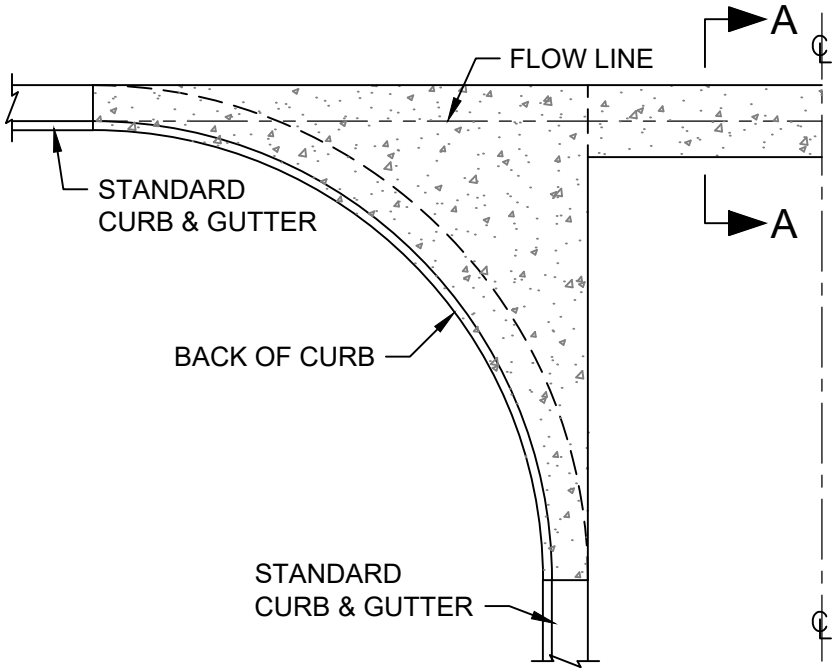


TYPICAL SECTION

DRIVEWAY

ST-4

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CONCRETE GUTTER CROSSING

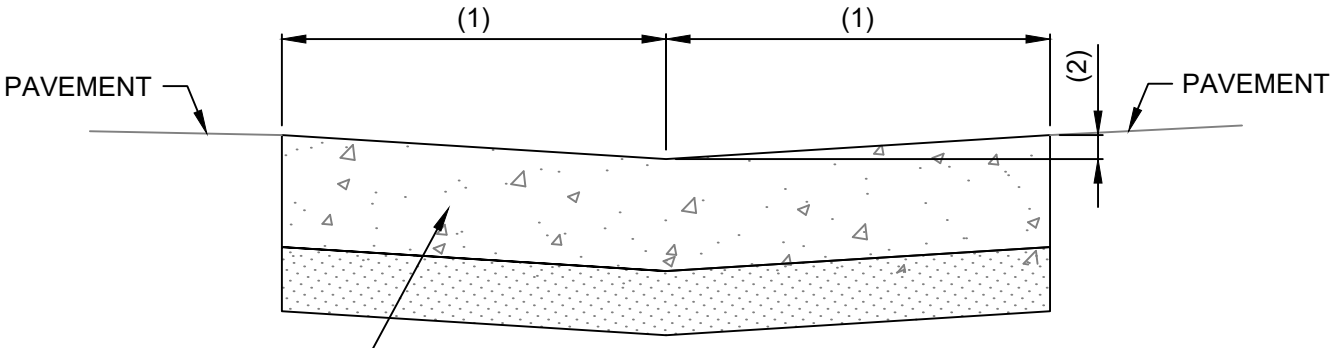
NOTES:

IF CURB & GUTTER IS EXISTING PLACE EXPANSION JOINT MATERIAL BETWEEN GUTTER AND THE NEW GUTTER CROSSING.

IF NO CURB & GUTTER EXISTS, CONSTRUCTION OF CURB, GUTTER & GUTTER CROSSING SHALL BE MONOLITHIC.

(1) TO MATCH STANDARD CURB & GUTTER WIDTH.

(2) TO MATCH STANDARD CURB & GUTTER DEPTH AND SLOPE.

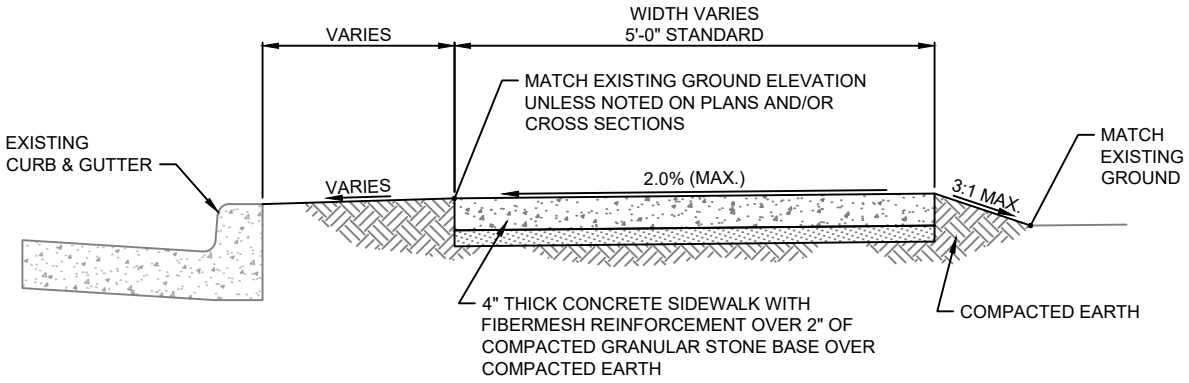


SECTION A-A

1" = 1'-0"

ST-5

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4" CONCRETE SIDEWALK

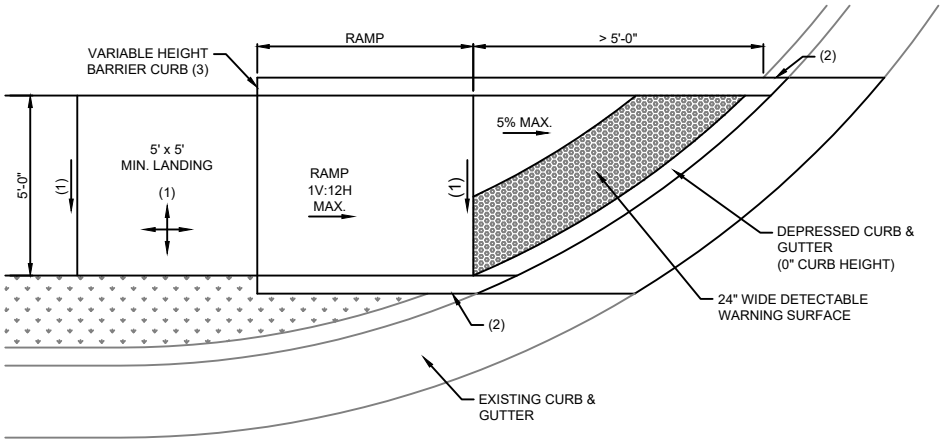
ST-6

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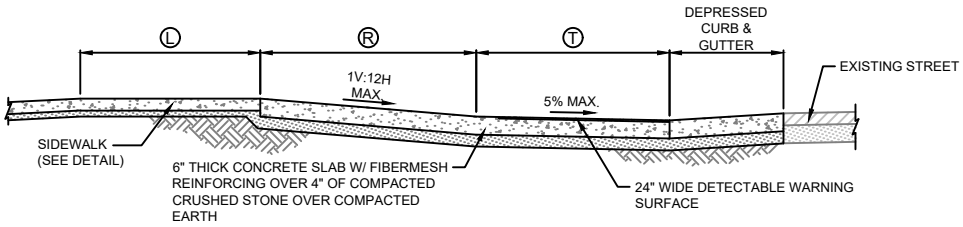
NOTES:

(1) 1.0% MINIMUM, 2.0% MAXIMUM CROSS SLOPE.
(2) VARIABLE HEIGHT VERTICAL CURB. IF TRAVERSABLE USE A MAX. 1V:10H FLARE MEASURED PARALLEL TO THE CURB LINE.
(3) HEIGHT VARIES TO MEET EXISTING GROUND.

Ⓣ = TRANSITION
Ⓡ = RAMP
Ⓛ = LANDING



PLAN



TYPICAL SECTION

TYPE "A" CURB RAMP

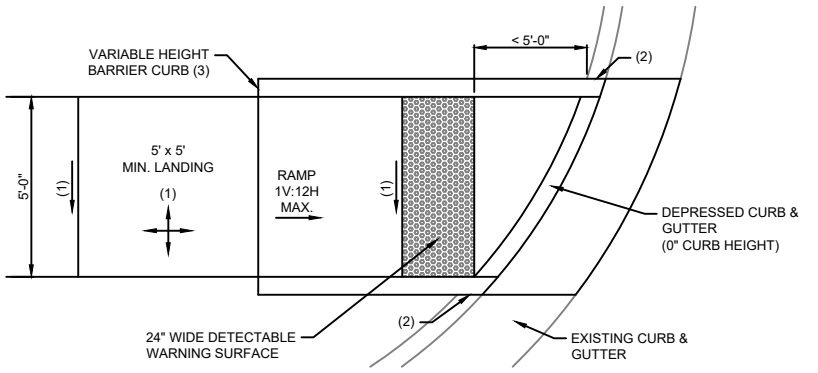
ST-7

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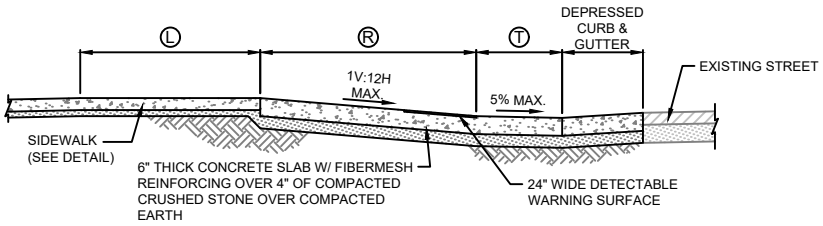
NOTES:

(1) 1.0% MINIMUM, 2.0% MAXIMUM CROSS SLOPE.
(2) VARIABLE HEIGHT VERTICAL CURB. IF TRAVERSABLE USE A MAX. 1V:10H FLARE MEASURED PARALLEL TO THE CURB LINE.
(3) HEIGHT VARIES TO MEET EXISTING GROUND.

Ⓣ = TRANSITION
Ⓡ = RAMP
Ⓛ = LANDING



PLAN



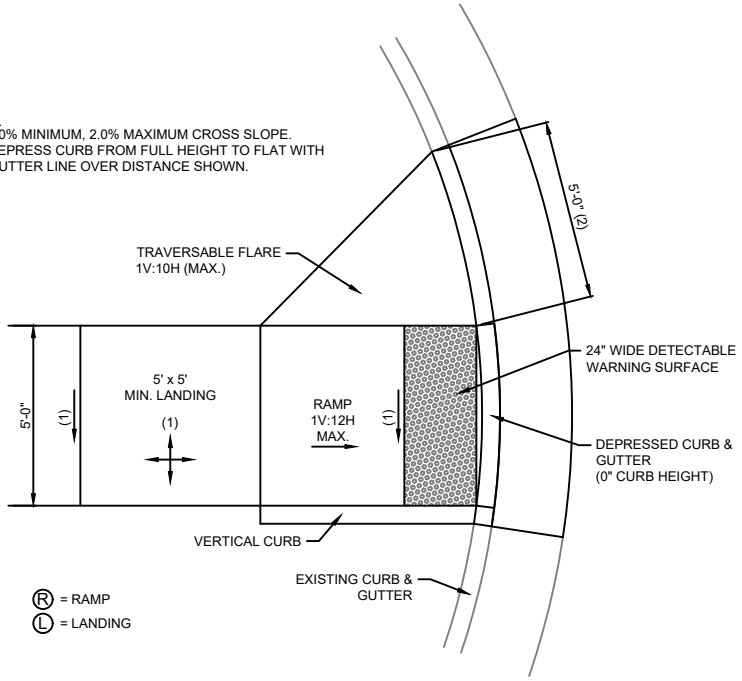
TYPICAL SECTION

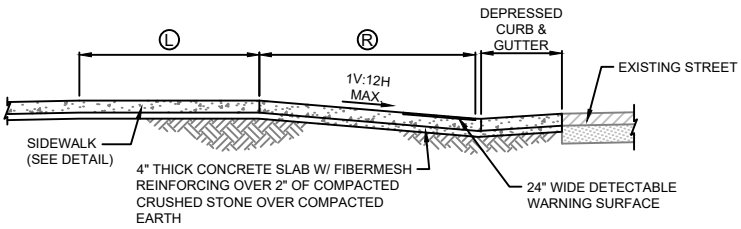
TYPE "B" CURB RAMP

ST-8

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NOTES:
(1) 1.0% MINIMUM, 2.0% MAXIMUM CROSS SLOPE.
(2) DEPRESS CURB FROM FULL HEIGHT TO FLAT WITH GUTTER LINE OVER DISTANCE SHOWN.



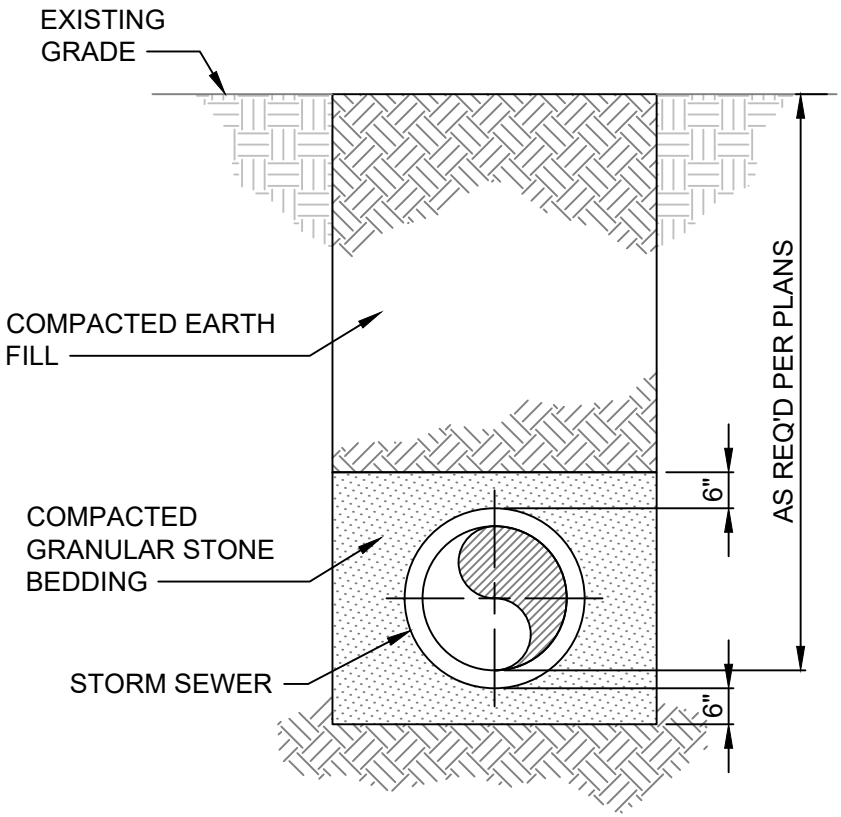


TYPICAL SECTION

TYPE "C" CURB RAMP

ST-9

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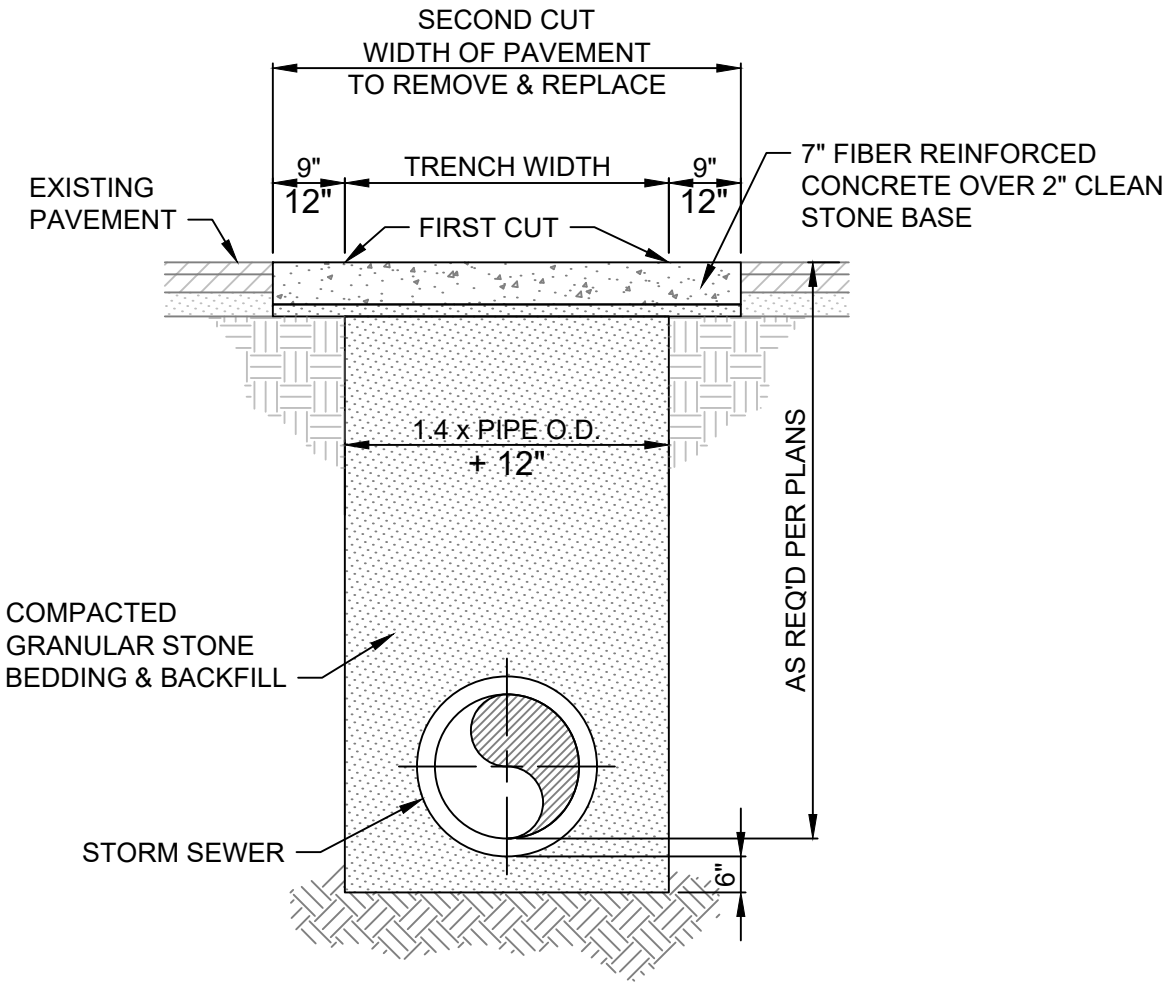
NOTES:

TRENCH SHALL BE EXCAVATED TO PROVIDE VERTICAL WALLS.
TRENCH SHALL BE EXCAVATED TO A DEPTH OF 6" BELOW BOTTOM OF PIPE, BEDDED IN CRUSHED STONE CONFORMING TO THE SPECIFIED GRADATION TO PROVIDE UNIFORM BEDDING FOR THE ENTIRE LENGTH OF THE PIPE, AND BACKFILLED FULL TRENCH DEPTH WITH COMPACTED EARTH.

TRENCH & BEDDING DETAIL

ST-10

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NOTES:

TRENCH SHALL BE EXCAVATED TO PROVIDE VERTICAL WALLS.
TRENCH SHALL BE EXCAVATED TO A DEPTH OF 6" BELOW BOTTOM OF PIPE AND BACKFILLED FULL TRENCH DEPTH WITH CRUSHED STONE CONFORMING TO THE SPECIFIED GRADATION TO PROVIDE UNIFORM BEDDING FOR THE ENTIRE LENGTH OF THE PIPE.

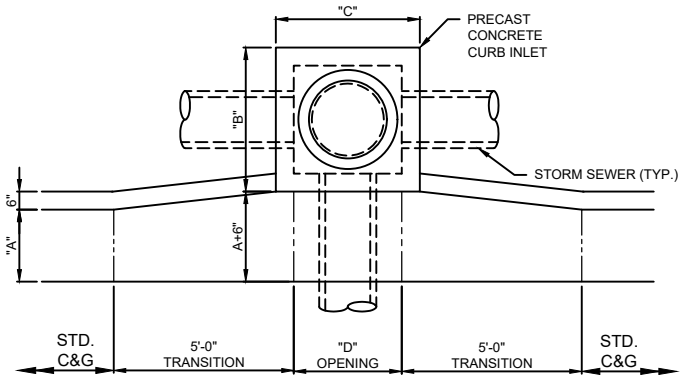
TRENCH & BEDDING DETAIL FOR PAVEMENT REPLACEMENT

ST-11

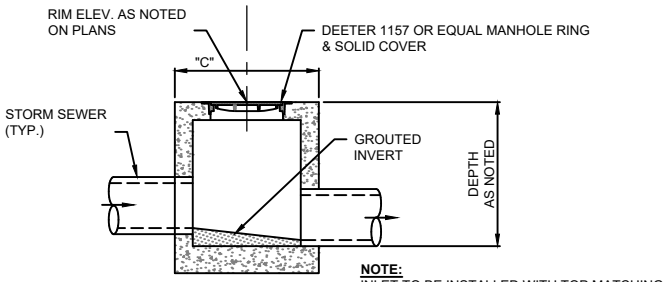
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NOTES:
"A" = 2'-0" OR 2'-6" (PER APPROVED DESIGN)

SEE STORM SEWER PLAN & PROFILE DRAWINGS, FOR SIZE AND DIRECTION OF STORM SEWER PIPES.

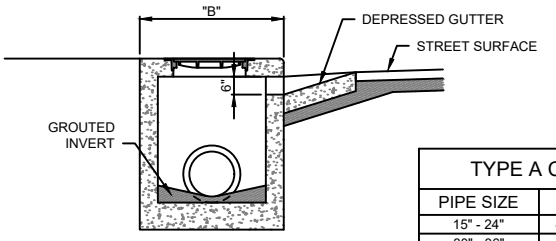


TOP VIEW



FRONT VIEW

NOTE:
INLET TO BE INSTALLED WITH TOP MATCHING SLOPE OF CURB



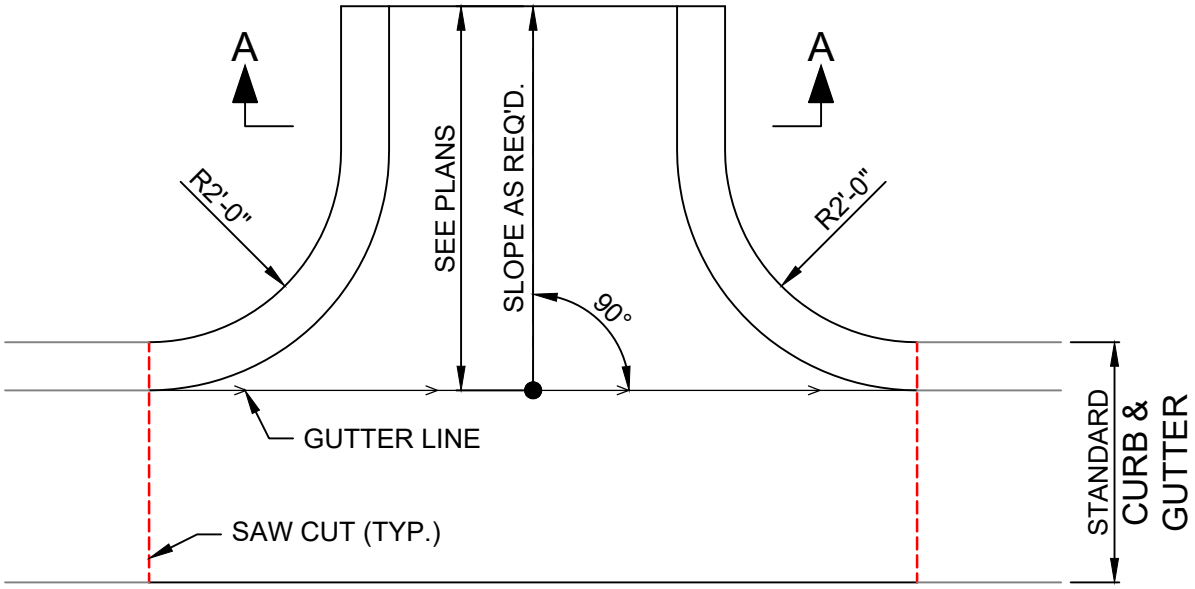
SIDE VIEW

TYPE A CURB INLET			
PIPE SIZE	B	C	D
15" - 24"	4'-0"	4'-0"	3'-0"
30" - 36"	5'-0"	5'-0"	4'-0"
>36"	TO BE DESIGNED		

TYPE "A" CURB INLET

ST-12

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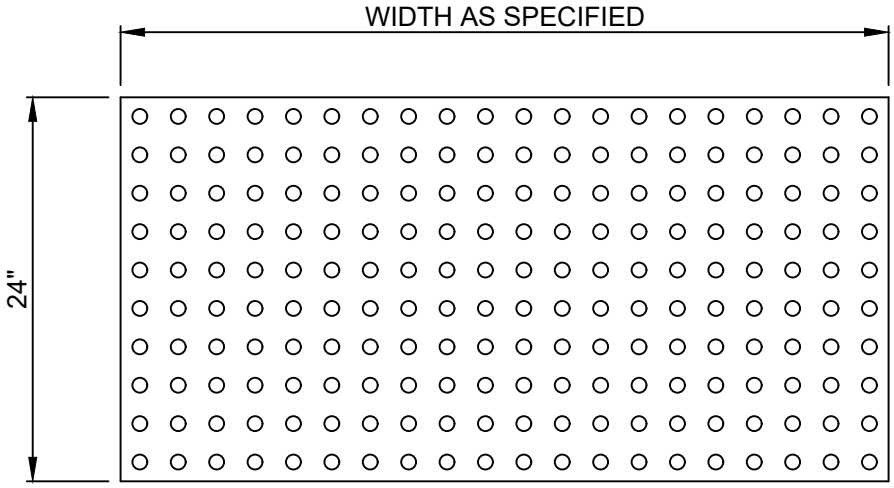


PLAN

90° CURB FLUME

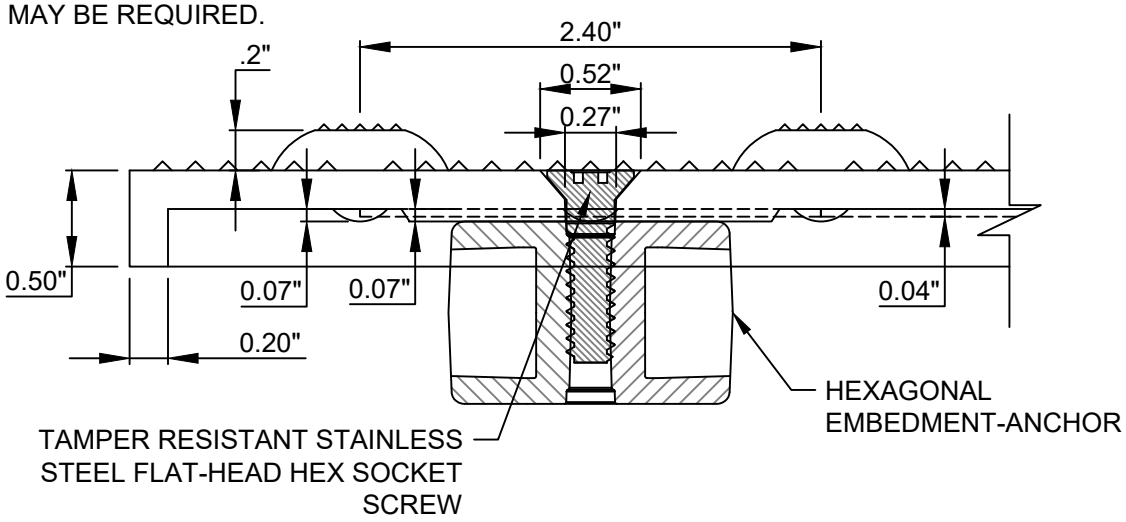
ST-13

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NOTE:
RECTANGULAR SECTION SHOWN.
DIFFERENT CONFIGURATIONS
MAY BE REQUIRED.

PLAN



TYPICAL ENLARGED SECTION

TACTILE WARNING SURFACE DETAILS

ST-14

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