UNIFORM STANDARD SPECIFICATIONS
CLARK COUNTY AREA

SPECIFICATIONS - YEAR 2001 REVISIONS

SPECIFICATION NUMBER AND TITLE	PAGE NUMBER(S)	NATURE OF CHANGE	EFFECTIVE DATE
301 Selected Material Base or Surface	301-1	Revision to Subsection 301.03.01 to establish a tolerance for the preparation of subgrade.	1/1/01
302 Aggregate Base Courses	302-1, 302-2	Revision to Subsections 302.03.01 and 302.03.06 to establish tolerances for the preparation of subgrade and aggregate base.	"
401 Plantmix Bituminous Pavements	401-(1-2), 401-(6-7), 401-12, 401-(18-20)	Revisions to Subsections 401.01.02, 401.02.05, 401.03.04 and 401.03.12 to establish pavement acceptance criteria and pavement structural design standards which are in accordance with AASHTO.	"
613 Concrete Curb, Walk, Gutters, Driveways and Alley Intersections	613-(2-3)	Revision to Subsection 613.03.06 to remove paragraphs five and seven.	"
706 Aggregate for Portland Cement Products	706-1	Revision to Subsection 706.02.01 to aggregate grading table and the addition of alternative to the mix design submittal process using qualified mix designs available on the Internet.	"
208.03.02, 213.02.10, 501.03.05, 502.01.01, 503.03.09, 502.04.01, 508.03.10, 601.05.01, 609.03.02, 611.02.01, 613.01.01, 616.03.01, 616.03.03, 617.02.01, 618.03.01, 621.02.01, 623G.03.06	Various	Revision to various subsections of these specifications to eliminate references to specific class of concrete.	"

SPECIFICATION NUMBER AND TITLE	PAGE NUMBER(S)	NATURE OF CHANGE	EFFECTIVE DATE
508 Piling	508-(8-10)	Addition of specification for crosshole sonic logging of piles to Subsection 508.01.10 (b).	3/1/01
701 Portland Cement	701-1	Revision to reduce the required minimum cement content in concrete used for precast products, pipe and box culverts, with zero slump design.	"
610 Slope and Channel Protection	610-2	Revision to Subsection 610.02.04 to remove 500 revolution rotation from "Percent of Wear" source requirement.	5/1/01
208 Trench Excavation and Backfill	Various	Revision to Subsections: 208.02.08 - Type III table changed; 208.03.02 - Change requirement for use of crushed rock as a pipe bedding material; 208.02.06, 208.03.02-05 - Change references of flowable backfill to CLSM; 208.03.05 - Clarification of mechanical placement requirement for asphalt.	6/1/01
505 Reinforcing Steel	505-1	Revision to Subsection 505.02.02 to clarify sampling of rebar.	"
629 Water Distribution Facilities	629-9	Revision to Subsection 629.02.24 to replace concrete specification with a reference to Section 501, "Portland Cement Concrete."	"
401 Plantmix Bituminous Pavements - General	401-3, 401-18	Revision to Subsection 401.02.01 to base design on Traffic Index (TI) rather than Equivalent Single Axle Load (ESAL) and to Subsection 401.03.12 to change field density testing requirements.	12/1/01

SPECIFICATION NUMBER AND TITLE	PAGE NUMBER(S)	NATURE OF CHANGE	EFFECTIVE DATE
705 Aggregates for Bituminous Courses	705-2	Revision to Subsection 705.03.01 to include new test methods such as methylene blue, fine aggregate angularity, stripping, etc. for Type 2 and 3 mixes and change the requirement for fractured faces.	12/1/01

Revised January 2002

UNIFORM STANDARD SPECIFICATIONS

FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS

CLARK COUNTY AREA NEVADA

FOREWORD

Publication of these Uniform Standard Specifications for Public Works Construction Off-site Improvements, Clark County Area, Nevada, is the third edition of this important document and will supersede the 1986 edition. **All revisions to these specifications approved by the Regional Transportation Commission through December 2001 have been included in this publication.**

This edition modified to fit local conditions and problems follows the format of the Nevada Department of Transportation Specifications for Road and Bridge construction. It is felt this similarity of general makeup will be an aid to all those using both specifications.

Special provisions and drawings will be provided, when necessary, to supplement or modify these standard specifications.

The Uniform Standard Specifications for Public Works Construction may be revised by issuance of revisions or supplements to correct errors and omissions found in these specifications and to reflect advanced thinking and the changing technology of the construction industry. Each revision or supplement will supersede any previous supplement by inclusion of all pertinent portions. Upon approval by the Regional Transportation Commission, revisions will be posted to the RTC website, **www.rtc.co.clark.nv.us**, on the first day of the month following the meeting.

To implement this end, a Specifications Committee has been established as a permanent organization to continually study and recommend changes to the standard specifications. Interested parties may address suggested changed and questions to the Uniform Standard Specifications Committee c/o Regional Transportation Commission, 600 South Grand Central Parkway, Suite 350, Las Vegas, Nevada 89106-4512.

The following participating entities of the Clark County, Nevada area have adopted these specifications, as revised, by Resolution or Council or Board Action of the governing bodies as follows:

CLARK COUNTY
Adopted by Resolution . . . . . July 20, 1993

CITY OF LAS VEGAS
Adopted by Resolution R32-93 . . . . . June 16, 1993

CITY OF NORTH LAS VEGAS
Adopted by Resolution No. 1685 . . . . . June 16, 1993

CITY OF HENDERSON
Adopted by Ordinance No. 549 . . . . . August 20, 1984
Revisions Adopted By Council Action (3rd Edition) . . . . . June 15, 1993

CITY OF BOULDER CITY
Adopted by Resolution No. 2379 . . . . . March 22, 1994

CITY OF MESQUITE
Adopted by Resolution No. 26 . . . . . January 8, 1987
Revisions Adopted By Council Action (3rd Edition) . . . . . June 10, 1993

REGIONAL TRANSPORTATION COMMISSION
Adopted by Resolution No. 7 . . . . . June 14, 1984
Revisions Adopted By Commission Action . . . . . Various Dates

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Special care shall be taken in placing and thoroughly compacting the material under the haunches of all pipe culverts.

Unless otherwise directed, the backfilling shall continue as directed to the level of the ground or to an elevation six (6) inches (150 millimeters) above the structure in the case of a pipe culvert in projection, or even with the top of the structure in the case of reinforced concrete box culvert in projection.

No construction equipment or other traffic shall be permitted to cross any culvert until a safe minimum depth of fill above the culvert has been placed and compacted in accordance with these specifications. The Contractor shall be solely responsible for protecting the structure from superimposed loading by construction equipment and shall repair any damage to the structure or replace the structure as ordered without extra compensation.

Special care shall be taken in backfilling arches, particularly half-circle arches. The arch shall be covered in layers, each layer conforming to the shape of the arch and tamped thoroughly.

207.03.04 PLACING AND COMPACTING OF BIN-TYPE RETAINING WALLS: Placing and compacting backfill material for bin-type retaining walls shall progress concurrently with the assembly of the bins, and backfilling around the outer sides thereof shall be kept approximately level with the inside fills. The materials shall be thoroughly tamped and meet the density requirements as set forth in Subsection 207.03.01, "General." Care shall be exercised to completely fill the depressions of stringers and spacers without displacing them from established line and batter.

BASIS OF PAYMENT

207.04.01 PAYMENT: Unless otherwise provided in the Special Provisions or Proposal, no payment will be made for structure excavation or backfill as such; the cost thereof under normal circumstances being considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant. Payment for such excavation or backfill will be made when the Special Provisions or Proposal provides.

SECTION 208

TRENCH EXCAVATION AND BACKFILL

DESCRIPTION

208.01.01 GENERAL: This work shall consist of the excavation and backfill of trenches for the accommodation of substructures including, but not limited to electrical conduits, telephone conduits, television cable, traffic signal conduits, gas lines, sewer lines, water lines, and storm drains.

When the terms "Backfill" or "Trench Backfill" are used herein, they shall be construed to mean one or more of the types of backfill specified below under "MATERIALS."

MATERIALS

208.02.01 SELECTED BACKFILL: Selected backfill shall be as specified in Subsection 207.02.01, "Selected Backfill."

208.02.02 GRANULAR BACKFILL: Granular backfill shall be as specified in Subsection 207.02.02, "Granular Backfill."

208.02.03 SAND BACKFILL: Sand backfill shall consist of natural sand or a mixture of sand with gravel or stone. In addition thereto, the material shall conform to the following gradation requirements:

Sieve Sizes	Percentage of Weight Passing
3/8"	100
No. 4	80-100
No. 200	5-20

The plasticity index of the material shall be as specified in Subsection 704.02.03, "Plastic Limits." The soluble sulfate content shall not exceed 0.3% by dry weight of soil.

208.02.04 TYPE II AGGREGATE BASE BACKFILL: Type II aggregate base backfill shall be as specified in Subsection 704.03.04, "Type II Aggregate Base". The soluble sulfate content shall not exceed 0.3% by dry weight of soil.

208.02.05 DRAIN BACKFILL: Drain backfill shall be as specified in Subsection 704.03.01, "Drain Backfill." The type shall be as shown on the plans or approved by the Engineer.

208.02.06 CONTROLLED LOW STRENGTH MATERIAL (CLSM): CLSM (flowable fill) shall consist of a low-strength, self-leveling concrete material composed of various combinations of cement, fly ash, aggregate, water, and chemical admixtures. It shall have a design compressive strength at an age of 28 days within the ranges

required in the table below for the specified class:

Class I (50 to 150 psi (345 kPa to 1.03 MPa)): Specified where the maximum strength is of primary concern due to the desire to have material that can be excavated in the future with relative ease.

Class II - 100 to 300 psi (1.03 Mpa to 2.07 Mpa): Specified where the minimum strength is of primary concern for pipe support.

Class Special (as shown in project specifications or drawings): Specified where project unique criteria, such as erosion control, are the primary concern.

For Class I CLSM, compressive strength testing shall be performed in accordance with ASTM D 4832, except molds shall be made of masonry block. Masonry block molds can be 4" x 4" x 8" (100 mm x 100 mm x 200 mm) rectangular prisms constructed in accordance with UBC Standard Test Procedure 21-18, or the specimen may be 4" (100 mm) diameter by 8" (200 mm) high cylinders made using concrete block with cylindrical cells of that size. All other requirements of ASTM D 4832 shall apply.

For Class II CLSM, compressive strength testing shall be performed in accordance with ASTM D 4832, including mold requirements. For Class Special, the compressive strength testing procedures shall be specified in the project specifications or on the project drawings.

The mix shall result in a product having a slump in the range of 6 to 10 inches (150 to 250 mm)at the time of placement. The Contractor shall submit a mix design for approval by the Engineer prior to placement. The mix design shall be supported by laboratory test data verifying the potential of the mix to comply with the requirements of these specifications.

CLSM will be proportioned in general compliance with the methods outlined in ACI 211.1-91 Reapproved 1997, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete. The following materials shall be used:

Cement shall meet the requirements of Section 701, "Portland Cement". Type V cement shall be used unless otherwise specified.

Fly ash shall meet the requirements of Section 729, "Fly Ash". Fly ash not meeting the requirements of Section 729 may be used if prior testing indicates to the satisfaction of the Engineer the ability of the CLSM with this fly ash to meet these specifications.

Water shall meet the requirements of Section 722, "Water".

Aggregates shall have 100% by total weight of the aggregate passing the 1" (25 mm) screen and 15% or less passing the No. 200 sieve. The aggregate shall meet the plastic limits requirements of Section 704.02.03. If coarse aggregate (material retained on the No. 4 sieve) is present, the percentage of wear at 500 revolutions when tested in accordance with ASTM C 131 shall be less than 45%. If coarse aggregate is present, at least 35 percent of the weight of the total aggregate shall be passing the No. 4 sieve.

Chemical admixtures shall meet the requirements of Subsection 702.03.03, "Air-Entraining Admixtures", and Subsection 702.03.04, "Admixtures Other Than Air-Entraining." Other admixtures specifically approved for CLSM may be used.

All materials proportions shall be measured and the CLSM mixed in accordance with the requirements of Section 501, "Portland Concrete." Other proportion measuring and CLSM mixing systems are acceptable, if control can be demonstrated to be satisfactory to the engineer. These other methods include continuous feed, volumetric measurement of proportions, and pug mill and continuous mixing plants.

If the CLSM mix does not produce a flowable consistency or exhibits excessive bleeding, the mix shall be adjusted. Excessive bleeding is considered to occur when water flows from the CLSM in a manner that causes disturbance or displacement of the exposed surface of the CLSM. Mix adjustments shall include, but not be limited to: aggregate gradation, cementitious material content, admixtures, water content, or a combination of adjustments.

CLSM should be placed directly into the space to be filled. The mix may be placed to partial depth or full depth as conditions at the site dictate. When used as backfill in the pipe zone, care should be taken to prevent flotation or misalignment of the pipe by means of straps, soil anchors or other approved means of restraint. Material may be placed in stages to prevent movement or flotation of pipe.

Placement of backfill, pavement materials oron top of the CLSM shall not be allowed until the CLSM passed the ball drop test as per ASTM D6024.

208.02.07 CRUSHED ROCK: Crushed rock shall be the product from approved aggregate deposits and shall only be used as directed by the governing agency. The mineral aggregate shall be clean, hard, durable, free from any frozen lumps, deleterious matter, and harmful coatings. In addition thereto, the material shall conform to the following gradation requirements:

Sieve Sizes	Percentage of Weight Passing
3/8"	100
No. 4	20-80
No. 200	0-15

The percentage of wear (500 revolutions) in accordance with ASTM C 131 shall not exceed 45%.

208.02.08 TYPE III AGGREGATE: The soluble sulfate content shall not exceed 0.3% by dry weight of soil. The mineral aggregate shall be clean, hard, durable, free from any frozen lumps, deleterious matter, and harmful coatings. In addition thereto, the material shall conform to the gradation requirements of Type II aggregate base as per Subsection 704.03.04 with the following property testing:

Project Control Test	Test Method	Requirements
Sieve Analysis	AASHTO	704.03.04
Sampling Aggregate	ASTM D 75	n/a
Plasticity Index	ASTM D 4318	Section 207.02.01
Liquid Limit	ASTM D 4318	35% Maximum
No. 200 Sieve	AASHTO	2-15%

CONSTRUCTION

208.03.01 TRENCH EXCAVATION, GENERAL: Excavation including the manner of supporting excavation and provisions for access to trenches, shall comply with the current regulations ad determined by NOSHA. Excavation shall include, without classifications, the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grade shown. Excavation for pipe, wire, or conduits shall be by open trench unless otherwise specified or shown on the plans. However, should the Contractor elect to tunnel or jack any portion not so specified, he shall first obtain approval from the Engineer. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavation, and all pumping, ditching, or other approved measures for the removal or exclusion of water, including storm water and waste water reaching the site of the work from any source so as to prevent damage to the work or adjoining property. The Contractor shall be responsible for any damage to persons or property due to interruption or diversion of storm or waste water on account of his operations. If due to delays in delivery of materials or for other reasons, and the Contractor is not expected to fully complete the work within any excavated area in a reasonable length of time as determined by the Engineer, the Engineer may require the Contractor to backfill the excavation and re-excavate when the work can be completed expeditiously, with no additional payment therefore.

(a) Except as otherwise shown or provided herein, excavation shall be open cut trenches with vertical sides up to the top of the pipe, and from the top of the pipe to the ground surface. The bottom of the trench shall have a maximum width equal to the outside diameter of the pipe plus 24 inches (600 millimeters) or as shown on the plans. If the maximum trench width is exceeded, the Contractor shall provide either additional bedding, another type of bedding, or a higher strength of pipe if required by the Engineer, with no additional payment therefor. Trench widths greater than the outside diameter of the pipe plus 24 inches (600 millimeters) may be required by the Engineer for flexible pipe to compensate for low stability soils, with payment for the additional work to be paid for in accordance with Subsection 104.03, "Extra Work."

Except when otherwise specified or ordered by the Engineer, the bottom of the trench shall be excavated uniformly to the grade or depth indicated on the drawings. The maximum amount of open trench permitted in any one location shall be 500 feet (152 meters), or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater, unless otherwise approved by the Engineer. Trench shall be considered open until backfilled to finish surface. Trenches across streets shall be completely backfilled as soon as possible after pipe, wire, or conduit installation.

Substantial bridging, properly anchored, capable of carrying the legal limit loading, in addition to adequate trench bracing, shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular working hours. Safe and convenient passage for pedestrians and access to all properties shall be provided.

(b) **Trench Overexcavation.** Wherever the excavation is made below the grade shown on the drawings, or below the grade ordered by the Engineer, it shall be refilled to the required grade with suitable bedding material as specified in Subsection 208.03.02.

Trench overexcavation below the specified level of bedding material, and additional backfill material, ordered by the Engineer because unsuitable materials are encountered, shall be paid by the appropriate contract item. If no price is included in the contract, the work may be paid for according to the provisions of Subsection 104.03, "Extra Work."

Trench overexcavation and backfill to control groundwater or to facilitate ponding or jetting shall be at the option and expense of the Contractor.

(c) **Disposal of Unsuitable and Excess Excavated Materials.** Excess material and excavated material unsuitable for backfill, shall be removed from the site of the work by the end of each working day unless otherwise approved by the Engineer and disposed of by the Contractor as specified in Subsection 107.14, "Disposal of Material Outside Project Right-of-Way."

(d) **Changes in Alignment or Grade.** In the event that changes in elevation of the trench of less than six (6) inches (150 millimeters) are ordered by the Engineer no changes in the contract amount will be allowed. When such changes in elevation are more than six (6) inches (150 millimeters) or changes in alignment are made that change the character of the work required, the work shall be performed as specified in Subsection 104.02, "Increased or Decreased Quantities and Change in Character of Work."

208.03.02 PIPE BEDDING: Except as otherwise provided herein or in the Special Provisions, or as otherwise shown on the plans, the trench shall be excavated to a depth of at least six (6) inches (150 millimeters) below the bottom of the pipe barrel and to a depth which will be sufficient to provide at least two (2) inches (50 millimeters) clearance under the pipe bell, and backfilled to the required grade of the bottom of the pipe with "Type II Aggregate Base Backfill" or "Sand Backfill." "Crushed Rock" may be used for pipe bedding only if material use has been specifically approved by the governing agency. When "Crushed Rock" is used for pipe bedding the Contractor shall follow the same procedures described later in this subsection when "drain backfill" is used to control groundwater.

The bedding shall be compacted to at least 90% of maximum density. Pipe bedding shall be placed and prepared in such a manner that there will be a firm, continuous support along the entire length of the pipe barrel. Bell holes in the bedding shall provide at least two (2) inches (50 millimeters) clearance beneath pipe joints.

Unless otherwise specified, laying pipe on mounds of the approved bedding material compacted firmly in place will be allowed whenever pipe eighteen (18) inches in diameter or smaller is being used, excepting sanitary sewer pipe and storm drain pipe; when "Type II Aggregate Base Backfill" or "Sand Backfill" is used for bedding material; and when the character of the bedding material and adjacent native material is such that ponding or jetting will be used for compaction. The mounds shall be a minimum of six (6) inches (150 millimeters) along the length of the pipe and of adequate size to hold the pipe in alignment and to maintain a two (2) inch (50 millimeter) minimum clearance from the bottom of the coupling to the trench bottom. Each pipe shall be laid on two mounds with the center of each mound placed approximately one-fifth of the pipe length from each end. The clearance between the trench bottom and the bottom of the coupling and/or pipe barrel shall be properly backfilled utilizing "Type II Aggregate Base Backfill" or "Sand Backfill" and the material shall be compacted utilizing appropriate methods and equipment to provide a firm and uniform bedding throughout the entire length of the pipe.

In the event that "Drain Backfill" is used to control groundwater, the Contractor shall at his expense, construct dams within the drain rock bedding material at maximum intervals of 600 feet (180 meters) or at each manhole, whichever is less. In areas with active groundwater, the dams shall be constructed to the top of the pipe or the

level of groundwater, whichever is greater. For "Crushed Rock" bedding, the dams are to be constructed to the top of bedding elevation, as a minimum, which could be the foundation of the manhole. The dam material shall be portland cement concrete conforming to the requirements of Section 501, and shall have a minimum thickness of six (6) inches (150 millimeters). All pipe shall be placed directly on the drain rock bedding material unless otherwise required or approved by the Engineer.

If groundwater is present or anticipated to be present, a filter material as specified in Subsection 207.03.01, "General," may be required by the Engineer.

CLSM may also be used for pipe bedding material. When CLSM is used, laying pipe on mounds of approved bedding material as described above precedes the placement of CLSM. CLSM is then place adjacent to the pipe and allowed to flow and is worked beneath the pipe to provide continuous, uniform support. Care shall be exercised as discussed in Subsection 208.02.06 to prevent movement or floatation of the pipe caused by placement of the CLSM. Note that the Las Vegas Valley Water District (LVVWD) requires that the materials used for backfill in the pipe zone and the pipe bedding be the same material.

208.03.03 TRENCH BACKFILL: Except as otherwise provided or approved by the Engineer, after the pipe or conduit is laid, trenches shall be backfilled with "Sand Backfill," "Type II Aggregate Base Backfill," or with "CLSM" in the pipe zone as defined in the following table:

Pipe or Conduit	Pipe Zone
2 inch (50 millimeters) or less diameter	Bottom of pipe to 6 inches (150 millimeters) above the top of the pipe
Greater than 2 inch (50 millimeters) diameter,	Bottom of pipe to 12 inches (300 millimeters) above the except vitrified clay pipetop of the pipe
Vitrified clay pipe	Bottom of pipe to 24 inches (600 millimeters) above the top of the pipe

"Crushed Rock" shall not be used to backfill in the pipe zone unless specifically pre-approved by the governing agency.

The partially backfilled trench shall be compacted to not less than 90% of maximum density except when "CLSM" is used. Jetting or ponding methods of compaction performed in accordance with the provisions of Subsection 207.03.01 will be permitted in the pipe zone, except for corrugated metal pipe and thermoplastic pipe.

(a) In unpaved areas and areas outside the existing or proposed street right-of-way, the remaining backfill shall be "CLSM," "Granular Backfill," or "Selected Backfill," except that no stones or lumps greater than three (3) inches will be permitted if "Selected Backfill" is used in trenches two (2) feet (600 millimeters) or less in width. Except when "CLSM" is used, the material shall be compacted to not less than 85% of maximum density, except for the top twelve (12) inches (300 millimeters) which shall be compacted to 90% of maximum density unless otherwise approved by the Engineer. Compaction of backfill by ponding or jetting methods will be permitted when performed in accordance with the provisions described in Subsection 207.03.01, but shall not be restricted by the amount of material passing the No. 200 sieve. The upper twelve (12) inches (300 millimeters) below the existing grade in the traveled portion of an unpaved road shall be by mechanical means only.

(b) In paved areas and areas within the existing or proposed street right-of-way, the remaining backfill shall consist of one of the following types as determined by the Engineer.

(1) **Granular or Selected Backfill.** Backfill material from the pipe zone to a plane which is a minimum of 16 inches (400 millimeters) below the bottom of pavement shall be "Granular Backfill," or "Selected Backfill."

If "Selected Backfill" is used in trenches two (2) feet (600 millimeters) or less in width, no stones or lumps greater than three (3) inches will be permitted. The material shall be compacted to not less than 90% of maximum density.

Trench backfill may be compacted by ponding or jetting methods performed in accordance with the requirements of Subsection 207.03.01, "General" when the character of the backfill material and adjacent native materials are as specified in Subsection 207.03.01, "General," except ponding or jetting methods will not be permitted in the trench sixteen (16) inches (400 millimeters) below the bottom of an existing pavement.

Backfill material for the minimum of 16 inches (400 millimeters) beneath the pavement shall consist of "Type II Aggregate Base" conforming to the requirements of Subsection 704.03.04. The material shall be mechanically compacted to not less than 95% of maximum density.

(2) **CLSM.** "CLSM" shall be placed from the top of the pipe zone to the bottom of the pavement. In deep trenches, backfill material from the pipe zone to a plane which is a minimum of 24 inches (600 mm) below the bottom of the pavement may be "Selected Backfill," "Granular Backfill," or "CLSM."

If ponding or jetting is used to compact the backfill, the Contractor shall take all necessary precautions to prevent the pipe from floating including the filling or partially filling of the pipe with water if necessary. Adequate sumps and pumping shall be provided, as determined by the Engineer, for removing excess water from the trench. Any free standing water in a partially backfilled trench shall be allowed to completely drain away before the remaining backfill is placed.

Ponding or jetting methods shall be supplemented by the use of vibratory or other mechanical compaction equipment when necessary to obtain the required compaction.

Compaction not accomplished by ponding and jetting shall be done by mechanical means. Mechanically compacted backfill shall be placed in layers of thickness compatible with the characteristics of the backfill and the type of equipment being used, but not exceeding eight (8) inches (200 millimeters) in loose thickness before compaction when hand-directed compaction equipment is used unless otherwise approved by the Engineer. Each layer shall be evenly spread, moistened, and tamped or rolled until the specified relative compaction has been attained.

208.03.04 TESTING: Where backfill is required to be compacted to a specified density, field tests for compliance may be made by the Contracting Agency using the test procedure prescribed in Section 111, "Soils and Aggregate Tests." For density determination tests the Contractor shall excavate at his expense in accordance with Subsection 208.03.01 any trench horizon the Contracting Agency may request. Where tests reveal non-compliance with the

requirements of the contract, the Contractor shall bear the costs of subsequent recompaction and retesting until the required density is obtained.

Where CLSM is required to meet compressive strength requirements, field tests will be performed by the Contractor or Agency in accordance with the testing procedures outlined in Subsection 208.02.06. The Contractor shall provide the Contracting Agency all materials and access required to perform this testing. If tests indicate potentially non-complying materials, the Contractor shall bear the cost of subsequent retesting and engineering analysis necessary to determine necessary corrective measures and all costs related the corrective measures required for resolution of the non-compliance to the satisfaction of the Engineer, including, if required, removal and replacement of the work.

COMPRESSIVE STRENGTH TESTING PROCEDURE VERIFICATION

The Contractor shall cast one (1) set of six (6) four (4) inch by eight (8) inch (600 millimeter by 1200 millimeter) specimens in concrete masonry block molds. The Contractor shall insert six (6) four (4) inch by eight (8) inch (600 millimeter by 1200 millimeter) perforated molds into the in-place CLSM represented by the cast specimens. Both the cast specimens and the in-place specimens shall be field-cured for four (4) days; after which they shall be returned to the testing laboratory. The specimens shall then be laboratory-cured in a 100% humidity, temperature-controlled concrete cure room (cure tanks should not be used). Two (2) samples from each set shall be tested at the ages of seven (7), twenty-eight (28), and ninety (90) days.

208.03.05 CUTTING AND RESTORING STREET SURFACING:

(a) Prior to beginning work within any public right-of-way, or cutting any street surfacing therein, an encroachment permit and barricade plan approval shall be obtained from the governmental entity or agency having jurisdiction over that right-of-way.
Permit fees and construction restrictions shall be in accordance with the rules, regulations, and ordinances of the entity or agency having jurisdiction.

(b) While undergoing improvements, all streets upon or within which any work is being done shall be kept open to all traffic by the Contractor, as specified in Subsection 104.04, "Maintenance of Traffic," unless otherwise approved by the Engineer, or as provided in the Special Provisions.

Prior to beginning the work, barricading and traffic control devices conforming to the latest editions of the Traffic Control Plans for Highway Work Zones for the Clark County Area and the Manual on Uniform Traffic Control Devices shall be in place, and shall be in compliance with the governmental agency approved traffic control and barricade plan.

(c) Pavement in the area of the trench excavation may be wheel cut or spade cut. Trench excavation and backfill shall be per the applicable sections of the Uniform Standard Specifications and Standard Drawings. "CLSM" shall be used in the following cases:

(1) All trenches eight (8) inches (200 millimeters) or less in width for installation of conduit (full depth to bottom of asphalt surface).

(2) Trenches for service laterals on developed major streets (greater than 60 feet of planned right-of-way) as determined by the Engineer.

(d) Whenever permanent pavement patches are not constructed immediately following trench backfilling operations, temporary pavement patches consisting of a minimum of two (2) inches (50 millimeters) of hot or cold plantmix or plates must be utilized to provide the required number of paved travel lanes. Plates may be left in place for the short duration as approved by the Engineer. Temporary pavement patches may be left in place for a maximum of thirty (30) working days following completion of backfilling operations unless otherwise approved by the Engineer.

The following surface tolerance for temporary patches shall be observed. When a twelve (12) foot (4 meter) straight edge is laid across the temporary patch parallel to the centerline of the street and in a direction transverse to the centerline, a rut, hump, or depression of more than three-fourths (3/4) inch (20 millimeters) shall not be evident. Deteriorated temporary patches exhibiting ruts, humps, or depressions shall be repaired or replaced immediately upon notification of the Engineer. If the existing street exceeds the above tolerances, then the temporary patch shall be equal to or better than the condition of the surrounding pavements.

(e) Prior to placing the permanent patch, the existing pavement shall be sawcut to a neat line and to a minimum width as follows:

(1) For transverse trenches, sufficient width (four (4) feet (1.2 meters) minimum) to accommodate mechanical placement using Agency approved spreader box or paving machine, rolling and compaction in compliance with Subsection 401.03.11, "Rolling and Compaction."

(2) For longitudinal trenches on streets with rights-of-way greater than 60 feet , one lane width in its entirety. Sawcut lines shall be made at the edge of the travel lane and shall not fall within the travel lane. Pavement patches for longitudinal trenches on streets with rights-of-way 60 feet or less shall be sufficient width (four (4) feet (1.2 meters) minimum) to accommodate mechanical placement using Agency approved spreader box or paving machine, rolling and compaction in compliance with Subsection 401.03.11, "Rolling and Compaction" and sawcut shall not be placed in wheel path area of travel lane.

(3) For narrow trenches (six (6) inches (150 millimeters) or less in width) for conduit placement within two (2) feet (600 millimeters) of the curb and gutter, a minimum of four (4) feet (1.2 meters) from the lip of gutter and removed to the curb and gutter. Pavement patch width shall be sufficient to accommodate mechanical placement using Agency approved spreader box or paving machine, rolling and compaction in compliance with Subsection 401.03.11, "Rolling and Compaction" and sawcut shall not be placed in wheel path area of travel lane.

Existing aggregate base, if disturbed, shall be recompacted to meet the requirements of Section 302 of the Uniform Standard Specifications. Compaction by rolling with vehicle tires will not be permitted. Aggregate base courses which were constructed with geosynthetics shall be repaired in conformance with the manufacturer's recommendations.

(f) Existing asphalt concrete shall be replaced with the same depth on major streets (greater than 60 feet of planned right-of-way) except that the minimum depth shall be four (4) inches (100 millimeters) and shall be placed in multiple lifts of equal thickness. Existing asphalt concrete shall be replaced with the same depth in local streets (60 feet or less of planned right-of-way) except that the minimum depth shall be three (3) inches (75 millimeters); for existing depth of four (4) inches (100 millimeters) or more, pavement shall be replaced in multiple lifts of equal thickness.

(g) Completion of the permanent patch in areas where an opengraded surface course exists, which is less than 5 years in age, shall include placement of a surface course to match the existing surface texture.

(h) Existing asphalt pavement or concrete shall be replaced with like material. In areas where lime treated sub-base, cement modified sub-base, soil cement, or similar materials have been used, the Contractor may substitute a lean concrete mix or asphalt concrete equivalent, subject to approval of the Engineer.

Upon completion of the permanent patch, including the surface treatment, the surface shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge twelve (12) feet (4 meters) long is laid across the permanent patch parallel to the centerline of the street and in a direction transverse to the centerline, the surface shall not vary more than one-quarter (1\4) inch from the lower edge of the straightedge. Patches exhibiting deviations greater than one-quarter (1\4) inch shall be replaced prior to acceptance of the patch. If the existing street exceeds the above tolerances, then the patch shall be equal to or better than the condition of the surrounding pavement.

(j) Any concrete improvements disturbed or damaged during construction shall be replaced prior to placement of the permanent pavement patch. Damaged sections of concrete sidewalk shall be removed and replaced to the nearest expansion joint or score line. Damaged concrete curb and gutter shall be removed and replaced to the nearest expansion joint, or as approved by the Engineer. Replacement of less than a ten (10) foot length of curb and gutter will not be permitted. Under no circumstances will sawcutting of concrete valley gutters be allowed. Valley gutters shall be replaced in their entirety.

(k) All traffic control devices removed or disturbed during construction must be replaced upon completion of the permanent patch including but not limited to delineation, paint, thermoplastic pavement markings, and traffic signal detector loops. Temporary lane lines and other markings used during construction shall be permanently removed, to the satisfaction of the Engineer, prior to placing the new traffic stripes or markings.

BASIS OF PAYMENT

208.05.01 BASIS OF PAYMENT: Unless otherwise provided in the Special Provisions or Proposal, no payment will be made for trench excavation or backfill as such; the cost thereof under normal circumstances being considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant.

Payment for such excavation or backfill will be made only when the Special Provisions or Proposal provides.

SECTION 209

DRAIN BACKFILL

DESCRIPTION

209.01.01 GENERAL: This work shall consist of furnishing, hauling, placing, and compacting drain backfill material around structures, pipes or perforated underdrains to the lines designated on the plans or established by the Engineer.

MATERIALS

209.02.01 GENERAL: Material shall conform to the requirements as set forth in Subsection 704.03.01, "Drain Backfill."

CONSTRUCTION

209.03.01 GENERAL: The trench shall be excavated and drain backfill placed in accordance with provisions of Section 607, "Underdrains."

Where drain backfill is part of the structural section, it shall be compacted to not less than ninety (90) percent maximum density. Test method to be determined by the Engineer.

Compacting by ponding or jetting will not be permitted.

METHOD OF MEASUREMENT

209.04.01 MEASUREMENT: The quantity of drain backfill to be measured for payment will be the number of cubic yards (cubic meters) measured in accordance with the dimensions shown on the plans or established by the Engineer complete and in place.

All measurement will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

209.05.01 PAYMENT: Payment for drain backfill will be made only when provided for in the Special Provisions or Proposal.

The accepted quantities of drain backfill measured as provided in Subsection 209.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard (cubic meters) of drain backfill.

Full compensation for furnishing, hauling, placing, and compacting drain backfill shall be considered as included in the contract price paid for drain backfill.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

213.02.08 CONTROL VALVES: Manual control valves shall be straight or angle pattern globe valves of all brass or bronze construction with replaceable compression disks. Manual control valves shall be of the same size as the pipes on which they are placed unless otherwise indicated on the plans, and shall be provided with a union connection. Manual control valves shall be capable of withstanding a cold water working pressure of 150 psi (1.03 MPa) except for valves of 1-1/2 inch (3.8 centimeters) and larger where 200 psi (1.38 MPa) valves will be required.

Electric control valves shall be of the diaphragm type, normally closed, 24-volt, 60-cycle. The valve solenoids shall operate with 18-30 volts of power. Solenoids shall be completely encapsulated for positive waterproofing. The valve body and bonnet shall be of cast brass or bronze, flanger or threaded type. If threaded type is used it shall be provided with a union connection. The time interval between opening and closing the valve shall not be less than five (5) seconds. The solenoid plunger shall be spring loaded so the valve may operate when installed in any position and shall be constructed of stainless steel with neoprene seat. Valve bonnet shall have a bleed screw for manual operation and a manual flow control adjustment. Electric control valves shall be capable of withstanding a non-shock cold water working pressure of 150 psi (1.03 MPa).

213.02.09 QUICK-COUPLER VALVES: The quick-coupler valve shall be of brass or bronze construction with one (1) inch (2.5 centimeters) F.I.P. bottom connection. The valve shall be of two-piece construction with removable upper body. The valve body shall be designed with a single slot to receive a single slot coupler. The one (1) inch (2.5 centimeters) male and 3/4 inch (1.9 centimeter) female I.P.S. coupler for the quick-coupler valve shall be single slot of bronze construction.

213.02.10 VALVE BOXES: Valve boxes shall be reinforced precast Portland cement concrete boxes of the general dimensions shown on the plans with a steel lid. Concrete made of Type V Portland cement shall be used. Valve boxes shall have extensions as necessary to reach the depth indicated.

213.02.11 BACKFLOW PREVENTERS: Backflow preventers shall meet the requirements of the governing agency concerned. Each backflow preventer shall be equipped with a gate valve at each end of the backflow prevention unit. Three (3) inch (7.6 centimeters) and larger valves shall be flanged type, iron body, brass trimmed, wedge gate valves with non-rising stem,and shall be capable of withstanding a cold water working pressure of two hundred (200) pounds per square inch (1.38 MPa.) Two and one-half (2-1/2) inch (6.3 centimeters) and smaller valves shall be as specified above, except that they shall be screw type and shall be installed with a union between each valve and the backflow prevention unit. Backflow preventers and valves shall be the size shown on the plans.

It will be the responsibility of the Contractor to determine the requirements of the governing agency in regard to the type and detail of backflow prevention required.

For purpose of payment the valves required to be installed at each end of the backflow prevention unit and all fittings between such valves required for proper installation shall be considered as a part of the backflow preventer.

213.02.12 DRAIN VALVES: Automatic ball check drain valves shall be of precision machined brass with a threaded keeper rather than a crimped type at the inlet end. Ball checks shall be spring loaded and shall close under a pressure of two (2) to four (4) psi (13.9 to 27.6 KPa). Valves shall be installed with a gravel sump as shown on the plans.

The gravel to be used in gravel sumps for ball check drain valves, shall conform to the requirements for Size No. 67 as specified in Subsection 706.03.01 of the Standard Specifications.

213.02.13 HOSE BIBS: The hose bib shall be a no-freeze burial type hydrant with a self-closing handle and shall have a 3/4 inch (1.91 centimeters) male I.P.S. threads at the supply line end.

213.02.14 VACUUM BREAKERS: When called for in the contract documents or as required by local ordinances, vacuum breakers meeting the following requirements shall be furnished and installed. All vacuum breaker installations are subject to inspection by authorized county or municipal authorities.

Atmospheric vacuum breakers shall have all bronze bodies and be of the same dimension as the pipe on which it is attached. Design shall permit free flow of water under pressure. When vacuum conditions exist it shall automatically close the check valve stopping all flow of water and admit air into the main line. Upon restoration of water pressure the air intake shall be shut off and the check valve re-opened without spillage. Unless otherwise specified, the vacuum breaker shall be installed on the discharge side of the control valve six (6) inches (15 centimeters) above the highest sprinkler head on the line. Vacuum breakers shall not be required on sprinkler lines when all sprinkler heads on the line are elevated to a minimum of six (6) inches (15 centimeters) above the finished grade, such as sprinkler lines irrigating shrub beds. Atmospheric vacuum breakers shall have a service rating of one hundred-fifty (150) psi (1.03 MPa) for non-shock cold water and shall be designed for operation up to temperatures of one hundred-forty (140) degrees Fahrenheit (60 degrees Celsius.)

Pressure type vacuum breakers shall be installed on the discharge side of the meter or service connection as shown on the plans. Vacuum breakers shall be of heavy duty construction with all bronze bodies, check valves, and test cocks. Pressure type vacuum breakers shall be designed to operate under continuous pressure permitting the free flow of water at all times. Air intake shall be spring loaded to insure positive opening upon release of pressure or vacuum created in the supply lines. Vacuum breakers shall be furnished with approved check valves, inlet and discharge shut-off valves and field testing cocks. Assembly for various pipe sizes shall be according to local requirements or as specified in the contract documents. Unless otherwise specified pressure type vacuum breakers shall have a service rating of three hundred (300) psi (21 kilograms per square centimeters) for non-shock cold water.

All vacuum breaker installations shall meet local ordinances and plumbing requirements.

213.02.15 AIR RELIEF VALVE: The air relief valve shall be designed to release air entrapped in a pipeline until liquid reaches the float which will rise to the seat and close the valve. The float shall be stainless steel resting within a stainless steel or bronze cup. The valve body and flange shall be gray iron casting. The valve shall be one (1) inch (2.54 centimeters) size with screwed inlet, and shall be capable of withstanding pressures up to 300 psi (2.07 MPa). The valve shall be fitted with a galvanized steel return elbow as indicated on the plans.

CONSTRUCTION

213.03.01 GENERAL: The Contractor shall not alter or change the location of pipes, valves, sprinklers, or other equipment as shown on the plans unless so authorized by the Engineer. All necessary arrangements for connecting to mains shall be made by the Contractor with the agency supplying the water, and such installations and equipment shall conform to the requirements set forth by the supplying agency.

SECTION 301

SELECTED MATERIAL BASE OR SURFACE

DESCRIPTION

301.01.01 GENERAL: This work shall consist of excavating and placing selected granular materials in one or more courses for base or surface in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

MATERIALS

301.02.01 GENERAL: Material shall be as set forth in the Special Provisions.

CONSTRUCTION

301.03.01 SUBGRADE PREPARATION: The surface of the subgrade upon which the selected material is to be placed shall conform to the established lines and grade, shall be smooth and uniform and shall be compacted to the required density. The tolerance to the plan elevation grade shall be plus zero (+0) inches (millimeter) and minus one-half (-1/2) inch (17 millimeters).

301.03.02 PLACING: In producing, handling, and placing selected materials, care shall be taken to prevent segregation of the fine particles from the coarse. When the required compacted thickness is more than six (6) inches (15 centimeters), the material shall be placed in layers, none of which shall exceed six (6) inches (15 centimeters) in depth after compaction, except as provided in Subsection 301.03.04, "Compaction."

After the material has been uniformly deposited, it shall be thoroughly blade-mixed to the full depth of the layer by alternately blading the entire layer to the center and back to the edges of the roadbed. It shall then be spread and finished to the required cross section. At the option of the Contractor, selected material may be spread with equipment meeting the requirements of Subsection 303.03.03, "Spreading and Finishing."

Binder material, if required, shall be incorporated either in the surfacing aggregate at the plant where the aggregate is produced, or shall be incorporated uniformly on the roadbed in amounts designated by the Engineer.

301.03.03 WATERING: Water shall be applied prior to and during all blading operations, to moisten the material sufficiently to prevent segregation of the fine and coarse particles. Water shall also be applied during the compaction and maintenance stages in sufficient amounts to attain compaction and prevent raveling.

301.03.04 COMPACTION: Compaction shall immediately follow the spreading operation. Where the required thickness is six (6) inches (15 centimeters) or less, the base course may be spread and compacted in one layer. However, if vibratory compaction equipment approved by the Engineer is used, and the requirement for density is complied with, the compacted thickness of any one layer must be increased to eight (8) inches (20 centimeters). Aggregate bases, placed on road approaches and connections, street intersection areas, median strip areas, shoulder

areas, and at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any means to obtain the specified results.

Each layer of material shall be compacted to not less than ninety-five (95) percent relative compaction. Test method to be determined by the Engineer.

It is to be expected that a loss of density in the upper portions of the material may occur due to the elements, or for other reasons. Recompaction to the specified density will be required prior to placement of any subsequent course and no additional compensation will be allowed for such recompaction.

METHOD OF MEASUREMENT

301.04.01 MEASUREMENT: The quantity of selected material base or surface to be measured for payment will be in the number of cubic yards or tons (cubic meters or metric tons) complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

301.05.01 PAYMENT: The accepted quantity of selected material base or surfacing, measuring as provided above, will be paid for at the contract unit price bid per cubic yard or ton (cubic meter or metric ton) for selected material base or surface, which price shall be full compensation for stripping the pit, crushing, screening, loading, hauling, placing, compacting, and maintaining the base or surface as shown on the plans and as directed by the Engineer.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Partial payments may be made in accordance with Subsection 109.06, "Partial Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Selected Material Base	Cubic Yard or Ton (Cubic Meter or Metric Ton)
Selected Material Surface	Cubic Yard or Ton (Cubic Meter or Metric Ton)

SECTION 302

AGGREGATE BASE COURSES

DESCRIPTION

302.01.01 GENERAL: This work shall consist of furnishing, placing, and compacting aggregate base courses constructed in accordance with the requirements hereinafter set forth and in conformity with the lines, grades, thicknesses, and cross sections shown on the plans or established by the Engineer.

MATERIALS

302.02.01 GENERAL: All materials shall conform to the requirements as set forth in the following subsections:

Type I Aggregate Base	Subsection 704.03.02
Type II Aggregate Base	Subsection 704.03.04

Acceptance sampling will conform to the tests requirements as set forth in the above mentioned subsections and in Subsection 106.04, "Samples and Tests."

CONSTRUCTION

302.03.01 SUBGRADE PREPARATION: Any ruts, holes, defects, or soft yielding places which occur in the subgrade or sub-base for any cause whatsoever shall be corrected and compacted to required density and stability before an aggregate base course is placed thereon. The above mentioned repairs are to be made at the expense of the Contractor, except as provided for in Subsection 203.03.02, "Unsuitable Material." The tolerance to the plan elevation grade shall be plus zero (+0) inches (millimeter) and minus one-half (-1/2) inch (17 millimeters).

302.03.02 SPREADING AGGREGATES: The aggregate shall be uniformly deposited on the approved subgrade by means of the hauling vehicle with or without spreading devices. Aggregate will be distributed over the surface to the depth specified on the plans or established by the Engineer.

After base course material has been deposited, it shall be thoroughly blade-mixed to full depth of the layer by alternately blading the entire layer to the center and back to the edges of the road. It shall then be spread and finished to the required cross section by means of a self-propelled pneumatic-tired motor grader.

At the option of the Contractor, the aggregate may be spread with an approved self-propelled spreader with the aggregate ready for compaction without further shaping. If this option is exercised, however, the operation shall become subject to the requirements of Subsection 302.03.03, "Watering and Mixing Aggregates."

302.03.03 WATERING AND MIXING AGGREGATES: The base course material and water may be mixed at the plant in a mixer approved by the Engineer. Water shall be added during the mixing operation by means of spray bars in the amount necessary to provide the optimum moisture content for compacting. After mixing to the extent that the product has a uniform homogeneous appearance, the material shall be transported to the job while

it contains the proper moisture content and may be placed on the roadbed by means of an approved self-propelled aggregate spreader. If the material has dried appreciably prior to final compacting, additional water shall be added by means of a pressurized water truck to assist in compaction and to prevent raveling.

302.03.04 WATERING: Water may be applied prior to and during all blading and processing operations to moisten the material sufficiently to prevent segregation of the fine and coarse particles. Water shall be applied during the compaction and maintenance stages in sufficient amounts to assist in compaction and prevent raveling. Reference is made to Section 210, "Watering."

302.03.05 COMPACTION: Compaction shall immediately follow the spreading operation. Where the required thickness is six (6) inches (150 millimeters) or less, the base course may be spread and compacted in one layer. However, if vibratory compaction equipment of a type approved by the Engineer is used, and the requirement for density is complied with, the compacted thickness of any one layer may be increased to eight (8) inches (200 millimeters). Aggregate bases, placed on road approaches and connections, street intersection areas, median strip areas, shoulder areas, and at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any means to obtain the specified results. Each layer of material shall be compacted to not less than ninety-five (95) percent compaction, except for under sidewalk areas, in which case the material shall be compacted to not less than ninety (90) percent compaction. Test method to be determined by the Engineer.

It is to be expected that a loss of density in the upper portions of the material may occur due to the elements, or for other reasons. Recompaction to the specified density will be required prior to placement of any subsequent course and no additional compensation will be allowed for such recompaction.

302.03.06 TOLERANCE FOR FINISHED SURFACE: When a ten (10) foot (3 meters) straightedge is laid in any direction, the finished surface shall not deviate at any point more than one-half inch (12 millimeters) from the bottom thereof. The tolerance to the plan elevation grade shall be plus zero (+0) inches (millimeter) and minus one-half (-1/2) inch (17 millimeters).

METHOD OF MEASUREMENT

302.04.01 MEASUREMENT: The quantity of aggregate base to be measured for payment will be the number of cubic yards or tons (cubic meters or metric tons) complete and in place.

The weight of material will be determined by deducting from the weight of material delivered to the work, the weight of water in excess of optimum plus one percentage point. Optimum moisture will be determined by Test Method No. ASTM 1557 and 1556, as determined by the Engineer. Moisture content will be determined by Test Method No. ASTM 2216. The weight of water thus deducted will not be measured for payment.

Due to possible variations in the specific gravity and voids of the aggregates, the tonnage used may vary from proposal quantities and no adjustment in contract unit price will be made because of such variation.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

302.05.01 PAYMENT: The accepted quantity of aggregate base material, measured as provided in Subsection 302.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard or ton (cubic meters or

metric ton) for the type specified, which price shall be full compensation for stripping the pit, crushing, screening, mixing, hauling, placing, compacting, and maintaining the base course as shown on the plans and as directed by the Engineer.

It is to be expected that deviations in thickness will occur in placing aggregate base courses. It shall be the inherent responsibility of the Contractor to bring the various base courses to the required grade line. Payment will be limited to the number of tons or cubic yards (metric tons or cubic meters) complete and in place and no additional payment will be made for any labor or equipment used in bringing the course to grade.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Partial payments may be made in accordance with Subsection 109.06, "Partial Payment."

Payment will be made under:

PAY ITEM	**PAY UNIT**
Type I Aggregate Base	Cubic Yard or Ton (Cubic Meter or Metric Ton)
Type II Aggregate Base	Cubic Yard or Ton (Cubic Meter or Metric Ton)

SECTION 303

PLANTMIX BITUMINOUS BASE

DESCRIPTION

303.01.01 GENERAL: This work shall consist of aggregate and bituminous material mixed in a central plant and spread and compacted on a prepared surface in accordance with these specifications and in conformance with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer.

The requirements of Section 401, "Plantmix Bituminous Pavements - General" shall be applicable to this work, except as hereinafter specified.

MATERIALS

303.02.01 GENERAL: The materials shall conform to the requirements as specified in Subsections 401.02.01 through 401.02.04 inclusive, of Section 401, "Plantmix Bituminous Pavements - General."

CONSTRUCTION

303.03.01 GENERAL: The construction requirements shall conform to the requirements as specified in Subsections 401.03.01 through 401.03.15 inclusive, of Section 401, "Plantmix Bituminous Pavements - General," with the exceptions contained in the following two subsections.

303.03.02 SPREADING AND FINISHING: Unless otherwise specified, bituminous plantmix base shall not be placed in courses exceeding four (4) inches (100 millimeters) in compacted thickness. When more than one course is placed, the courses shall be of approximately equal thickness.

303.03.03 SURFACE TOLERANCES: The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge ten (10) feet (3 meters) long is laid on the finished surface and parallel with the centerline of the highway, the surface shall not vary more than one-half inch (12 millimeters) from the lower edge of the straightedge. The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than one-half inch (12 millimeters) are present when tested with a straightedge ten (10) feet (3 meters) long laid in a direction transverse to the centerline and extending from edge to edge of a twelve (12) foot (3.7 meters) traffic lane.

Any ridges, indentations, or other objectionable marks left in the surface of the bituminous mixture by blading or other equipment shall be eliminated by rolling or other means. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the bituminous mixture shall be discontinued and other acceptable equipment shall be furnished by the Contractor.

METHOD OF MEASUREMENT

303.04.01 MEASUREMENT: Plantmix bituminous base will be measured as specified in Subsection 401.04.01, "Measurement."

SECTION 401

PLANTMIX BITUMINOUS PAVEMENTS - GENERAL

DESCRIPTION

401.01.01 GENERAL: These specifications include general requirements that are applicable to all types of bituminous pavements of the plantmix type irrespective of gradation of aggregate, kind, and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

401.01.02 PAVEMENT STRUCTURAL DESIGN: All public pavement sections shall be designed in accordance with the 1993 AASHTO® Guide for Design of Pavement Structures. The following parameters, based upon the AASHTO® Guide and the 1996 Nevada Department of Transportation Pavement Structural Design and Policy Manual, shall be used in the design calculations. Parameters which are specific to a road classification are identified by the right-of-way dimension. The design must be stamped and signed by a Professional Engineer registered in the State of Nevada.

(1) The reliability factor will be a minimum of eighty (80) percent for fifty-one (51) foot, sixty (60) foot, and eighty (80) foot right-of-way, and a minimum ninety (90) percent for one hundred (100) foot right-of-way.
(2) The standard deviation will be 0.45 for all classifications.
(3) The initial service index will be 4.2 and the final service index 2.5 for all classifications.
(4) Drainage coefficients shall not exceed 1.0.
(5) The structural coefficient for asphalt will be 0.35.
(6) For materials meeting the Uniform Standard Specification 704.03.04, Type II Aggregate Base, the elastic modulus will be 25,000 psi (172 MPa) and the structural coefficient 0.12.
(7) For materials meeting the Uniform Standard Specification 704.03.02, Type I Aggregate Base, the elastic modulus will be 15,000 psi (103 MPa) and the structural coefficient 0.11.
(8) Prior to design, soil testing will be performed in accordance with ASTM D 2844, or AASHTO T-140, to determine a representative Resistance (R) value for the prepared subgrade. The subgrade shall be prepared in accordance with the Geotechnical Soils Investigation Report, and soil sampling performed subsequent to rough grading to confirm the original results. An average of the R-values can be used if the soil classification results are consistent, or the if the values do not differ by more than 10. The minimum testing requirements are one (1) right-of-way R-value test and post grading soil classifications every one thousand (1,000) lineal feet (305 meters) of roadway, with a minimum of two (2) classifications per project.
(9) The subgrade R-value (psi) shall be converted to a Resilient Modulus (M_R, psi) using the following correlation: $MR = 145*(10^{((0.0147*R)+1.23)})$

(10) The minimum AC sections are two (2.0) inches (51 millimeters) for a residential street, three (3.0) inches (76 millimeters) for a minor collector, four (4.0) inches (102 millimeters) for a major collector, and four (4.0) inches (102 millimeters) for an arterial street.
(11) All designs require a minimum of four (4) inches (102 millimeters) Type II aggregate base material.
(12) The subgrade must be scarified and recompacted to a minimum of ninety-five (95) percent, to a minimum depth of eight (8) inches (204 millimeters).
(13) Expansive soils may require additional design compensation. If native soils classify as either an AASHTO A-6 or A-7 (more than thirty-six (36) percent passing the #200 sieve and a PI equal to or greater than 11), the design may include stabilization, over-excavation, or utilization of a geomembrane, as recommended by the geotechnical engineer.
(14) Hydro-collapsible soils, or the presence of soluble materials, may require additional design compensation, as recommended by the geotechnical engineer.

The minimum design equivalent axial loads (EAL) based on a 20 year design are 7.2E+3 for a residential street, 3.3E+4 for a minor collector, 3.7E+5 for a major collector, and 1.0E+6 for an arterial street. Locations with heavier than normal traffic must be designed accordingly. A traffic study may be required for roads with a projected TI greater than 9.5. Definition of the roadway classifications, for design purposes, are listed below:

(1) Residential roadways are those that provide access for residential areas only: Most fifty-one (51) foot right-of-way roads are residential. The normal design TI is 5.0. A Residential road is considered to have heavy traffic, and a TI of 5.5, if minor amounts of thru-traffic use the road or bus traffic is encountered due to an adjacent school. Category II mix designs shall be used on residential streets.
(2) Minor Collector roadways are those that collect residential traffic or service limited commercial facilities: Most sixty (60) foot, and some fifty-one (51) foot, right-of-way roads fit this classification. The normal design TI is 6.0. A Minor Collector is assumed to have heavy traffic, and a TI of 6.5, if there is substantial commercial truck traffic, or bus traffic due to an adjacent school.
(3) Major Collector roadways are those that serve as destination roadways or service normal commercial or light industrial facilities: Most eighty (80) foot, and some sixty (60) foot, right-of-way roads fit this classification. The normal design TI is 8.0. A Major Collector is assumed to have heavy traffic, and a TI of 8.5, if there is substantial commercial or industrial truck traffic.
(4) Arterial roadways are those that provide primary traffic routes or service heavy industrial facilities: All one hundred (100) foot, and some eighty (80) foot and sixty (60) foot, right-of-way roads fit this classification. The normal design TI is 9.5. An arterial may have light traffic, if there is a disruption or decrease in the road capacity, in which case the design TI is 9.0. An Arterial is assumed to have heavy traffic if it is at full capacity with substantial truck traffic, or if there is heavy industrial traffic. A traffic study is recommended in those situations.

MATERIALS

401.02.01 COMPOSITION OF MIXTURES: The bituminous plantmix shall be composed of a mixture of aggregate, mineral filler if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job-mix formula.

Before starting work, the Contractor shall submit a proposed job-mix formula in writing, for use by the Engineer in setting the job-mix formula to be used. The proposed job-mix formula shall be determined by a testing laboratory under the direction and control of a Registered Professional Engineer, based on tests performed in accordance with the "Marshall Method of Mix Design" as described in the Asphalt Institute Manual Series No. 2 (MS-2), Latest Edition. The number of compaction blows to be applied to the specimens will be based on the appropriate traffic category. Traffic Category I will use a 75 blow design and will apply to all arterial streets and wherever "heavy" traffic is expected. Traffic Category II will use a 50 blow design and will apply to collector and local streets. Voids determinations and effective asphalt contents will be determined and reported in accordance with procedures described in this publication unless otherwise amended in the Special Provisions.

The job-mix formula shall be selected in accordance with the following procedures:

(a) Determine asphalt content required for 4 percent air voids, and
(b) Determine the average asphalt content for: (1) maximum density, (2) maximum stability, and (3) 4 percent air voids, and
(c) The lower of the asphalt contents obtained for (a) or (b) will be used as the design asphalt content for the job-mix formula.

The job-mix formula asphalt content shall satisfy all Marshall design criteria as shown in the following table:

MARSHALL DESIGN CRITERIA

TRAFFIC CATEGORY*	**I TRAFFIC INDEX (TI) ≥ 7.0**		**II TRAFFIC INDEX (TI) < 7.0**	
COMPACTION BLOWS EACH END OF SPECIMEN	75		50	
TEST PROPERTY	Min.	Max.	Min.	Max.
STABILITY, LB.	1800	----	1500	----
FLOW, 0.01 IN.	8	14	8	16
PERCENT TOTAL AIR VOIDS	3	5	3	5
PERCENT VOIDS FILLED WITH ASPHALT	65	75	65	78
MINIMUM VOIDS IN MINERAL AGGREGATE - PERCENT	See Table	In Asphalt	Institute MS-2	Manual

*Traffic Category I - Applies to arterials and major collectors. See roadway classification in Subsection 401.01.02.

Traffic Category II - Applies to minor collectors and residential streets. See roadway classification in Subsection 401.01.02.

The applicable Traffic Category will be designated in the Special Provisions for each project.

In addition to the Marshall Design Criteria set forth herein, the job-mix formula shall also meet the following tensile strength requirements for all traffic categories:

TEST PROPERTY	TEST METHOD	REQUIREMENTS
INDIRECT TENSILE STRENGTH (Unconditioned)	AASHTO T283	65 p.s.i. minimum (50 p.s.i. minimum with AC-10 asphalt)
INDIRECT TENSILE STRENGTH (Retained Strength)	AASHTO T283	70% minimum

Should the job-mix formula fail to meet the tensile strength requirements, the Contractor shall add hydrated lime (hereinafter referred to as mineral filler) to the plantmix bituminous aggregates as specified in Subsection 401.03.08. If the addition of mineral filler fails to achieve the minimum tensile strengths, the Contractor will be required to change sources of material, and submit a new job-mix formula that will satisfy all design criteria.

The test report shall show the curves and data tabulations used to determine the following characteristics:

1. Unit weight per cubic foot
2. Percentage of air voids
3. Percent voids filled with asphalt
4. Marshall stability
5. Percent voids in mineral aggregate (VMA)
6. Marshall flow
7. Indirect tensile strength (Unconditioned and Retained strength)

Data tabulations shall include indications of the water absorption, aggregate bulk specific gravities for both coarse (retained on No. 8 sieve) and fine (passing No. 8 sieve) aggregate, theoretical specific gravity of bituminous mixture, absorbed asphalt, and effective asphalt content as determined in accordance with referenced Asphalt Institute procedures. ASTM Test Method D 2041 will be used for determination of theoretical maximum specific gravity of bituminous paving mixtures.

The test report shall give the recommended asphalt content and the values for:

1. Unit weight per cubic foot (bulk density)
2. Stability
3. Flow
4. Air voids
5. Voids filled with asphalt
6. Voids in mineral aggregate (VMA)
7. Indirect tensile strength (Unconditioned and Retained strength)

The formula submitted shall propose definite single values for:

(A) The percentage of aggregate passing each specified sieve
(B) The percentage of bitumen to be added (to 0.1 percent) based on weight of total mix
(C) The percentage of mineral filler to be added to the aggregate
(D) The temperature of the mixture leaving the mixer
(E) The temperature of the mixture in the hopper of the paving machine

The job-mix formula aggregate with the allowable tolerances herein shall conform to the requirements of Section 705 "Aggregates for Bituminous Courses," for plantmix bituminous base aggregates, plantmix bituminous surface aggregate, or plantmix bituminous open-graded aggregate, as the case may be.

The Engineer will determine a job-mix formula with single values for (A), (B), (C), (D) and (E) above and so notify the Contractor in writing. This job-mix formula shall not be modified except with the written approval of the Engineer. The mix furnished shall conform to this job-mix formula, within the following range of tolerances:

Aggregate passing the No. 4 and larger sieves	±7%
Aggregate passing the No. 8 to 100 sieves	±4%
Aggregate passing the No. 200 sieve *	± 2%, but not to exceed upper limit of specification
Bitumen content	±0.3%
Temperature leaving the mixer	± 20 degrees F. (11 degrees C.)
Temperature in hopper of paving machine	± 20 degrees F. (11 degrees C.)

*Mineral filler is not considered as part of the aggregate.

Should there be a change in sources of materials, a new job-mix formula shall be established before the new material is used. Check tests of properties of the plantmix bituminous materials shall be made on the first day of production and as requested by the Engineer during period of construction to confirm that all properties are in compliance with Marshall Design Criteria and tensile strength requirements. Adjustments in gradation, mineral filler content and asphalt content shall be made as necessary in order to meet design criteria.

The temperature of the bituminous material just prior to mixing and of the completed mixture in the hauling vehicle just prior to leaving the plant shall conform to the following table:

PLANTMIX BITUMINOUS MIXTURE WITH ASPHALT CEMENT

Grade Of Asphalt Cement	Bituminous Material		Plantmix Bituminous Base of Surface Mixtures		Plantmix Bituminous Open-Graded Mixtures	
	Min.	Max.	Min.	Max.	Min.	Max.
AC-40	275°F 135°C	350°F 177°C	255°F 124°C	350°F 177°C	245°F 118°C	275°F 135°C
AC-20, AC-30	265°F 129°C	330°F 166°C	245°F 118°C	325°F 163°C	245°F 118°C	275°F 135°C
AC-10	255°F 124°C	325°F 163°C	235°F 112°C	325°F 163°C		
AC-20P	280°F 138°C	350°F 177°C	300°F 149°C	350°F 177°C	300°F 149°C	350°F 177°C

401.02.02 AGGREGATES: Aggregates shall meet the applicable requirements of Section 705, "Aggregates for Bituminous Courses."

401.02.03 COMMERCIAL MINERAL FILLER: Commercial mineral filler shall meet the requirements of Subsection 705.03.04, "Commercial Mineral Filler."

401.02.04 BITUMINOUS MATERIALS: The bituminous material shall meet the applicable requirements of Section 703, "Bituminous Materials." Bituminous material may be conditionally accepted at the source.

Unless otherwise specified in the Special Provisions for Category I pavements, the grade of bituminous material for dense-graded mixes shall be AC-30 asphalt cement. An AC-30, or AC-20P asphalt cement shall be used for open-graded mixes as specified in Section 403.02.02. The grade may be changed one step by the Engineer.

Unless otherwise specified in the Special Provisions, for Category II pavements the grade of bituminous material for dense-graded mixes shall be AC-20 asphalt cement. The grade may be changed one step by the Engineer.

Certificates of Compliance for the asphalt, showing test values necessary for specification compliance, shall be made available upon request by the Engineer.

401.02.05 FIELD COMPACTION AND MIX DESIGN CORRELATION: Type 2 coarse mix design annual submittals only.

In an effort to establish the "point of refusal", a maximum density of the field compaction must be obtained. If it has been determined that the in-place air voids are less than six (6) percent or more than eight (8) percent, the mix design bitumen content will be adjusted. This procedure will be required as a part of all new mix designs, and any field adjustment so noted.

The field compaction shall be as required in Section 401.03.11. The in-place air voids, as based on the Maximum Theoretical Specific Gravity and ten (10) correlated nuclear tests or five (5) cores, shall then be calculated. If the mean percent air voids is outside the limits noted above, the bitumen content shall be mathematically increased or reduced and noted on the mix design submittal. If adjustment is made, then a new control strip is required. Once the control strip meets the above requirements, it becomes the control strip for subsequent mix placements.

Subsequent compaction testing lots shall be tested in accordance to Section 401.03.12. If the compaction cannot be maintained between the above limits, a new control strip shall be implemented to re-establish the mean density for testing.

CONSTRUCTION

401.03.01 BITUMINOUS MIXING PLANT: Sufficient storage space shall be provided for the aggregate, or for each size aggregate when required. The storage yard shall be maintained neat and orderly and the stockpile, or separate stockpiles when required, shall be readily accessible for sampling.

Plants used for the preparation of bituminous mixtures shall conform to all requirements under (A). In addition, batch mixing plants shall conform to the requirements under (B) and drum drier plants shall conform to the requirements under (C).

(A) Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

(1) **Equipment for Preparation of Bituminous Material.** Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank or contents. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provisions shall be made for measuring and sampling storage tanks.

(2) **Drier.** The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process.

(3) **Thermometric Equipment.** An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregate.

The Engineer may require replacement of any thermometer by an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

(4) **Smoke and Dust Control.** The Contractor will be required to install satisfactory precipitation devices, or use other methods which will meet local conditions, city and county regulations as set forth by the Clark County Air Pollution Control Officer, and state laws pertinent to air pollution.

(5) **Truck Scales.** Except as allowed in Subsection 401.04.01, "Measurements," bituminous mixture shall be weighed on approved scales furnished by the Contractor or on public scales at the Contractor's expense. Such scales shall be platform scales and conform to the provisions of Subsection 109.01, "Measurement of Quantities."

(6) **Safety Requirements.** Adequate and safe stairways to the mixer platform and sampling points shall be provided and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the Engineer to obtain sampling and mixture temperature data. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return. All gates, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept from drippings from the mixing platform.

(B) **Requirements for Batching Plants**

(1) **Plant Scales.** Scales shall be accurate to 0.5 percent of the minimum load that may be required. Poises shall be designed to be locked in any position to prevent unauthorized change of position.

Scales shall be as described in Subsection 109.01 "Measurement of Quantities." In lieu of truck scales, the Contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching control system. Such weights shall be evidenced by a weight ticket for each load.

The amount of filler material shall be determined by weighing on springless dial scales separate from the plant weigh hopper or by some method that uniformly feeds the mixer within ten (10) percent of the required amount.

(2) **Feeder for Drier.** The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained.

(3) **Screens.** Plant screens capable of screening the aggregate to the specified sizes will be required.

(4) **Bins.** The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler when used and the plant shall be equipped to feed such material into the mixer.

Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that samples representative of the entire material in the bin can be readily obtained.

(5) **Weigh Box or Hopper.** All materials shall be proportioned by weight. Aggregate scales shall be either (1) a multiple beam scale, (2) a springless dial type scale, or (3) a fully automatic solid-state digital strain gage transducer measuring device having a capacity exceeding 1-1\4 times the total amount of materials to be weighed in one operation. Each scale gradation shall be approximately 1/1000 of the total capacity of the scale.

All scales used for proportioning materials shall be accurate to within one (1) percent. They shall be sealed and certified by the State Sealer of Weights and Measures. These certifications shall be dated within the past twelve (12) months and shall be renewed whenever required by the Engineer. In the event the plant is moved, a new certificate will be required.

All scales shall be of such size and so arranged that they may be read easily from the operator's platform. They shall indicate the true net weight without the application of any factor. The dials of scales shall not be less than twelve (12) inches (300 millimeters) in diameter and the figure thereon, shall be clearly legible.

Weighing equipment shall be so insulated against the vibration or movement of other operating equipment in the plant, that the error in weighing with the entire plant running will not exceed one and one-half (1-1/2) percent for any batch.

(6) **Bituminous Control Unit.** Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

(7) **Bituminous Control.** The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than three-fourths the length of the mixer and it shall discharge directly into the mixer. The bituminous material bucket, its discharge valve or valves, and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least fifteen (15) percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

Bituminous material shall be measured by means of springless dial scales or metering devices. Springless dial scales shall have a capacity of not more than one thousand (1,000) pounds (450 kilograms) in two (2) pound (1 kilogram) gradations.

The indicator dial shall have a capacity of at least fifteen (15) percent in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over. All of the bituminous material required for one batch shall be discharged in not more than fifteen (15) seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the accuracy of the meter when a metering device is substituted for a bituminous material bucket.

(8) **Mixer.** The batch mixer shall be of a twin pugmill type, steam jacketed, or heated by other approved means and capable of producing uniform mixtures within the specified tolerances. It shall be equipped with a sufficient number of paddles or blades set in proper order and operated at such speed as to produce a properly and uniformly mixed batch. At the beginning of the mixing operation, the clearance between paddle tips and liner shall not exceed half the maximum aggregate diameter for the specified job-mix. The clearance of the paddles or blades from all fixed and moving parts shall not exceed one (1) inch (25 millimeters). Badly worn or defective paddles or blades shall not be used in mixing operations.

(9) **Control of Mixing Time.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the mixer gates throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of bituminous material. The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixer gate.

The mixer shall be equipped with a timing device which will indicate by a definite audible or visual signal the expiration of the mixing period. The device shall measure the time of mixing within an accuracy of two (2) seconds. A suitable automatic device for counting the number of completely mixed batches shall be provided and maintained in proper working condition.

When the aggregate and the bituminous material have been combined, the entire mass shall be mixed in a approved mixer. The mixing shall continue until homogeneity and a uniform coating are achieved. The output rate shall not exceed the manufacturer's capacity rating.

(C) **Requirements for Dryer Drum Mixing Plants**

(1) **Aggregate Stockpiles.** The first paragraph of Subsection 401.03.08, "Preparation of Aggregates," shall apply.

(2) **Aggregate Proportioning.** The plant shall include a means for accurately proportioning each bin size of aggregate prior to the drying operation.

The plant shall have a mechanical feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive means. Indicators shall be provided for each gate to show the respective gate opening in inches (millimeters).
A meter for determining the rate of each feeder, or a revolution counter, shall be provided.
Commercial filler material introduced into the mixer shall be drawn from storage bins by a continuous mechanical feeder which will uniformly feed the mixer within ten (10) percent of the required amount.

(3) **Weight Calibration of Aggregate.** The plant shall include a means for calibration for each aggregate feeder by weighing test samples.

(4) **Bituminous Metering Device.** The bituminous material shall be introduced into the mixer through a gallonage meter by a positive displacement metering device. This metering device shall be equipped with a ready means of varying the bituminous material delivery rate.

(5) **Synchronization of Aggregate Feed and Bituminous Material Feed.** Satisfactory means shall be provided to afford a positive interlocking control between the flow of aggregate from each feeder and the flow of bituminous material. The interlocking control shall indicate a visible or audible signal when the level of material in any one feeder approaches the strike off capacity of the feed gate, or shut the plant down.

(6) **Mixer.** The plant shall include a mixing device which will obtain homogeneity and a uniform coating. The mixing output shall not exceed the manufacturer's capacity rating. The moisture content of the bituminous mixture shall not exceed 3% at the discharge end of the dryer.

(7) **Surge Bins.** The plant will be equipped with an approved surge bin at the discharge. This surge bin will be in excess of twenty (20) tons (18 metric tons), and shall be equipped with an approved surge batcher or other approved method satisfactory to the Engineer that will prevent segregation of the bituminous mixture as it is being discharged into the hauling vehicle.

401.03.02 HAULING EQUIPMENT: Trucks used for hauling bituminous mixtures shall have tight, clean, smooth beds which have been thinly coated with a minimum amount of paraffin oil, lime solution, or other approved material to prevent the mixture from adhering to the beds.

401.03.03 PAVERS: Bituminous pavers shall be self-contained, self-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading the finishing courses of bituminous plantmix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plantmix material in widths shown on the plans.

The asphalt paver shall operate independently of the vehicle being unloaded and shall be capable of propelling the vehicle being unloaded in a satisfactory manner and, if necessary, the load of the haul vehicle shall be limited to that which will insure satisfactory spreading. While being unloaded, the haul vehicle shall be in contact with the machine at all times and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.

Pavers shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

Pavers shall be capable of placing the bituminous mixture to meet the surface tolerances specified under the respective sections of bituminous pavement.

401.03.04 ROLLERS: Rollers shall be vibratory, steel-wheeled or pneumatic-tired type. They shall be in good condition, capable of reversing without backlash, and operating at slow speeds to avoid displacement of the bituminous mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the completed material as determined by the Engineer. Attention is directed to Subsection 401.03.11, "Rolling and Compaction."

Rollers for the test strip shall meet the following requirements:

a) Breakdown rollers shall be either a three (3) wheeled steel roller or a two (2) axle tandem or a three (3) axle tandem weighing not less than ten (10) tons.

b) Except as hereinafter permitted, pneumatic-tired rollers shall consist of not less than nine (9) wheels equipped with pneumatic tires of equal size and diameter mounted on two (2) axles attached to a rigid frame equipped with a loading platform or body suitable for ballast loading; so that the total weight of the roller can be varied to produce an operating weight per tire of between one thousand (1,000) and two thousand (2,000) pounds (450 and 900 kilograms). The tires shall have treads satisfactory to the Engineer. The tires on the rear axle shall be so spaced that the entire gap between adjacent tires on the front axle will be covered by one (1) tread of the following tires. The tires shall be uniformly inflated so that the air pressure in the several tires will not vary more than five (5) pounds per square inch (34 kPa). Inflation pressure in pounds per square inch shall be the tire manufacturer's recommendation. Minimum tire size shall be 7.50 x 15 inches, four (4) ply. The use of pneumatic-tired rollers with lesser number of wheels and a greater maximum operating weight per tire than that specified herein will be permitted subject to the following requirements:
   1. The minimum width between the outer edge of the outside tires on a given axle shall be sixty (60) inches (1.5 meters).
   2. The weight of the roller and the tire pressure can be varied to produce a ground contact pressure between fifty (50) and seventy (70) p.s.i. (345 and 483 kPa).

c) The finish roller shall be a two (2) axle tandem weighing not less than eight (8) tons (7.3 metric tons).

401.03.05 WEATHER LIMITATIONS: The bituminous mixture shall not be placed upon any wet surface or when the surface temperatures of the underlying course is less than specified in Table I. The temperature requirements may be modified, but only when so directed by the Engineer.

TABLE I - BASE TEMPERATURES LIMITATIONS

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 INCHES OR GREATER	40	4
GREATER THAN 1 INCH BUT LESS THAN 3 INCHES	45	7
1 INCH OR LESS	50	10

The open-graded plantmix surface shall be placed only when the pavement surface temperature is above sixty (60) degrees F. (15.5 degrees C.).

401.03.06 PREPARATION OF EXISTING SURFACE: When the surface of the existing pavement or old base is irregular, it shall be brought to a uniform grade and cross section as shown on the plans.

The subgrade to receive asphalt concrete or asphalt concrete base immediately prior to applying prime coat, shall conform to the compaction and elevation tolerance specified for the material involved and shall be free of loose or extraneous material.

If the plantmix bituminous surface is being constructed directly upon an existing hard-surfaced pavement, a tack coat of grade CSS-1h or SS-1h emulsified asphalt diluted 50/50 at an approximate rate of 0.05 to 0.10 gallon per square yard (0.23 to 0.45 liters per square meter), shall be uniformly applied upon the existing pavement preceding the placement of the asphalt concrete. The surface shall be free of water, foreign material, or dust when the tack coat is applied. To minimize public inconvenience, no greater area shall be treated in any one day than is planned to be covered by plantmix during the same day, unless otherwise authorized by the Engineer.

A similar tack coat shall be applied to the surface of any previous course placed longer than 24 hours, or if the surface is such that a satisfactory bond cannot be obtained between it and a succeeding course, as determined by the Engineer.

The contact surfaces of all cold pavement joints, curbs, gutters, manholes, and the like, shall be painted with grade CSS-1h or SS-1h emulsified asphalt immediately before the new asphalt concrete is placed. Reference is made to Section 405, "Tack Coat."

When specified in the contract, longitudinal and transverse joints and cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon a Portland cement concrete surface. Excess bituminous material shall be removed from joints and cracks prior to spreading the mixture.

401.03.07 PREPARATION OF BITUMINOUS MATERIALS: The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

401.03.08 PREPARATION OF AGGREGATES: Aggregates proportioned prior to the heating and drying process, shall be separated into at least two general sizes (1) that portion of the material having a minimum of 80% passing No. 4 sieve, and (2) that portion of the material having a minimum of 80% retained on a No. 4 sieve. The material shall be maintained within these limits with a uniformity of plus or minus 5%. Each portion of the material shall be stored separately. When moving the aggregate from storage to compartment bins, any method may be used which will not cause segregation, degradation, or combinations of aggregate which fail to meet the specified gradation requirement. Plantmix operations shall not commence until sufficient aggregate material is stockpiled to insure one day's run.

Aggregate proportioned immediately after the heating and drying process shall be screened into a minimum of two fractions in the case minus ½" aggregate is used, and into a minimum of three fractions when larger sized aggregate is used. The screened material shall be conveyed to separate compartments ready for proportioning and mixing with bituminous material.

If the CONTRACTOR elects to introduce baghouse fines into the mix, the material shall be drawn from a storage facility in which the material is kept in a uniform free flowing condition. The baghouse fines for delivery to the plant shall be from a vane type metering device which is interlocked, (electrical driven feeders shall be activated from the same circuit) to the flow of each aggregate feeder. The drive shaft on the baghouse fines vane feeder shall be equipped with a revolution counter accurate to one tenth (1/10) of a revolution, and a means for varying the rate.

In a continuous mix and/or dryer drum plant the baghouse fines shall be added at the asphalt feed line to insure a uniform mix.

In batch plants the baghouse fines shall be added by the use of a separate bin.

The baghouse fines shall be introduced at a point as approved by the Engineer at a percentage determined by the Engineer, not to exceed two (2) percent by dry weight of the aggregate.

Baghouse fines shall be considered as part of the aggregate, and not as a mineral filler.

If mineral filler is required to meet the tensile strength requirements of the job-mix formula, it shall be added by one of the following methods:

(a) **Cold Feed Method.** Hydrated lime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates at the rate of not less than one (1) percent nor more than two and one-half (2-1/2) percent of the weight of the dry aggregate. The exact rate of application shall be as determined by the job mix formula.

Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition. The mineral filler for delivery to the mixer shall be from a vane type metering device which is interlocked, (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder. The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to one tenth (1/10) of a revolution, and a means for varying the rate.

In continuous mix and/or drum dryer plants the mineral filler shall be added to the aggregate after the aggregate is proportioned.

In batch plants the mineral filler shall be added to the aggregate prior to drying.

Regardless which type of plant is used the following methods shall be utilized:

Prior to the introduction of the mineral filler sufficient moisture shall be added by way of spray bars at the aggregate bins to bring the aggregate to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and wet the lime. This content shall be a minimum of four (4) percent. The actual amount of moisture required will be determined by the ENGINEER. After the addition of water and mineral filler the aggregate shall be mixed using a horizontal twin-shaft pugmill. The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to assure that the aggregate is thoroughly coated with mineral filler. The volume of material in the pugmill shall not extend above the vertical position of the blade tips. The completed mixture shall be directly introduced into the hot plant. Stockpiling of the completed mixture is strictly prohibited.

The moisture control valve shall be interlocked with the hot plant control room so the moisture control valve is automatically turned off when the cold feed belts are shut off. The control valve shall also turn on automatically when the cold feed belts are activated.

(b) **Marination Method.** Hydrated lime (hereinafter referred to as mineral filler) shall be added to all fractions of the plantmix bituminous aggregates. The coarse aggregates are to be wet cured with mineral filler at a rate of one (1) percent of the weight of dry aggregate. The fine aggregates are to be wet cured with mineral filler at a minimum rate of two (2) percent of the weight of the dry aggregate. The aggregates are to be marinated (wet cured) in the stockpiles for a minimum of forty-eight (48) hours.

The wet cured aggregate in the stockpile shall be used within forty-five (45) calendar days. Material marinated in stockpile in excess of forty-five (45) calendar days shall not be used for the production of plantmix bituminous aggregates unless otherwise approved by the Engineer.

Prior to the introduction of the mineral filler sufficient moisture shall be added to by way of spray bars at the aggregate bins to bring the aggregates to a moisture content where enough free surface moisture is available to thoroughly wet the aggregate and activate the lime. This content is recommended to be a minimum of three (3) percent for coarse aggregates and six (6) percent for the fine aggregates. The actual amount of moisture required will be determined by the ENGINEER. After the addition of water and mineral filler the aggregate shall be mixed using a horizontal twin-shaft pugmill. The mixing paddles shall be adjustable for angular position on the shaft to permit altering of the mixing pattern or retarding the flow to assure that the aggregate is thoroughly coated with mineral filler. The volume of material in the pugmill shall not extend above the vertical position of the blade tips.

Mineral filler shall be drawn from a storage facility in which the mineral filler is agitated by air or other means to keep it in a uniform free flowing condition. The mineral filler for delivery to the mixer shall

be from a vane type metering device which is interlocked, (electrical driven feeders shall be actuated from the same circuit) to the flow of each aggregate feeder. The drive shaft on the mineral filler vane feeder shall be equipped with a revolution counter reading to one tenth (1/10) of a revolution, and a means for varying the rate.

(c) **Slurry Method.** Hydrated lime or slaked quicklime (hereinafter referred to as mineral filler) shall be added to all plantmix bituminous aggregates in slurry form at a rate of not less than one (1) percent nor more than two and one-half (2-1/2) percent of dry mineral filler based on the weight of the dry aggregate. The exact rate of application shall be as determined by the job-mix formula.

A slurry containing one (1) part mineral filler and two (2) parts water by weight is recommended. The actual amount of water required in the production of the slurry will be determined by the Engineer after a visual inspection to assure that the aggregate is thoroughly and uniformly coated with the mineral filler. The addition of moisture to the aggregate prior to mixing of the mineral filler and aggregate will not normally be required.

The slurry shall be prepared in a central mixing tank provided with agitation for keeping the mineral filler in suspension until applied to the aggregate. The slurry mixing tanks must be capable of producing sufficient slurry for the hot mix asphalt manufacturing facility production rate, and shall produce a uniform slurry consistency. The plant shall be equipped with suitable pumps and meters for introducing the required amount of slurry to the aggregate. A suitable device shall be provided to the Engineer for determining the weight of mineral filler per gallon of slurry.

If quicklime is used as the mineral filler, it shall be converted to hydrated lime by using one or more slaking tanks. The slaking unit must be capable of complete slaking or hydration of the quicklime, and shall be capable of providing agitation for mixing and keeping the mineral filler in suspension until use.

After the addition of the mineral filler slurry, the aggregate shall be mixed using a horizontal twin-shaft pugmill. The mixing paddles shall be adjustable for angular position of the shaft to permit altering of the mixing pattern or retarding the flow to assure that the aggregate is thoroughly coated with mineral filler. The volume of material in the pugmill shall not extend above the vertical position of the blade tips. The completed mixture shall be directly introduced into the hot plant. Stockpiling of the completed mixture is strictly prohibited.

401.03.09 MIXING: The permissible moisture content of the bituminous mixture just behind the paver shall not exceed one and one-half (1-1/2) percent as determined by test method ASTM D 1461 or equivalent. Should the aggregate contain excessive moisture when heated within the temperature limits, the Contractor will be required to take satisfactory corrective action before resuming plantmix operations. When an approved dryer drum mixing process is used, the moisture content of the bituminous mixture at discharge from the mixer shall not exceed three (3) percent, and the resulting product at the discharge end of the drier shall be a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance.

The drier aggregate shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gaged and introduced into the mixer in the amount specified by the job-mix formula.

Commercial filler material, when required, shall be added to the mixer separately and shall be thoroughly dry. If the materials are mixed in a batching plant, the filler material shall be fed directly into the mixer as near the center as possible.

The time of mixing a batch shall begin on the charging stroke of the weight hopper dumping mechanism and shall end when discharge is started. Mixing shall continue until a homogenous mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced. In general, the time of mixing shall not be less than thirty (30) seconds, except that the time may be reduced when in the opinion of the Engineer the sizes of aggregates are uniformly distributed and all particles are thoroughly and uniformly coated with asphalt binder. The output rate shall not exceed the manufacturer's capacity rating.

Should the mixture, at the plant or in place, show an excess or deficiency of bitumen, show injury or damage due to burning or overheating, or show an improper combination of aggregates, due to the Contractor's failure to conform to the specified requirements, it shall be rejected and if still in the truck shall be disposed of as required. If an unsatisfactory mix, as referred to above, has been placed, it shall be disposed of and replaced as directed. No compensation will be allowed for rejected material.

401.03.10 SPREADING AND FINISHING: The mixture shall be laid upon an approved surface, and shall be spread and struck off to the grade, and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

The forward rate of travel of the paving machine(s) shall be regulated to a speed dependent upon the capacity of the mixing plant to furnish the mixture and the rate at which the rollers can obtain the required compaction. The machine shall be operated so that material does not accumulate and remain along the sides of the receiving hopper.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and compacted by hand tools. For such areas, the mixture shall be dumped, spread, and screeded to give the required compacted thickness, correct grade, and cross section.

The Contractor may windrow plantmixed bituminous base or surface material in front of the spreading and finishing machine, provided that the following conditions and requirements are strictly adhered to:

(a) The windrow is properly sized, thereby insuring the delivery of the correct amount of material to the spreading and finishing machine at all times.

(b) The bituminous mixture shall be transferred from the windrow to the spreading and finishing machine in such a manner that the materials in the spreading machine will be a uniform mixture. The base, upon which the windrow was formed shall not be disturbed and there shall be no paving material remaining on this base between the pickup device and the spreading and finishing machine.

(c) The temperature requirements for the material in the hopper of the spreading and finishing machine are complied with. Plantmix bituminous mixture that does not meet the minimum temperatures specified shall not be incorporated in the work, but shall be waste in a manner satisfactory to the Engineer.

Should any course of bituminous mixture placed by utilizing a windrow be inferior, as determined by the Engineer, to that placed by transferring the bituminous mixture directly from the hauling vehicle to the spreading machine, the use of a windrow shall be discontinued.

The bituminous mixture spread through the paving machine during one day's operation shall come from a single plant manufacturer. Intermixing from more than one source shall not be allowed.

401.03.11 ROLLING AND COMPACTION: The initial or breakdown rolling shall consist of one complete coverage of the bituminous mixture with a steel-wheeled roller. Initial rolling shall commence at the lower edge and shall progress toward the highest portion of the roadbed. Under no circumstances shall the center be rolled first. The initial or breakdown rolling shall be followed by rolling such that uniform density is obtained throughout the depth of the layer of the material being compacted. At least two rollers, one steel-wheeled, the other pneumatic-tired, shall be used and the total number of rollers used shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The final rolling of the bituminous mixture shall be performed with the same type of roller used for breakdown rolling. Rolling shall be performed in such a manner that cracking, shoving, or displacement will be avoided. All rollers shall be in good condition, and the reversing mechanism so maintained that the roller is capable of changing directions smoothly. The roller shall be kept in continuous motion while rolling so that all parts of the pavement shall receive equal compression. The motion of the roller shall be slow enough at all times to avoid displacement of the pavement. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly maintained. The use of diesel oil on pneumatic-tired rollers shall be kept to a minimum as determined by the Engineer. Preferably water soluble oil or an asphalt release agent shall be used. The compaction for Type 2 C control strips shall proceed until the rate of change of in-place densities of subsequent compaction tests is less than two-tenths (0.2) percent.

401.03.12 ACCEPTANCE SAMPLING AND TESTING OF BITUMINOUS MIXTURE: At the Contractor's expense, field thickness and density determinations of the bituminous mixture shall be made in lots, each lot representing one day's placement. A lot shall be divided into five (5) equal sublots, and one (1) test shall be made for each sublot. The location of the field tests may be chosen on a random basis using ASTM D3665 Section 4.3, except that any random location given shall be set-back two (2) feet (0.6 meter) from a curb or three (3) feet (0.9 meter) from an edge, joint, or seam. A summary of the random number chart used and the lot description shall be completed and approved by the Engineer prior to sampling and shall be included in the finished test results.

Determination of the field thickness of the compacted bituminous mixture, as required by the Engineer, shall be accomplished by ASTM D 3549, "Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens".

Determination of the field density of the compacted bituminous mixture shall be accomplished by either of the methods listed below. In case of dispute, the ASTM D 1188 test method, as modified shall govern.

1.) ASTM D 2950, "Density of Bituminous Concrete in Place by Nuclear Method." When this method is used, the nuclear device shall be first correlated with the density of core samples.
2.) ASTM D 1188, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens." When this method is used, the procedure shall be modified to require the use of "Coated Specimens" (Parafilm or Paraffin) only. The use of Bulk Specific Gravity determinations by SSD (saturated surface dry) method are prohibited.

The use of ASTM D 2950, shall include correlation of test results to drilled cores. A minimum of one lot (one full day's production), and not less than five (5) sub-lots, shall be used for this correlation. Should any nuclear test density in the first lot, differ from it's corresponding drilled core density by more than three (3.00) percent relative compaction, a second lot shall be correlated and the average of all sub-lots in the first and second lots, but not less than ten (10) sub-lots, shall be used for the correlation. The four (4) inch (100 millimeter) cores are to transferred to the Engineer along with the random number generator listing station/offset locations.

The theoretical maximum density of the bituminous mixture shall be determined by taking random samples of the mixture delivered to the job site and testing in accordance with ASTM D 2041, "Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures." At least two theoretical maximum density determinations shall be made for each day's production of bituminous mixture used in the work, unless the day's production is less than 500 tons (454 metric tons), then only one theoretical maximum density determination is required.

As a quality control measure, the Contractor shall, at his expense, make periodic checks of the field density of the compacted bituminous mixture at any time during paving operations. The testing performed by the Contractor may be used by the Engineer in part or in whole as the basis of acceptance in addition to the Quality Assurance testing to be done by the Engineer.

The pavement thickness acceptance criteria are as listed below (unit costs to be updated January 2002):

(1) If the average of all measurements meets or exceeds the design thickness, with no core more than ten (10) percent less than the design thickness, the placement is acceptable.

(2) If there is only an isolated thin area, the limits of the area should be identified to determine if a construction resolution is necessary.

(3) If the core results indicate a consistently thin section, with no core more than fifteen (15) percent less than the design thickness and with the approval of the Engineer, the contractor has the option of proposing a construction resolution or contributing an amount equivalent to the reduction in the asset value. Calculation of the lost asset value is accomplished with the following steps:
   (a) Determine the annual numbers of 18-kip equivalent single axle loads (ESAL), based upon the design traffic index (TI), a 20-year design life and an assumed traffic growth rate.
   (b) Calculate the composite structural number of the designed road section (i.e., the AC and aggregate base sections).
   (c) Using the average AC thickness, calculate the structural number of the constructed road section.
   (d) Determine the ESAL value that correlates with the reduced structural number.
   (e) Based upon the annual ESAL counts, determine the corresponding design life of the reduced section.
   (f) Using a three (3) percent inflation factor and the unit cost of the AC (on a $/square yard basis) determine the equivalent uniform annual cost (EUAC) of each section.
   (g) Multiply the reduction in design life by the EUAC to determine the reduced value of the pavement, on a unit cost basis.
   (h) Multiply the unit cost by the pavement area.
   (i) As an alternative, use the following unit cost values for the four (4) road classifications (dollars per square yard per inch deviation from design thickness): Residential=$6.97, Minor Collector=$7.10, Major Collector=$6.14, and Arterial $7.20.

(4) If the core results yield an average thickness greater than the design thickness, but are alternately very high and very low (more than ten (10) percent out), the engineer may reject the placement.

The pavement density acceptance criteria for production placements are as listed below (unit costs to be updated January 2002):

(1) The average density for Residential roadway pavement must be 92% ±20% (90.0%-94.0%), with no single density deviating more than four (4) percentage points (all measurements between 88%-96%). If the average is between 2.0%-4.0% out (88%-90.0% or 94.0%-96%), with no density more than 5.0% out (all measurements between 87%-97%), the contractor has the option of

contributing the lost asset value of $1.22 per square yard per percentage point deviation from the acceptance range.

(2) The average density for Minor Collector roadway pavement must be 93.0% ±20% (91.0%-95.0%), with no single density deviating more than four (4) percentage points (all measurements between 89%-97%). If the average is between 2.0%-4.0% out (89%-91.0% or 95%-97%), with no density more than 5.0% out (all measurements between 88%-98%), the contractor has the option of contributing the lost asset value of $1.22 per square yard per percentage point deviation from the acceptance range.

(3) The average density for Major Collector roadway pavement must be 93.0% ± 15% (91.5%-94.5%), with no single density deviating more than four (4) percentage points (all measurements between 89%-97%). If the average is between 1.5%-4.0% out (89%-91.5% or 94.5%-97%), with no density more than 5.0% out (all measurements between 88%-98%), the contractor has the option of contributing the lost asset value of $0.81 per square yard per percentage point deviation from the acceptance range.

(4) The average density for Arterial roadway pavement must be 93.0% ± 15% (91.5%-94.5%), with no single density deviating more than four (4) percentage points (all measurements between 89%-97%). If the average is between 1.5%-4.0% out (89%-91.5% or 94.5%-97%), with no density more than 5.0 % out (all measurements between 88%-98%), the contractor has the option of contributing the lost asset value of $0.81 per square yard per percentage point deviation from the acceptance range.

(5) Or as may otherwise be specified in the project plans or contract documents.

401.03.13 MAINTAINING TRAFFIC: Traffic shall not be allowed on newly placed pavement for at least 24 hours or until the bituminous paving mix in-place temperatures has dropped below 104°F (60°C).

Exceptions shall be made at the discretion of the Engineer. Artificial means to reduce the pavement temperature may be used as approved by the Engineer.

401.03.14 JOINTS: Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of the freshly laid mixture unless authorized by the Engineer. Transverse joints shall be conformed by cutting back on the previous run to expose the full depth of the course. A brush coat of asphalt emulsion shall be used on contact surface of transverse joints just before additional mixture is placed against the previously rolled material.

Longitudinal joints shall be spaced in such a manner that joints in succeeding courses will be at least six (6) inches (150 millimeters) horizontally from joints in any preceding course. Lanes will be evened up each day to eliminate cold longitudinal joints insofar as practicable.

Transverse joints shall be spaced in such a manner that joints in succeeding courses will be a minimum of five (5) feet (1.5 meters) horizontally from joints in any adjacent course. Lanes shall be evened up each day to eliminate cold transverse joints insofar as practicable.

Attention is directed to Subsection 401.03.10, "Spreading and Finishing."

401.03.15 SURFACE TOLERANCES: Surface tolerances will be specified under the respective sections of bituminous pavement.

401.03.16 SURFACING MISCELLANEOUS AREAS: Surfacing of road approaches and connections, street intersection areas, frontage roads, island areas, sidewalks, dikes, curbs, gutters, gutter flares, ditches, downdrains, spillways, aprons at the ends of drainage structures, and other designated areas outside the travelled way shall conform to the provisions specified in these specifications.

The combined aggregate grading for bituminous mixtures placed on miscellaneous areas shall conform to that specified for the bituminous mixture placed on the travelled way, except the aggregates used in the construction of island areas and dikes shall be constructed of aggregate conforming to the requirements of Plantmix Surface Aggregate, Type 3. The amount of bituminous material used in the bituminous mixture placed in dikes, gutters, gutter flares, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled ways shall be increased not less than one (1) percent by weight of the aggregate over the amount of bituminous material used in the bituminous mixture placed on the travelled way. Submittal of a revised job-mix formula will not be necessary.

The bituminous mixture placed in island areas, sidewalks, dikes, gutters, gutter flares, ditches, downdrains, spillways, aprons at the end of drainage structures, and other designated areas outside the travelled way may be spread in one layer. The material shall be compacted to the required lines, grades, cross section, and density.

Dikes shall be shaped and compacted with an extrusion machine or other equipment capable of shaping and compacting the material to the required correct grade and cross section.

METHOD OF MEASUREMENT

401.04.01 MEASUREMENT: The quantity of bituminous plantmix to be measured for payment shall be the number of tons used in the accepted work, and will be determined by weighing the completed mixture of aggregate, mineral filler if required, and bituminous material.

The quantity of shoulder dikes constructed of bituminous plantmix to be measured for payment shall be the number of linear feet (meters) and will be determined from measurement taken along the top of the completed dikes to the nearest one (1) foot (meter) length.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantity." Batch weights will not be permitted as a method of measurement unless the alternate provisions of Subsection 401.03.01(b)1, "Plant Scales," are met, in which case the cumulative weight of all the acceptable batches will be used for payment.

Due to possible variations in the specific gravity and voids of the payment, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variation.

BASIS OF PAYMENT

401.05.01 PAYMENT: All accepted work and materials measured as prescribed above will be paid for as provided in the representative sections for each type specified.

Full compensation for furnishing and applying bituminous material or asphaltic emulsion as provided for in Subsection 401.03.06, "Preparation of Existing Surface" including "Tack Coat" and 401.03.14, "Joints" shall be considered as included in the contract price paid for the principal items involved and no further compensation will be allowed.

When bituminous plantmix, Type III, is used in the construction of island areas, or dikes, and there is no separate payment for said mixture, this bituminous plantmix shall be included in the payment for plantmix bituminous surface of the major type shown in the list of bid items and the proposal.

SECTION 402

PLANTMIX BITUMINOUS SURFACE

DESCRIPTION

402.01.01 GENERAL: This work shall consist of constructing one or more courses of bituminous pavement on a prepared base in accordance with these specifications, and in conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer. The prepared base shall be prime coated or tack coated as specified in Section 405 and 406 prior to the placement of any plantmix bituminous surface. The cured prime coat shall have no raw asphalt exposed and shall be cleaned of all loose material.

The requirements of Section 401, "Plantmix Bituminous Pavements - General" shall be applicable to this work, except as hereinafter specified.

MATERIAL

402.02.01 GENERAL: The material shall conform to the requirements as specified in Subsections 401.02.01 through 401.02.04, inclusive, of Section 401, "Plantmix Bituminous Pavements - General."

CONSTRUCTION

402.03.01 GENERAL: The construction requirements shall conform to the requirements as specified in Subsections 401.03.01 through 401.03.15, inclusive, of Section 401, "Plantmix Bituminous Pavements - General," with the exception contained in the following two subsections.

402.03.02 SPREADING AND FINISHING: Unless otherwise specified, bituminous plantmix surface shall be placed in courses not exceeding four (4) inches (100 millimeters) in compacted thickness. When more than one course is placed, the courses shall be of approximately equal thickness.

Bituminous plantmix surface to be placed on shoulders and other areas of the travelled way having a width of eight (8) feet (2.4 meters) or more, shall be spread as specified in Subsection 401.03.10, "Spreading and Finishing." When the areas are less than eight (8) feet (2.4 meters) in width the material may be deposited and spread in one or more layers by other mechanical means that will provide a uniform smoothness and texture. Stockpiling bituminous mixture on contiguous pavement that might be stained thereby will not be permitted.

402.03.03 SURFACE TOLERANCES:

402.03.03.01: The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. When a straightedge ten (10) feet (3 meters) long is laid on the finished surface and parallel with the centerline of the highway, the surface shall not vary more than one quarter inch (6 millimeters) from the lower edge of the straightedge.

The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than one quarter inch (6 millimeters) are present when tested with a straightedge ten (10) feet (3 meters) long laid in a

TABLE 1

Class of Concrete	Cement Range Sacks Per Cubic Yard	Kg. Per Cubic Meter	Coarse Min. Agg. Size No.	Compressive Strength (28 Day) PSI	Compressive Strength (28 Day) Mpa	Slump Range Inches** ASTM C 143	Slump Range Centimeters	Air Range %	Unit Weight Variation Pounds	Unit Weight Variation Kg.	Use
A	6.0 - 7.5	334 - 419	467	3000	20.7	1 - 4	2.5 - 10	--	±3	1.4	General use
AA	6.0 - 7.5	334 - 419	467	3000	20.7	1 - 4	2.5 - 10	4 - 7	±3	1.4	General use
D	6.0 - 7.5	334 - 419	67	3000	20.7	1 - 4	2.5 - 10	--	±3	1.4	General use
DA	6.0 - 8.0	334 - 446	67	3000	20.7	1 - 4	2.5 - 10	4 - 7	±3	1.4	General use
E	6.0 - 7.5	334 - 419	57	3000	20.7	1 - 4	2.5 - 10	--	±3	1.4	Reinforced sections curbs, etc.
EA	6.0 - 8.0	334 - 446	57	3000	20.7	1 - 4	2.5 - 10	4 - 7	±3	1.4	
PAA	6.0 - 8.0	334 - 446	67	Specified on Plans	--	0 - 4	0 - 10	Specified on Plans	±3	1.4	Prestressed Members
Modified A & AA	6.0 - 8.0	334 - 446	467	Specified on Plans	--	1 - 4	2.5 - 10	4 - 7 (AA only)	±3	1.4	Where specified on plans
Modified D & DA	6.0 - 8.0	334 - 446	67	Specified on Plans	--	1 - 4	2.5 - 10	4 - 7 (DA only)	±3	1.4	Where specified on plans

* NOTE: Based on aggregate in a saturated dry condition.

** NOTE: When the deck of a structure is used as a riding surface, the slump shall conform to that specified in Subsection 409.03.01, "Classification and Proportions." The difference in slump, determined by comparing slump tests on two samples of mixed concrete for each individual batch tested, shall not exceed two (2) inches (5) centimeters). When the difference in slump does exceed two (2) inches (5 centimeters), procedure and equipment used in producing the concrete shall be adjusted to reduce the difference in slump to not more than two (2) inches (5 centimeters).

Samples will not exceed five hundred (500) pounds (200 kilograms) for each separate grading.

Before beginning concrete work, the Contractor shall submit in writing to the Engineer the proposed concrete mix design giving the cement factor in sacks per cubic yard (cubic meter) indicating the proportions of cement, water, admixtures and the gradation of the primary aggregate nominal sizes which he proposes to furnish. When the primary coarse aggregate is separated into two sizes, the gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically with the fine aggregate to indicate one proposed gradation. Such gradation shall meet the grading requirements shown in the following table. (Not applicable to light-weight concrete). If the Contractor proposes to use an admixture other than an air-entraining agent, he shall state its complete brand name and the quantity proposed to be used per sack of cement.

GRADING LIMITS OF COMBINED AGGREGATES

Sieve Size	Percent Passing	
	1½" Maximum	¾" Maximum
2	100	---
1-1/2	87-100	---
1	65-90	100
3/4	48-82	80-100
3/8	39-58	46-70
4	30-45	34-50
8	23-38	24-42
16	15-33	17-34
30	8-24	10-25
50	4-13	5-15
100	1-5	2-7
200	0-3	0-3

Portland cement concrete shall be proportioned using the aggregates tested such that the compressive strength requirements in Table 1 of this subsection will be satisfied. The Contractor shall give the Engineer advance notice in writing when any changes are to be made in the batch proportions.

Batches of concrete shall not vary more than ±three (3) pounds per cubic foot (±48 kilograms per cubic meter) in unit weight from design mix. The cement factor of any individual batch placed in the work shall not be more than 0.15 sack per cubic yard less, nor more than 0.25 sack per cubic yard (8.4 kilograms per cubic meter less or 14.0 kilograms per cubic meter more) greater than the designated factor (sacks of cement per cubic yard) (kilograms of cement per cubic meter). The weights used may be varied as necessary to comply with the above tolerances in cement factor and unit weight.

501.03.05 PROPORTIONING METHODS: Except as hereinafter noted, aggregate bins shall conform to either (a) or (b) as follows:

(a) Each specified size of aggregates shall be stored in a separate bin. Except as hereinafter specified, each bin shall be provided with an individual outlet gate, designed and constructed to prevent leakage when closed. The gates shall cut off quickly and completely.

(b) Each size aggregate shall be weighed individually in a single bin, providing there is a satisfactory method employed to eliminate any excess material resulting from over-charging of the bin before the material reaches the surge hopper.

(a) and (b) above will not be required when batching for culvert headwalls, manholes, small boxes, sidewalks, etc., and the total quantity of concrete called for on the project does not exceed 300 cubic yards (229 cubic meters).

All aggregates for use in Portland cement concrete shall be proportioned by weight, with the exception that aggregates for culvert headwalls, short pieces of curb and gutter, or small sections of sidewalk and related minor work may be proportioned either by weight or volume as the Contractor may elect. Measuring boxes of known capacity shall be furnished and used to measure each size of aggregate proportioned by volume.

Batches requiring fractional sacks of cement will not be permitted, unless the Contractor elects to weigh the cement in each batch.

Bulk cement shall be weighed separately when the batch is one (1) cubic yard (cubic meter) or more. The scale and weigh hopper for the cement shall be separate and cement hopper shall be interlocked against opening before the full amount of cement is in the hopper, against closing before the contents of the hopper are entirely discharged and the scales are back in balance, and against opening when the amount of cement in the hopper is underweight by more than one (1) percent of the amount specified. An interlock system will not be required on projects having less than three hundred (300) cubic yards (229 cubic meters) in the bid schedule.

Scales utilized in the proportioning device may be of the springless dial type or of the multiple beam type.

If of the dial type, the dial shall be of such size and so arranged that it may be read easily from the operating platform.

If of the multiple beam type, the scales shall be provided with an indicator operated by the main beam which will give positive visible evidence of over or under weight. The indicator shall be so designed that it will operate during the addition of the last four hundred (400) pounds (180 kilograms) of any weighing. The over travel of the indicator hand shall be at least one-third of the loading travel. The indicator shall be enclosed against moisture and dust.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading and cutoff shall not vary from the weight designated by more than one (1) percent for cement and one and one-half (1-1/2) percent for any size aggregate, nor one and one-half (1-1/2) percent for the total aggregate in any batch.

Scales shall be approved with a certificate of inspection as required by Subsection 109.01, "Measurement of Quantities."

Should separate supplies of aggregate and material of the same size group, but of different moisture content or specific gravity be available at the proportioning plant, withdrawals shall be made from one supply exclusively and the material therein completely exhausted before starting upon another.

Stockpiled aggregates shall be in a saturated surface dry condition just prior to batching. The moisture content of the aggregate shall be such that no visible separation of moisture and aggregate will take place during transportation from the proportioning plant to the point of mixing. Aggregate containing excess moisture shall be stockpiled prior to use until sufficiently dried to meet the above requirements.

Batches with cement in contact with damp aggregates shall be mixed within thirty (30) minutes after being proportioned. Batch trucks hauling more than one (1) batch of cement and aggregate shall be so constructed that materials do not flow from one compartment to another during haul or discharge.

Coarse and fine aggregate shall be handled and measured separately. Each bag of cement shall contain ninety-four (94) pounds (42.5 kilograms) net and shall be emptied directly into the charging skip of the mixer. Water shall be measured either by volume or by weight.

The equipment for measuring and supplying the water to the mixer shall be so constructed and arranged that the amount of water added to the mixture can be measured in one operation into the mixing drum without dribbling. The equipment shall be so designed that water from the source of supply cannot enter the measuring tank while the water is being discharged from the measuring tank into the mixer. Tanks or other equipment for measuring and discharging water into the mixer shall be sufficiently accurate that the amount of water delivered to the mixer for any batch shall not vary more than one (1) percent from the required quantity of water for any position of the mixer with respect to a level plane. The tanks or other equipment shall be so arranged as to permit the checking of the amount of water delivered by discharging into measured containers.

501.03.06 MACHINE MIXING: Concrete manufactured by any procedure which results in any unmixed lumps of cement in the mixed product shall be rejected.

The Engineer shall be provided with a legible ticket with each load of concrete delivered to the contract which shall contain the following information:

Name of Vendor
Name of Contractor
Number of Cubic Yards in the Load
Actual Weights of Cement and of each Size of Aggregate
Amount of Water Added at the Plant
Amount of Water in the Aggregate
Brand and Type of Cement
Brand and Amount of Admixture
Time and Date of Batching

When mix proportions have been designated for a project and are identified by number, the Engineer may waive the foregoing and accept a legible ticket which shall contain the following information:

Name of Vendor
Name of Contractor
Number of Cubic Yards in the Load
Mix Designation Number
Amount of Water Added at the Plant (including Water in Aggregates)
Time and Date of Batching

Space shall be provided on the ticket so the amount of water added on the job may be indicated.

(a) **General.** All concrete shall be mixed in mechanical mixers, except that when permitted by the Engineer, batches not exceeding one-third (1/3) cubic yard (1/3 cubic meter) may be mixed by hand methods in accordance with the provisions of Subsection 501.03.07, "Hand Mixing." Mixers shall have legible permanently attached plates showing manufacturer's rated capacity, mixing speeds, and serial number.

SECTION 502

CONCRETE STRUCTURES

DESCRIPTION

502.01.01 GENERAL: This work shall consist of furnishing and placing Portland cement concrete in bridges, culverts, headwalls, retaining walls, barrier rail, and all other types of concrete structures. The concrete structures shall be constructed to the lines and grades given by the Engineer and in accordance with the design shown on the plans; the concrete shall be of the class or classes of concrete designated in the proposal on the plans and shall conform to the requirements of Section 501, "Portland Cement Concrete." Unless otherwise specified.

MATERIALS

502.02.01 GENERAL: The materials used shall be those prescribed for the several items which constitute the finished work and shall conform to the requirements for such materials in the following sections:

Portland Cement Concrete	Section 501
Concrete Curing Materials and Admixtures	Section 702
Joint Materials	Section 707
Reinforcement	Section 713
Miscellaneous Metals	Section 712
Elastomeric Bearing Pads	Section 725

CONSTRUCTION

502.03.01 DEPTH OF FOOTINGS: The elevation of the bottoms of footings as shown on the plans, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.

502.03.02 FORMS: All forms shall be built mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly coated with an approved coating or form oil. Coating or form oil shall leave no film on the surface of the form that can be absorbed by the concrete. When required by the Engineer and immediately before placing concrete, the forms shall be thoroughly wetted with water.

When requested by the Engineer, the Contractor shall submit detailed plans of form work for examination by the Engineer. If such plans are not satisfactory to the Engineer, the Contractor shall make such changes as may be required, but it is understood that the Engineer's concurrence in the use of the plans as submitted or corrected shall in no way relieve the Contractor of responsibility in obtaining satisfactory results.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration on the concrete as it is placed.

Forms shall be filleted at all exposed corners unless corners are rounded as hereinafter provided. Triangular molding used for fillets shall have two (2) equal sides. In general, the width of the equal sides of moldings shall be three-fourths (3/4) inch (2 centimeters). For massive work, such as heavy pier copings and columns, the width shall be one and one-half (1-1/2) to two (2) inches (4 to 5 centimeters). Top edges of walls may be filleted or rounded as hereinafter provided for curbs. Top edges of curbs and slabs shall be rounded with an edging tool to a radius of one-half (1/2) to three-fourths (3/4) inch (1.25 to 2 centimeters).

When concrete is placed in excavation, forms shall be provided for all vertical surfaces unless otherwise permitted by the Engineer. On thin walls, such as abutments, wing walls, and retaining walls, the forms on one face may be built up as the concrete is poured, but only to such elevation as will permit proper placing and thorough spading, and in no case greater than the height which can be placed in one day's run. Ports shall be provided in high, thin walls to permit thorough cleaning before placing concrete.

If the forms develop any defects, such as bulging or sagging, after the concrete has been placed, that portion of the work shall be corrected in a manner satisfactory to the Engineer, without additional compensation to the Contractor.

During the erection and after the completion of the forms, they shall be protected in such a manner as to preclude shrinkage, warping, curling, and distortion. Form lumber used a second time shall be free from bulge or warp and shall be thoroughly cleaned.

Forms for concrete over or in the vicinity of operating railroads shall be so constructed and placed that standard clearances demanded by the railroad company will be maintained at all times.

The falsework and forms supporting the bottom slab of the superstructure of box girder structures shall remain in place until the curing period of the deck of the superstructure has expired. Unless otherwise permitted by the Engineer, forms for the webs of box girders shall be removed before the deck slab is poured. All interior forms in box girders, except those permitted to remain in place, shall be completely removed and the inside of the box girder cleared of all loose material and swept clean.

Side forms for beams, girders, columns, railing, or other members of the structure wherein the forms do not resist dead load bending may be removed as specified in Subsection 502.03.12(c).

The side forms are arch rings, columns and piers shall be removed before the members of the structure which they support are poured or placed, so that the quality of the concrete may be inspected. All such side forms shall be so constructed that they may be removed without disturbing other forms which resist direct load or bending stresses.

The condition of the forms will have a direct bearing upon the amount of finishing required.

Full pieces of forms shall be used and shall extend from the bottom to the top of the wall or post.

Curved surfaces shall be formed to provide a smooth surface without visible breaks.

The forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portions of forms to remain.

Forms shall be of sufficient strength to carry the dead weight of the concrete as a liquid without a deflection in excess of L/270, and if such deflection occurs, it shall be sufficient cause for rejection of the work.

Forms for girders and slabs shall be cambered in such amounts as may be required by the Engineer.

Approved form clamps or bolts shall be used to fasten forms. The use of ties consisting of twisted wire loops to hold forms in position during the placing of concrete will not be permitted.

Concrete in columns shall be placed in one continuous operation, unless otherwise specified. The concrete shall be allowed to set at least twelve (12) hours before the succeeding pour is started.

Before pouring concrete for superstructure, the forms on base of columns shall be exposed sufficiently to determine the character of the concrete in the columns.

502.03.09 CONCRETE DEPOSITED UNDER WATER: If conditions render it impossible or inadvisable, in the opinion of the Engineer, to dewater excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or underwater bottom dump bucket, a seal course of concrete of sufficient thickness to thoroughly seal the cofferdam. The concrete shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit.

The use of an aluminum tremie for placing concrete is prohibited.

A tremie shall consist of a watertight tube having a diameter of not less than ten (10) inches (25 centimeters) with a hopper at the top. The tube shall be equipped with a device that will prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The tremie shall be filled by a method that will prevent washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tremie tube shall contain sufficient concrete to prevent any water entry. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

The underwater bucket shall have an open top and the bottom doors shall open freely and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash and shall not be dumped until it rests on the surface upon which the concrete is to be deposited. After discharge, the bucket shall be raised slowly until well above the concrete.

Concrete deposited in water shall be in accordance with Section 501 with ten (10) percent extra cement added. The exact thickness of the seal will depend upon the hydrostatic head, bond and spacing of piles, size of cofferdam, and other related factors, but in no case shall the seal be less than two (2) feet (60 centimeters) in thickness, unless otherwise shown on the plans. Before dewatering, the concrete in the seal shall be allowed to cure for not less than five (5) days after placing.

If a seal which is to withstand hydrostatic pressure is placed in water having a temperature below forty-five (45) degrees F. (7 degrees C.), the curing time before dewatering shall be increased. Periods of time during which the temperature of the water has been continuously below thirty-eight (38) degrees F. (3 degrees C.) shall not be considered as curing time. After sufficient time has elapsed to insure adequate strength in the concrete seal, the cofferdam shall be dewatered and the top of the concrete cleaned of all scum, laitance, and sediment. Before fresh concrete is deposited, local high spots shall be removed as necessary to provide proper clearance for reinforcing steel.

502.03.10 CONSTRUCTION JOINTS: Construction joints shall be made only where located on the plans or shown in the pouring schedule, unless otherwise approved by the Engineer.

Construction joints where the placing of concrete is delayed until the concrete has taken its initial set and for which no expansion is provided, shall be planned in advance and shall be subject to approval by the Engineer. The placing of concrete shall be continuous from joint to joint. These joints shall be perpendicular to the principal lines of stress and, in general, located at points of minimum shear. Only joints shown on the plans will

be permitted in a cantilevered member. Horizontal joints at piers and abutments, except where specified, shall be avoided, and when used shall not be located within two (2) feet (60 centimeters) of the normal water level.

Unless otherwise specified, construction joints shall be struck off but not troweled.

When making a horizontal construction joint, care shall be taken to have the concrete as dry as possible, and any excess water or creamy material shall be drawn off before the concrete sets. On all exposed surfaces, the line of the proposed joint shall be made straight by placing a temporary straightedge on the inside of the form and pouring the concrete so that it will set flush with the edge as provided.

To avoid visible joints as far as possible upon exposed faces, the top surfaces of the concrete adjacent to the forms shall be smoothed with a trowel. Where a "feather edge" might be produced at a construction joint, as in the slope top surface of a wing wall, an insert form block shall be used to produce a blocked out portion in the proceeding layer which shall produce an edge thickness of not less than six (6) inches (15 centimeters) in the succeeding layer.

When the work is unexpectedly interrupted by breakdowns, storm, or other causes, and the concrete as placed would produce an improper construction joint, the Contractor shall either rearrange the freshly deposited concrete, or continue by hand mixing, if necessary, until a suitable arrangement is made for a construction joint. When such a joint occurs at a section on which there is shearing stress, he shall provide adequate mechanical bond across the joint by inserting reinforcing steel, or by some other means satisfactory to the Engineer, which will prevent a plane of weakness.

In resuming work, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance, or other soft or porous materials by one of the following methods:

(a) Concrete surface of fresh concrete (not more than eight (8) hours after placement) shall be cleaned with air and water jets in such a manner that the surface is thoroughly cleaned and the aggregate is not loosened.

(b) Hardened concrete surface (more than eight (8) hours after placement) shall be cleaned by abrasive blast methods in such a manner that the aggregate is not loosened or the edges of the concrete shattered.

The surface of the joint shall be thoroughly washed with clean water and the forms tightened to close contact with the previously placed work, after which the concreting may proceed. The surface of the joint shall be wet just prior to placing new concrete.

502.03.11 REMOVAL OF FALSEWORK AND FORMS:

(a) **General.**

(1) Methods of form removal likely to cause overstressing of the concrete shall not be used. Forms and their supports shall not be removed without the approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

(2) Compressive strengths will be determined by Test Method No. ASTM C39 and ASTM C31 and will be considered information tests only and not acceptance tests as described in Subsection 501.02.04, "Concrete Making Properties."

(345 kilopascals) or portion thereof below the specified minimum compressive strength, to a maximum of fifty (50) percent, as set forth in the following example for the class of concrete shown:

Specified 28 Day Compressive Strength		Liquidated Damages (Per Unit Bid Price)
P.S.I.	**MPa**	**Percent**
3000	20.69	0
2999-2950	20.68-20.34	5
2949-2900	20.33-19.99	10
2899-2850	19.98-19.65	15
2849-2800	19.64-19.31	20
2799-2750	19.30-18.96	25
2749-2700	18.95-18.62	30
2699-2650	18.61-18.27	35
2649-2600	18.26-17.93	40
2599-2550	17.92-17.58	45
2549-2500	17.57-17.24	50
Below 2500	17.23	Remove

The reduced price shall apply to all concrete represented by the strength tests below the specified minimum compressive strength.

When a compressive strength test falls below the specified twenty-eight (28) day compressive strength, the Contracting Agency may determine that an alternate strength test is required or the Contractor may request such a test. When the Contracting Agency determines an alternate strength test is required, the Contractor will not be liable for the cost of such test. In case the Contracting Agency has not determined that an alternate strength test is necessary and the Contractor elects to have an alternate strength test made, the Contracting Agency will then make such a test; however, should this test indicate that the twenty-eight (28) day compressive strength requirement has not been met, the cost thereof shall be deducted from any money due or to become due the Contractor from the Contracting Agency. The cost of all other alternate strength tests made at the Contractor's request shall be borne by the Contractor. The alternate strength test shall consist of obtaining and testing three drilled core samples in accordance with Test Method ASTM C 42. The test specimens will be taken at a single location approved by the Engineer, and shall be from the same area represented by the original strength test. The cores shall be obtained and the test performed by the Contracting Agency. The test shall be accomplished as soon as possible after the twenty-eight (28) day compressive strength test.

The average compressive strength of the three drilled core samples at the age tested shall be converted to a twenty-eight (28) day compressive strength as shown by Chart No. 1 in Section 501. This calculation value shall be termed the "result of the core test". When the result of the core test validates the original twenty-eight (28) day strength test, the quality of the concrete shall be assessed on the basis of the original test. When the core test does not validate the twenty-eight (28) day strength, then the result of the core test shall be used to assess the quality of the concrete.

Concrete removed will not be paid for and the removal thereof will be at the Contractor's expense.

No measurement or other allowances will be made for work, materials for forms, falsework, cofferdam, pumping, bracing, etc.

The quantity of concrete involved in fillets, scorings and chamfers two (2) square inches (13 square centimeters) or less in cross-sectional area shall be neglected. No deduction shall be made for the volume of concrete displaced by reinforcing steel, expansion joint material, drainage and weep holes. The volume of concrete displaced by pipes, conduits, ducts, and forms for voids embedded in concrete that are in excess of two (2) square inches (13 square centimeters) in cross-sectional area shall be deducted. Deductions shall also be made for the volume of timber piles, concrete piles and cast-in-place piles embedded in the concrete.

Each class of concrete will be considered separately.

Tremie seal concrete will be measured on the basis of batched volume placed.

The quantity of concrete handrail to be measured for payment will be the number of linear feet (meters) complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

502.05.01 PAYMENT: The accepted quantity of concrete measured as provided in Subsection 502.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard (cubic meter) for the Class or Type specified. Reinforcing steel will be paid for as provided in Section 505, "Reinforcing Steel." All metal parts, fabrics, pads, joint fillers, drains, and any other materials not specifically mentioned for payment herein, will be considered subsidiary to the other pay items of the work and no further compensation will be allowed therefor.

The accepted quantity of concrete rail measured as provided in Subsection 502.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot (meter).

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Class _____ Concrete (Major)	Cubic Yard (Cubic Meter)
Class _____ Concrete (Minor)	Cubic Yard (Cubic Meter)
Concrete Rail	Linear Foot (Meter)
Tremie Seal Concrete	Cubic Yard (Cubic Meter)
Class _____ Concrete, Modified (Major)	Cubic Yard (Cubic Meter)

SECTION 505

REINFORCING STEEL

DESCRIPTION

505.01.01 GENERAL: This work shall consist of furnishing and placing reinforcing steel and mesh reinforcing in accordance with these specifications and in conformity with the plans.

MATERIALS

505.02.01 GENERAL: Materials shall conform to the requirements specified in the following subsections:

Fabricated Steel Bar or Rod Mats Reinforcement	Subsection 713.03.02
Bar Steel Reinforcement	Subsection 713.03.01
Welded Steel Wire Fabric Reinforcement	Subsection 713.03.03

Bar steel reinforcement may be either Grade 40 or Grade 60 as specified in ASTM A 615 unless otherwise specified on the plans.

Spiral Reinforcement may be either Bar Steel Reinforcement or Steel Wire, of the equivalent size of the bar steel.

505.02.02 SAMPLES: One extra bar of each diameter shall be furnished per heat for each one hundred (100) tons (90 metric tons) or fraction thereof. This bar shall be the longest bar of each size so that it, or a portion of it, can be used to replace any bar of that diameter which is selected to be used as a field sample. The field sample must be of sufficient length to provide two (2) two, (2) foot (60 centimeters) samples of each diameter. The extra bars shall be indicated on the fabricator's details.

CONSTRUCTION

505.03.01 REINFORCING STEEL LIST: Before placing reinforcing steel, two copies of a list of all reinforcing steel showing sizes, lengths and numbers of pieces and bends required shall be furnished to the Engineer at the site of his use in administering the contract. Furnishing such lists to the Engineer shall not be construed to mean that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing all bar reinforcing steel in accordance with the details shown on the plans and as specified.

505.03.02 PROTECTION OF MATERIALS: Reinforcing steel shall be protected at all times from damage. When placed in the work, the reinforcing steel shall be free from dirt, detrimental scale, paint, oil, or other foreign substance. However, when steel has on its surface loose mill scale or dust which is easily removable, it may be cleaned by a satisfactory method, if approved by the Engineer.

505.03.03 BENDING: Bent bar reinforcement shall be cold bent to the shape shown on the plans; and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures.

505.03.04 PLACING AND FASTENING: All bar reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete. When the spacing of bars exceeds one (1) foot (30 centimeters) in either direction, all intersections shall be tied. When the spacing of bars is one (1) foot (30 centimeters) or less in both directions, alternate intersections shall be tied.

Distances from the vertical and horizontal forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports. Blocks used for holding reinforcing bars from contact with the forms or between layers of bars, shall be precast mortar blocks of approved shape and dimensions and shall have a compressive strength of not less than 3,000 psi (20.68 MPa). Metal chairs which are in contact with the exterior surface of the concrete shall be fabricated of either galvanized steel, or have the steel tips plastic coated to at least 3/4 inch (1.91 centimeters) into the concrete, or be of stainless steel conforming to the requirements of ASTM A 493, Type 430. The use of pebbles, pieces or broken stone or brick, metal pipe, and wooden blocks will not be permitted. Reinforcement in any member shall be placed, and then inspected and approved by the Engineer, before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and its removal required.

If mesh reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

505.03.05 SPLICING: All reinforcement bars shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible. Unless otherwise shown on the plans, bars near the top of beams and girders having more than twelve (12) inches (30 centimeters) of concrete under the bar shall be lapped thirty-five (35) diameters and all other bars shall be lapped twenty (20) diameters to make the splice. In lapped splices, the bars shall be placed in contact and wired together. Welding of reinforcing steel shall be done only if detailed on the plans or authorized by the Engineer in writing. Welding shall conform to the specifications for Welded Highway and Railway Bridges of the American Welding Society.

Lapped splices in reinforcement shall not be used for sizes larger than No. 11, (3.49 centimeters).

Tensile reinforcement shall preferably not be spliced at points of maximum stress. The length of lap for deformed bars shall not be less than 24 and 36 bar diameters for Grade 40 and Grade 60, respectively, nor less than 12 inches (30 centimeters).

Where lapped splices are used in reinforcement in which the critical design stress is compressive and with concrete having a strength of 3000 psi (20.68 MPa) or more, the length of lap for deformed bars shall be 20 bar and 24 bar diameters for Grade 40 and Grade 60, respectively, but not less than twelve (12) inches (30 centimeters). When the specified concrete strengths are less than 3000 psi (20.68 MPa), the amount of lap shall be 1/3 greater than the values given above.

Splices in spiral steel shall be made by welding or a lap of one and one-half (1-1/2) turns.

Sheets of mesh reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one (1) mesh in width.

505.03.06 SUBSTITUTIONS: Substitution of different size bars will be permitted only with specific authorization by the Engineer. The bars substituted shall have an area equivalent to the design area or larger.

508.03.10 CAST-IN-PLACE CONCRETE PILES: Concrete filling for cast-in-place concrete piles shall be Portland cement concrete conforming to the requirements of Section 501, "Portland Cement Concrete" of these specifications. Reinforcement shall conform with the details shown on the plans and the requirements of Section 505, "Reinforcing Steel." Cast-in-place concrete piles shall consist of one of the following: Steel shells driven permanently to the required bearing value and filled with concrete; or, drilled holes filled with concrete.

(a) **Steel Shells.** Steel shells shall be of sufficient strength and rigidity to permit their driving and to prevent distortion caused by soil pressures or the driving of adjacent piles until filled with concrete. The shells shall also be sufficiently watertight to exclude water during the placing of concrete.

The shells may be cylindrical or tapered, step tapered, or a combination of either with cylindrical sections. The tip diameter shall not be less than eight (8) inches (20 centimeters) and the butt diameter shall not be less than shown on the plans.

Shells to be driven without a mandrel shall be equipped with heavy steel driving ends and all joints in the shell shall be welded or adequately lock seamed.

After being driven and prior to placing concrete and reinforcing steel therein, the steel shells or casings shall be examined for collapse or reduced diameter at any point. Any shell or casing that is improperly driven or broken or shows partial collapse to such an extent as to materially decrease its bearing value will not be accepted and shall be replaced by the Contractor at his own expense. Driven shells or casings shall be clean and free from water before concrete and reinforcing steel are placed. The Contractor shall have available at all times a suitable light for the inspection of the shells, throughout the entire length, before they are filled with concrete and reinforcing steel.

Concrete shall be placed in steel shells so that it is dense and homogeneous. The upper portion of the shell shall be vibrated to a depth of not less than one-third (1/3) the length of the pile or ten (10) feet (3 meters), whichever is the greater.

The length of steel shell to be ordered shall be determined by the Contractor. Should the Contractor elect to order piling in short lengths, all splices necessary to build up these shorter lengths to the length required, other than those splices for payment in Subsection 508.04.01 of these specifications, shall be at the Contractor's expense.

(b) **Drilled Holes.** Each pile excavation shall be drilled to the minimum specified diameter and depth as shown on the plans. The bottom of each drilled excavation shall be reasonably free of loose soil and/or mud at the completion of drilling and prior to the placement of concrete. Existing groundwater may remain in the excavation and need not be pumped out. Holes shall be examined for straightness and any hole which on visual inspection from the top shows less than one-half (1/2) the diameter of the hole at the bottom of the holes shall be rejected. Suitable casing shall be furnished and placed when required to prevent caving of the hole before concrete is placed therein.

All loose material existing at the bottom of the hole after drilling operations have been completed shall be removed or recompacted to the satisfaction of the Engineer before placing concrete in the hole.

Materials resulting from drilling holes shall be disposed of as provided in the last paragraph of Subsection 206.03.01, "General."

Casing, if used in drilling operations, shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than five (5) feet nor less than one (1) foot (1.5 meters - 0.3 meters) below the top of the concrete during withdrawal and placing operations unless otherwise permitted by the Engineer. The casing shall be hammered or the concrete vibrated during withdrawal of the casing.

Care shall be exercised to insure that the concrete in the hole is dense and homogeneous. Vibration of the concrete during placing will be required. The concrete in the hole for the length of the reinforcing cage (bottom of spiral wire) shall be vibrated.

The reinforcing cage shall be placed and secured symmetrically about the axis of the pile and shall be securely blocked to clear the sides of the hole.

For either (a) or (b), the bottom of each shell casing or hole shall be filled with mortar to a depth of not less than two (2) feet (0.60 meters) immediately before placing the concrete filling materials. The mortar shall be as specified in Section 501.03.11, Class C.

Drilled pile excavations which encounter caving or sloughing conditions shall be deepened at the direction of the Engineer. The additional depth to be drilled shall equal the height of caving or sloughing encountered in the pile excavation.

Concrete placement in the pile excavation shall be accomplished with a concrete pump and steel pipe tremie. The concrete pump shall have sufficient capacity to fill the pile excavation by displacing the water and mud out of the top of the drilled hole. A minimum ten foot (3 meters) head of concrete shall be maintained above the bottom of the steel tremie pipe at all times.

It shall be the Contractor's responsibility to drill the pile excavations and to pour the concrete in such a manner as to insure the structural integrity of the concrete pile.
All phases of pile drilling, steel reinforcement installation, and concrete placement shall be inspected by the Engineer. Inspection by the Engineer does not, however, relieve the Contractor in any way of the responsibility of constructing piles that meet the requirements of the plans and specifications.

The Contractor shall test all completed drilled shaft foundations with a nondestructive testing (NDT) method called Crosshole Sonic Logging (CSL) after at least one (1) day of curing time. Final approval for the first drilled shaft constructed will be given after the CSL tests have been performed on the shaft and the results have been analyzed. Concrete placement in subsequent shaft excavations will not be allowed until the first shaft has been approved.

The consultant who will conduct the Crosshole Sonic Logging (CSL) tests shall submit evidence of qualification to the engineer for approval. Such evidence of qualification shall include the following:

(1) Written evidence of successful completion of CSL tests, brief descriptions and references for four recent CSL projects, and a list of tested shafts with a minimum of 75 shafts tested in the past five years;
(2) Personnel qualifications;
(3) Equipment description and test procedure; and
(4) Example reports.

For the purposes of CSL tests, tubes shall be installed in each pile to permit access for the CSL test probes. The tubes shall be ASTM A 53, Grade B Schedule 40 steel pipe or Schedule 40 PVC. The maximum number of days from placing concrete to completing CSL testing is forty-five (45) calendar days for schedule 40 steel access tubes and ten (10) calendar days for schedule 40 PVC access tubes.

The tubes shall be 1.5 inches (38.1 millimeters) to 2 inches (50.8 milimeters) inside diameter and shall have a round, regular inside diameter free of defects or obstructions, including obstructions at any pipe joints, in order to permit the free, unobstructed passage of 1.35 inch (34.3 millimeters) diameter source and receiver probes used for the CSL tests. The tubes shall be watertight, free from corrosion with clean internal and external faces to insure good bond between the concrete and the tubes. The tubes shall be fitted with a watertight cap on the bottom and the top.

The design drawings for each foundation may specify the number of tubes and the tube spacing angles. Otherwise, the CSL testing firm shall be consulted for the proper number of tubes, which shall be spaced evenly around the perimeter of the reinforcing cage.

Prior to placing the pile reinforcement cage into the shaft, the tubes shall be securely attached to the interior of the reinforcement cage. Use a regular, fairly symmetrical pattern in which each tube is spaced the maximum distance possible from adjacent tubes. The number and spacing of tubes around the perimeter of the cage must correspond to the design drawings. Position tubes so that after reinforcement operations they will be as near to vertical and as parallel as possible. Fit access tubes with a watertight shoe on the bottom and a removable cap on the top. Any joints added to make full-length tubes must be watertight. Wire-tie tubes to the interior of the cage every three (3) feet (0.9 meters), or otherwise secure so tubes remain in place for remaining operations.

The tubes shall extend from the bottom of the reinforcement cage to at least three (3) feet (0.9 meters) above the top of the shaft. If the shaft top is below ground elevation, extend tubes at least three (2) feet (0.6 meters) above the ground surface. Under no circumstance should the tubes be allowed to rest on the bottom of the drilled excavation. Care shall be taken to prevent damaging the tubes during reinforcement cage installation operations in the drilled shaft excavation. The tubes shall be filled with

potable water prior to or as soon as possible after concrete placement (but no later than 4 hours) and the tube tops shall be capped.

The contractor is responsible for good care and workmanship in installing testing tubes such that the testing equipment will pass through the entire length of the tube. If the inspection equipment cannot pass through the full length of the inspection tube, a two (2) inch (51 millimeter) diameter hole shall be cored through the concrete the full length of the pole to replace the defective tube. The cost for all work related to coring this hole, should it be necessary, shall be the sole responsibility of the Contractor. Core holes shall be located at a location determined by the Engineer and approximately nine (9) inches (229 millimeters) inside the drilled shaft reinforcement.

The final acceptance of each drilled shaft shall be determined by the Engineer and will be based on the CSL test results. If any shaft is determined to be unacceptable, the Contractor must submit a plan for remedial action to the Engineer for approval. Any modifications to the dimensions of the drilled shafts shown on the contract plans caused by remedial action will require calculations and working drawings stamped by a licensed professional engineer registered to practice in Nevada. The Engineer prior to repair operations shall approve any remedial correction procedures or designs.

At the Engineer's direction, a core hole shall be drilled in any questionable quality shaft (as determined from the CSL test results or by observation of the Engineer) to explore the shaft condition. A coring method that provides complete core recovery and minimizes abrasion and erosion of the core (i.e., double or triple core barrels) shall be used. If a defect is confirmed, the Contractor shall pay for all coring costs. If no defect is encountered, the Agency will pay for all coring costs, and compensation for the delay will be granted by an appropriate time extension and payment. Materials and work necessary, including engineering analysis and redesign, to effect corrections for the shaft defects shall be furnished to the Engineer's satisfaction with no additional compensation.

After completion of the CSL testing and acceptance of the pile, testing tubes shall be cut off flush with the top of the drilled shaft, and all core holes and testing tubes shall be filled with grout from the bottom up.

508.03.11 COVERING HOLES: To eliminate hazard to life and to preclude dirt or debris from falling or being thrown into them, the tops of driven pile shells or drilled holes shall be securely covered immediately upon withdrawal of the material or drilling equipment.

508.03.12 STEEL PILES: Steel piles shall be H-bearing of the section shown on the plans.

The length of steel pile may be built up in sections either before or during the driving operations. The sections, unless otherwise shown on the plans, shall be identical in cross section. The connections shall be made by welding the entire cross section in conformance with the requirements of Subsection 506.03.20, "Welding." Care shall be taken to properly align the sections connected so that axis of the pile will be straight. The number of welded connections in the length of a pile shall be as few as practicable. If a welded splice is made during the driving operation, it shall be done when the top of the lower portion is at least three (3) feet (1 meter) above the ground to permit observation of the welded connection during several feet of driving.

Piling built up from structural steel plates welded together may be substituted for the rolled steel piling shown on the plans provided that the depth, width, average mean thicknesses and moments of inertia of the built-up sections are at least equal to those of the rolled section, and the flanges are welded to the web with continuous fillet welds on each side of the web, and the welding conforms to Section 506.

METHOD OF MEASUREMENT

508.04.01 MEASUREMENT: The quantity of "Furnish and Drive (Type) Piles" to be measured for payment will be the number of linear feet (meters) of (type) pile complete and in place measured from the tip of the pile to the plane of pile cutoff.

If the Contractor casts concrete piles full length of the reinforcement bars to facilitate driving, no measurement will be made for that portion where concrete must be removed in order that bars may project as shown on the plans.

Load tests will be measured per each and the number used in the work will be the number paid for.

The quantity of splices to be measured for payment will be limited to the number required to splice the pile if it becomes necessary to drive beyond "Design Pile Tip Penetration." Length of extensions will be determined by the Engineer. All splices necessary to drive to "Design Pile Tip Penetration" and for extensions made of shorter lengths than ordered by the Engineer will be at the Contractor's expense.

Metal pile shells driven with a removable core or mandrel shall be spliced according to the manufacturer's specifications. No splices will be measured and paid for when thin shell piles are used that do not require complete circumferential welding performed in the field.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

508.05.01 PAYMENT: The accepted quantity of "Finish and Drive (Type) Piles," measured as provided in Subsection 508.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot (meter), which price shall be full compensation for furnishing all materials including Portland cement concrete, steel shells and reinforcing steel, placing filling materials, disposing of all unused material, and which price shall be full compensation for doing all the work involved in driving, drilling holes, cutting off piles, excavation and backfill, and for filling the space remaining around the pile with sand or crushed rock; all to the required bearing and penetration as shown on the plans or ordered by the Engineer.

Test piles that become a part of the completed structure will be paid for at the contract prices for the type of piling used.

No payment will be made for piles driven out of place or for imperfect piles, or for piles which are damaged in handling or driving.

When, in addition to the requirements of the plans and specifications, brackets or plates are required on steel piles, or special driving shoes are required on timber piles, the Contractor shall furnish and place such devices and the cost thereof will be paid for as extra work as provided in Subsection 104.03, "Extra Work."

The accepted quantity of load tests measured as provided in Subsection 508.04.01, "Measurement," will be paid for at the contract unit price bid per each for load tests, which price shall be full compensation for all material, equipment, tools, and labor incidental to make the tests and to construct the loading platform, procuring and placing the loading material, and removing and disposing of platform material in a satisfactory manner.

The accepted quantity of splices measured as provided in Subsection 508.04.01, "Measurement," will be paid for at the contract unit price bid per each for the splice, which price shall be full compensation for all material, equipment, tools, and labor incidental to make the splice.

Where piling built up from structural steel plates is substituted for the piling specified on the plans, the Contractor shall be entitled to no extra compensation for any excess thickness of steel furnished or for any extra work, materials, equipment, handling or treatment required to construct such piling.

The accepted quantity of "Furnish Cast in Drilled Hole Concrete Piles," measured as provided in Subsection

508.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot, which price shall be full compensation for drilling holes for piling and disposing of material resulting therefrom, and for furnishing and placing all materials including Portland cement concrete and reinforcing steel and for doing all the work necessary to install the piling complete and in place as shown on the plans and as directed by the Engineer.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	**PAY UNIT**
Furnish and Drive (Type) Piles	Linear Foot (Meter)
Load Test	Each
Splices	Each

SECTION 601

PIPE CULVERTS - GENERAL

DESCRIPTION

601.01.01 GENERAL: These specifications include general requirements that are applicable to all type culvert pipes except structural plate pipe, except that specifications for water distribution systems and sanitary sewer systems will specify the pipe to be used in their respective installations.

This work shall consist of furnishing and installing pipe culverts, siphons, end sections, end walls, etc., as may be required to complete the work shown on the plans or established by the Engineer.

MATERIALS

601.02.01 GENERAL: The materials used shall be those prescribed or used for the several items which constitute the finished work and shall conform to the requirements in the following subsections:

Corrugated Metal Pipe and Pipe Arches	Subsection 709.03.01
Bituminous Coated Corrugated Metal Pipe and Pipe Arches	Subsection 709.03.02
Reinforced Concrete Pipe	Subsection 708.03.01
Nonreinforced Concrete Pipe	Subsection 708.03.02
Clay Pipe	Subsection 708.03.04
Grout and Mortar Sand	Subsection 706.03.04
Rubber Gaskets	Subsection 707.03.02

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

The lengths shown on the plans are approximate. The Contractor shall not order and deliver the culvert pipe until a list of sizes and lengths is furnished him by the Engineer.

For structural plate pipe and arches, attention is directed to Section 606, "Structural Plate Pipe, Pipe Arch, and Arch Culverts."

CONSTRUCTION

601.03.01 EARTHWORK: Excavation and backfill shall conform to the requirements of Section 206, "Structure Excavation" and 207, "Structure Backfill," or Section 208, "Trench Excavation and Backfill" when the culvert is placed in a trench. The pipe shall be bedded as shown in the standard sheets appended to the plans or as specified in the Special Provisions. When no bedding class is specified, the requirements for Class B bedding as shown in the Uniform Standard Drawings - Clark County Area shall apply. The lines and grades will be established by the Engineer.

Class "A" bedding will be paid for at the contract unit bid price per cubic yard (cubic meter). Payment as stated above shall be full compensation for all the materials, labor, tools, and incidentals necessary to complete the work.

Provisions for handling of whatever water may be encountered at the site shall be an obligation of the Contractor, and payment therefor shall be considered as subsidiary to the items involved, and no further compensation will be allowed therefor.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

SECTION 602

NON-REINFORCED CONCRETE AND CLAY PIPE

DESCRIPTION

602.01.01 GENERAL: This work shall consist of furnishing and installing non-reinforced concrete pipe or clay culvert pipe of the kind, sizes, and dimensions shown on the plans or established by the Engineer and in accordance with the requirements of these specifications.

MATERIALS

602.02.01 GENERAL: Materials and their use shall conform to the applicable requirements of Subsection 603.02.01 of Section 603, "Reinforced Concrete Pipe" and Subsection 601.02.01 of Section 601, "Pipe Culverts - General."

CONSTRUCTION

602.03.01 GENERAL: The construction requirements shall be as prescribed in Subsection 603.03.01 through 603.03.06 of Section 603, "Reinforced Concrete Pipe," with the following modifications:

(a) External bands of Class "C" mortar as designated in Subsection 501.03.11 may be placed around the pipe joints as herein specified. Several sections of pipe shall be joined before commencing banding operations, but the placing of external bands shall never be more than five (5) lengths of pipe behind joining operations.

Immediately in advance of placing external band mortar, the external surface of the pipe sections at the joints shall be thoroughly cleaned and wetted to insure proper bonding of the band mortar with the pipe. Care shall be exercised to make a union between the band and the mortar which was placed under the joint before the pipe sections were abutted. The band shall not be less than three-eighths (3/8) inch (0.95 centimeters) thick at the pipe joint and shall be approximately four (4) inches (10 centimeters) wide, overlapping the abutting ends of the pipe sections approximately two (2) inches (5 centimeters). The edges of the band shall adhere to the pipe surface to prevent peeling and shall be finished in a workmanlike manner. Rubber gaskets may be used to join the pipe. Rubber gaskets shall conform to the requirements of Subsection 707.03.02, "Rubber Gaskets."

(b) When irrigation or sewer pipe is placed beyond the limits of roadway excavation or embankment, the initial covering of backfill material shall be fine earth or sand approved by the Engineer. Placing the remainder of the trench backfill in layers and compacting to a relative compaction of ninety (90) percent will not be required.

SECTION 609

CATCH BASINS, MANHOLES, AND INLETS

DESCRIPTION

609.01.01 GENERAL: This work shall consist of constructing or reconstructing catch basins, manholes, inlets, and similar structures, consisting of Portland cement concrete with necessary reinforcement, metal frames, grates, and lids, including required excavation and backfilling.

MATERIALS

609.02.01 GENERAL: Materials shall conform to the requirements specified in the following sections:

Portland Cement Concrete	Section 501
Reinforcing Steel	Section 505
Miscellaneous Metals	Section 712
Gray Iron Castings	Subsection 712.03.02

Casting shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting strength and value for the service intended. Casting shall be boldly filletted at angles and the arises shall be sharp and perfect. Casting shall be sand blasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

The Contractor shall obtain from the fabricator of the structural steel grates, frames, and gray iron castings a Certificate of Compliance stating that the fabrications meet the requirements of these specifications, and giving certified shop weights for the fabrications.

Mortar for setting grates shall be mixed in the proportions of one part cement to three parts of fine aggregate.

Pipe crossbars for drop inlets shall be unpainted standard weight black pipe conforming to the requirements of ASTM Designation A 53 or A 120. Straps shall be unpainted A 36 steel.

CONSTRUCTION

609.03.01 GENERAL: Catch basins, inlets, and manholes shall be constructed in accordance with all of the requirements of Section 501, "Portland Cement Concrete." Inlet and outlet pipes shall be placed prior to pouring concrete.

Grates shall be set in full mortar beds or otherwise secured as shown on the plans. Grates shall be set accurately to the final elevations so that no subsequent adjustments will be necessary. Concrete covers, when indicated on the plans, shall be constructed in such manner that they will fit snugly and be readily removable. Structural steel grates shall be painted as specified in Section 614, "Painting."

Pipe or tile placed in masonry for inlet or outlet connections shall extend through the walls and beyond the outside surfaces of the walls a sufficient distance to allow for connections with conduit and the masonry shall be carefully constructed around them so as to prevent leakage around their outer surfaces.

Commercially prefabricated frames and grates of equal or greater capacity and strength may be substituted for the design shown on the plans for drop inlets provided prior approval is obtained in writing from the Engineer.

Frames and grates shall be matchmarked in pairs before delivery to the work and grates shall fit into their frames without rocking.

609.03.02 ADJUSTING CATCH BASIN, MANHOLE, AND INLET COVERS: Unless otherwise provided on the plans or by the contract, existing covers, including frames, grates, or lids shall be adjusted to the required elevation by removing such existing covers and adjusting the top of the existing structures by removing or adding concrete, brick masonry, concrete block masonry or high density polyethylene adaptor rings, or by using steel or cast iron adaptor rings, as the case may be, reinstalling the fixtures by supporting them on a satisfactory collar of concrete constructed as to hold them firmly in place.

609.03.03 CLEAN OUT: All catch basins, manholes, inlets, and similar structures shall be thoroughly cleaned of any accumulations of silt, debris, or foreign matter of any kind, and shall be clean of such accumulations at the time of final inspection.

609.03.04 EARTHWORK: Structure excavation and structure backfill shall conform to the requirements of Section 206, "Structure Excavation" and 207, "Backfill."

METHOD OF MEASUREMENT

609.04.01 MEASUREMENT: The quantities of castings and structural steel grates measured for payment will be the number of pounds (kilograms) complete and in place. The weight of castings shall be computed from the dimensions shown on the approved shop drawings assuming the cast iron to weigh four hundred fifty (450) pounds per cubic foot (7.2 grams per cubic centimeter), with an allowance of ten (10) percent for fillets and overrun. The weight of structural steel grates shall be computed from the dimensions shown on the approved shop drawings, in accordance with Section 506, "Steel Structures." Certified shop weights will be acceptable in lieu of computed weights.

Adjusting covers for catch basins, manholes, and inlets will be measured per each complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

Pipe crossbars and straps for drop inlets shall be included in the measurement for payment by the contract bid price per pound (kilogram) for Structural Steel Grates.

BASIS OF PAYMENT

609.05.01 PAYMENT: The accepted quantities of grates measured as provided in Subsection 609.04.01, "Measurement," will be paid for at the contract unit price bid per pound (kilogram) for types and sizes specified.

The work for adjusting covers measured as specified in Subsection 609.04.01, "Measurement," will be paid for at the contract unit price bid per each for adjusting covers for catch basins, manholes, and inlets, which price shall be full compensation for furnishing all materials, tools, incidentals, and labor required to adjust the covers.

Sacks for concrete riprap shall be made of at least 10 ounce (285 gram) burlap, and shall be approximately 19 1/2 x 36 inches (495 x 915 millimeters) measured inside the seams when the sack is laid flat. The capacity of each sack shall be approximately 1.25 cubic feet (35 liters). Sound reclaimed sacks may be used.

610.02.04 STONES FOR RIPRAP: Stones used for riprap shall be hard, durable, angular in shape, resistant to weathering and erosion, and free from spoils, cracks and organic matter. The stone should be crushed (rounded stone should be avoided) with neither width nor thickness of a single stone less than one-third its length. The specific gravity of the riprap shall not be less than 2.45. The nominal stone size shall be as follows:

Riprap
D_{15} shall be a minimum of 6 inches.
D_{50} shall be a minimum of 12 inches.
D_{85} shall be a minimum of 18 inches.

Heavy Riprap
D_{15} shall be a minimum of 9 inches.
D_{50} shall be a minimum of 18 inches.
D_{85} shall be a minimum of 24 inches.

This stone shall conform to the following requirements:

Source Requirements	Test Method	Requirements
Percent of Wear	ASTM C 535	45% Maximum
Bulk Specific Gravity	ASTM C 127	2.5 Minimum

Control of gradation will be by visual inspection. Upon request by the Engineer the Contractor shall provide a sample of stone of at least 5 tons (4.54 metric tons) meeting the gradation for each location riprap is indicated. Each sample shall be located at the construction site near the location where the riprap is to be placed. The sample shall be used as a frequent reference for judging the gradation of the riprap supplied. The sample riprap shall be in place and acceptable to the Engineer before riprap placing work begins. The Contractor shall maintain the placed riprap until the project is completed and any material displaced by any cause shall be repaired to the lines and grades indicated on the plans.

Caliche stone or cementitious materials meeting the requirements of this section may be used as riprap with prior approval of the Engineer. The riprap shall be fully cemented material. Only materials designated as hard (scratches leave only dust, requires many hammer blows to break) or very hard (difficult to scratch or break), shall be utilized. Moderately hard (crumbles with several hammer blows) or partially cemented materials are not acceptable.

The Contractor may be required to provide riprap test results from an approved testing laboratory and a Certificate of Compliance in accordance with Subsection 106.05, "Certificate of Compliance".

610.02.05 STONES FOR GABIONS: Stones for filling the gabions shall be well graded, hard stones, conforming to the requirements specified in Subsection 706.03.05, "Stone for Masonry and Riprap".

Size and gradation shall be such that the predominant size is between 4 to 8 inches (100 to 200 millimeters), eighty-five percent by weight. Minimum stone dimensions shall be 3 inches (75 millimeters) and maximum stone dimension shall be 8 inches (200 millimeters). For gabion baskets less than 1 foot (0.3 meters) in height, the maximum stone dimension shall be 6 inches (150 millimeters).

610.02.06 FILTER MATERIAL: When filter material is specified or shown on the plans, it shall consist of mineral aggregate that is clean, hard, durable, and free of any deleterious matter or harmful adherent coatings. Gradation of the filter material shall conform to the requirements specified by the Engineer, or as shown in the special provisions.

610.02.07 FILTER FABRIC: When filter fabric is specified or shown on the plans, it shall consist of a geotextile that is made from synthetic fibers. The filter fabric shall be in accordance with the requirements of AASHTO M288, Section A4 and shall conform to the requirements specified by the Engineer.

610.02.08 WIRE MESH GABIONS: Wire mesh gabions shall be fabricated from either twisted wire mesh or welded wire mesh. Only one type of wire mesh may be used in any one structure.

Gabion dimensions of width, height, and length shall be as shown on the plans. Each gabion unit shall not vary more than five percent from the dimensions shown on the plans.

Where the length of the gabion basket exceeds its width, the basket shall be equally divided into cells equal to or less than the basket width using diaphragms of the same type and size mesh as the basket panels. Each basket shall be prefabricated with the necessary panels and diaphragms secured to the base in such a manner that no additional tying at this juncture is required.

Fabrication of the wire mesh gabion baskets shall be as follows:

(a) **Twisted Wire Mesh Panels**

Gabion panels of the twisted mesh style shall be manufactured from galvanized steel wire, Class 3, soft temper, conforming to ASTM A641, or from aluminized steel wire, soft temper, conforming to ASTM A809. The wire shall have a minimum tensile strength of 60,000 psi (415 MPa) when tested in accordance with ASTM A370.

The mesh shall be formed with non-raveling double twists by twisting each pair of wires through two 360 degrees turns. The mesh openings shall be hexagonal in shape and uniform in size, with the maximum line dimension of any hexagonal opening not to exceed 5 inches (125 millimeters), and the maximum area of any mesh opening not to exceed 10 square inches (6450 square millimeters).

All perimeter edges of the mesh panels forming the gabion basket shall be securely tied to a selvedge wire so that the selvedge is at least the same strength as the body of the mesh. Selvedge wire shall be the same kind and type of material used for the mesh.

When specified by the Engineer, the galvanized or aluminized wire shall be coated with a polyvinyl chloride (PVC) material. The coating shall be accomplished by using either extruded or extruded and bonded PVC material, and shall be applied prior to twisting the wire into mesh panels.

SECTION 611

CONCRETE SLOPE PAVING

DESCRIPTION

611.01.01 GENERAL: This work shall consist of constructing concrete slope paving and concrete mortar slope paving including aprons and cutoff walls in connection therewith, to the lines and grades established by the Engineer in accordance with the design shown on the plans.

MATERIALS

611.02.01 GENERAL: Materials shall conform to the requirements specified in the following sections:

Portland Cement Concrete	Section 501
Reinforcing Steel	Section 505

Concrete mortar slope paving shall consist of a mixture of one (1) part Portland cement to four parts sand, thoroughly mixed in a dry state prior to mixing with water. Measurement may be either by volume or weight. Before placing all lumps three-eighths (3/8) inch (1 centimeter) or over shall be removed by screening. Sand shall conform to the requirements of Subsection 706.03.03, "Fine Aggregate." An Air-Entraining Admixture shall be added to the Concrete Mortar at a rate of four to seven (4-7) percent.

Mesh reinforcing for ditch lining and slope paving reinforcement shall be of the sizes shown on the plans, fabricated of cold drawn steel wire and need not be galvanized. Mesh reinforcing shall conform to the requirements of ASTM A 185.

Header boards consisting of 2" x 4" (5 x 10 centimeters) redwood lumber furnished and placed in the concrete or mortar slope paving shall be as shown on the plans. Lumber used in the construction of header boards shall be commercial grade heart redwood, S4S.

Nails used in construction of header boards shall be commercial quality galvanized nails.

CONSTRUCTION

611.03.01 EARTHWORK: The subgrade for paved ditches and slope paving shall be formed by excavating to the required depth below the prepared finish surface grade in accordance with dimensions and design indicated on the plans or as directed by the Engineer.

The subgrade shall be thoroughly compacted. Any soft, spongy or other unsuitable material shall be removed to such depth as directed by the Engineer and backfilled with suitable material and thoroughly compacted. Water shall be sprinkled on the subgrade during compaction and the subgrade shall be sufficiently moist prior to placing concrete or mortar to prevent absorption.

Excavations for trenches, footings, cutoff walls, etc., shall conform to the requirements of Section 206, "Structure Excavation." Gradation and compaction requirements on structure backfill will not apply.

611.03.02 GENERAL: Concrete, after placing, shall be tamped until it is thoroughly consolidated and mortar flushes to the surface. If the slope is too steep to permit the use of concrete sufficiently wet to flush with tamping, the concrete may be tamped until consolidated and a mortar surface one-fourth (1/4) inch (0.6 centimeters) thick troweled on immediately. The mortar shall consist of one part Portland cement and three parts of clean, sharp sand. The mortar surface shall be considered as a part of the concrete and no additional allowance will be made therefor.

After striking off to grade, the concrete shall be hand floated with wooden floats not less than four (4) inches (10 centimeters) in width and not less than thirty (30) inches (76 centimeters) in length. Care shall be taken to prevent rotary marks of the hand floats. The entire surface shall be broomed with a fine texture hair push broom to produce a uniform surface and eliminate float marks. Brooming shall be done when the surface is sufficiently set to prevent deep scarring and shall be accomplished by drawing the broom down the slope leaving the marks parallel to the edges of the panel. Joints shall be edged with a one-fourth (1/4) inch (0.6 centimeters) radius edger prior to the brooming.

Materials for mortar that have been mixed for more than 45 minutes and have not been incorporated in the work shall not be used unless otherwise permitted by the Engineer.

Concrete or mortar shall not be placed against frosted or frozen surface. If concrete or mortar is placed during cold weather it shall be heated and protected during placing and curing as set forth in Section 501, except concrete or mortar shall be maintained at a temperature of not less than 50 degrees F. (10 degrees C.) for 72 hours after placing and at not less than 40 degrees F. (4.4 degrees C.) for an additional four days.

The slope paving shall be constructed without expansion joints.

The mesh reinforcing shall be placed so as to be in the approximate center of the concrete mortar. All joints shall be lapped six (6) inches (15 centimeters) and run continuously throughout paving or between headers.

Concrete slope paving, aprons and cutoff walls shall be cured as specified in Section 502, "Concrete Structures."

METHOD OF MEASUREMENT

611.04.01 MEASUREMENT: The quantity of concrete slope paving or concrete mortar slope paving including concrete or concrete mortar aprons and cutoff walls, measured for payment will be the number of cubic yards (cubic meters) or square yards (square meters) complete and in place.

The quantity will be computed from measurements of the actual areas placed based on the theoretical thickness shown on the plans. No additional allowance will be made for additional concrete placed by reason of low subgrades.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

611.05.01 PAYMENT: The accepted quantities of concrete slope pavement and concrete mortar slope paving as well as aprons and cutoff walls in connection therewith, measured as provided in Subsection 611.04.01, "Measurement," will be paid for at the contract unit price bid per cubic yard (cubic meter) or square yards (square meters) for the material and class specified, which payment shall be full compensation for excavation,

SECTION 613

CONCRETE CURB, WALK, GUTTERS, DRIVEWAYS AND ALLEY INTERSECTIONS

DESCRIPTION

613.01.01 GENERAL: Concrete curb, walk, gutters, cross gutters, driveways, and alley intersections shall be constructed of Portland cement concrete prepared as prescribed in Section 501, "Portland Cement Concrete".

MATERIALS

613.02.01 GENERAL: Materials shall conform to the applicable requirements of Section 501, "Portland Cement Concrete," Section 502, "Concrete Structures" and Section 505, "Reinforcing Steel."

CONSTRUCTION

613.03.01 The thickness of Type I or II Base under Concrete Curbs, Gutters, Walks, Driveways and Alley Intersections shall be shown on the Plans or Standard Drawings or as specified in the Special Provisions.

The subgrade shall be constructed true to grade and cross sections as shown on the Plans or as established by the Engineer. It shall be watered and compacted until the subgrade reaches the compaction required for the adjacent roadway or base course.

613.03.02 The dimensions of the concrete curbs, gutters, walks, driveways and alley intersections shall be as shown on the Plans or Standards Drawings or as specified in the Special Provisions.

613.03.03 DRAINAGE OUTLETS THROUGH CURB: The Contractor will be required to provide suitable outlets through new curb for all existing building drains along the line of the work. He shall place outlets opposite any low area on adjacent property, the drainage of which will be effected by the new work.

Where sidewalk or curb will be higher than adjacent property, the Contractor shall provide at least one four (4) inch (10 centimeters) diameter opening through the curb for each parcel when directed by the Engineer.

613.03.04 DRIVEWAY ENTRANCES AND ALLEY INTERSECTIONS: Driveway entrances and alley intersections shall be provided in new curb at all existing driveways and alley intersections along the line of the work at locations shown on the Plans or Standard Drawings or as specified in the Special Provisions.

613.03.05 STANDARD FORMS: Form material shall be free from warp, with smooth and straight upper edges, and if used for the face of curb, shall be surfaced on the side against which the concrete is to be placed. Wooden forms for straight work shall have a net thickness of at least one and one-half (1-1/2) inches (3.8 centimeters); metal forms for such work shall be of a gage that will provide equivalent rigidity and strength. Curb face forms used

on monolithic curb and gutter construction shall be of a single plank width when the curb face is ten (10) inches (25 centimeters) or less, except for those used on curb returns. Wooden forms used on curb returns shall be not less than three-fourths (3/4) inch (1.9 centimeters) in thickness, cut in the length and radius as shown on the plans, and held rigidly in place by the use of metal stakes and clamps. The curb face shall be cut to conform exactly with the curb face batter as well as being cut in the required length and radius. Forms shall be of sufficient rigidity and strength, and shall be so supported, as to adequately resist springing or deflection from placing and tamping the concrete. Metal forms shall not be used for curb returns or on curves of less than 250 foot radius.

Form material shall be clean at the time it is used, and shall be given a coating of light oil, or other equally suitable material, immediately prior to the placing of the concrete.

All forms except back planks of curb shall be set with the upper edges flush with the specified grade of the finished surface of the improvement to be constructed, and all forms shall be not less than a depth equivalent to the full specified thickness of the concrete to be placed.

Back forms shall be held securely in place by means of stakes driven in pairs at an interval not to exceed four (4) feet (1.2 meters), one at the front form and one at the back. Clamps, spreaders, and braces shall be used to such extent as may be necessary to insure proper form rigidity. Forms for walk, gutter, and similar work shall be firmly secured by means of stakes driven flush with the upper edge of the form at intervals not to exceed five (5) feet (1.5 meters). Form stakes shall be of sufficient size and be driven so as to adequately resist lateral displacement.

Commercial form clamps for the curb and gutter may be used provided they fulfill the requirements specified herein.

613.03.06 SLIP FORMS: At the option of the Contractor and with the approval of the Engineer, slip form equipment may be used for the construction of concrete curb and gutter and concrete curb, gutter, and sidewalk except for commercial driveways and curb returns with valley gutters.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machines will be discontinued. All applicable requirements of construction by use of forms shall apply to the use of machines.

Slip form equipment shall be provided with traveling side and top forms of suitable dimensions, shapes, and strength to support the concrete for a sufficient length of time during placement to produce curb and gutter of the required cross section. The equipment shall spread, consolidate and screed the freshly placed concrete in such a manner as to provide a dense and homogeneous product.

Any curb, except on structures, may be placed by using an extrusion machine provided the finished curb is true to line and grade and the concrete is dense and of the required surface texture and strength. The combined aggregate for the concrete placed by the extrusion method shall be of such size that the percentage composition by weight will conform to the Grading Limits of Combined Aggregates as specified in Subsection 706.02.01 for the three-fourths (3/4) inch (1.9 centimeters) maximum grading.

The grading limits shall be further restricted, if necessary, to produce concrete that after extrusion has well defined web marks of water on the surface and is free from surface pits larger than three-sixteenths (3/16) inch (0.5 centimeters) in diameter.

The concrete shall be of such consistency that after extrusion, it will maintain the shape of the curb section without support. It shall contain the maximum amount of water that will permit this result.

In lieu of placing dowels and bar reinforcing steel and in advance of placing curbs on existing pavement or base, the surface shall be thoroughly cleaned and the adhesive specified below shall be applied. Cleaning of the

pavement or base shall be accomplished by wire brushing or by blast cleaning if the latter method is ordered by the Engineer. The cleaned surface shall be free from dust, loose material or oil.

The adhesive shall consist of two (2) components which shall be mixed together at the site of the work and shall conform to the requirements of California State Specification 741-80-43 for "Epoxy Resin Adhesive for Bonding New Concrete to Old Concrete."

The grade for the top of the curb shall be indicated by an offset guide line set by the Contractor from survey marks established by the Engineer. The forming tube portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to provide when necessary, a variable height of curb conforming to the predetermined curb grade. A grade line gage or pointer shall be attached to the machine in such manner that a continual comparison can be made between the curb being placed and established curb grade as indicated by the offset guide line.

In lieu of the above method for maintaining the curb grade, the extrusion machine may be operated on rails or forms set at uniform depth below the predetermined finished top of the grade.

The top and face of the finished curb shall be true and straight, and the top surface of curbs shall be of uniform width, free from humps, sags, or other irregularities. When a straightedge ten (10) feet (3 meters) long is laid on the top or face of the curb or on the surface of gutters, the surface shall not vary more than 0.01 foot (0.30 centimeters) from the edge of the straightedge, except at grade changes or curves.

Crawler track driven extrusion machines shall not be used on finished course plantmix surface. Concrete shall be fed to the machine at a uniform rate. The machine shall be operated under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete free from surface pits larger than three-sixteenths (3/16) inch (0.48 centimeters) in diameter and requiring no further finishing, other than light brushing with a brush filled with water only. Finishing with a brush application of grout will not be permitted.

Expansion joints shall be required at E.C. and B.C. of curb returns, and also along the line of work at regular intervals not to exceed three-hundred (300) feet (91 meters). Unless otherwise specified transverse weakened plane joints on curb and gutter produced by an extrusion machine shall be constructed at ten (10) feet (3 meters) intervals along the line of the work.

Weakened plane joints shall be constructed as specified in Subsection 613.03.10.

Expansion joints shall be constructed as specified in Subsection 613.03.09.

Curing of slip form curb, gutter, and sidewalk shall be done as specified in Subsection 613.03.15.

613.03.07 PLACING CONCRETE: Concrete shall be placed on a subgrade sufficiently dampened to insure that no moisture will be absorbed from the fresh concrete.

Concrete shall be placed in curb, gutter, and curb and gutter forms in horizontal layers not exceeding six (6) inches (15 centimeters) in thickness, each layer being spaded along the forms and thoroughly tamped. Concrete may be placed in layers of more than six (6) inches (15 centimeters) in thickness only when authorized by the Engineer and the spading and tamping is sufficient to consolidate the concrete for its entire length.

After the concrete for walk has been placed, a strike-off shall be used to bring the surface to the proper elevation when compacted. It shall be spaded along the form faces and tamped to assure a dense and compact mass, and to force the larger aggregate down while bringing to the surface not less than three-eighths (3/8) inch (1 centimeter) of free mortar for finishing purposes.

Concrete shall be placed in cross gutters in horizontal layers of not more than four (4) inches (10 centimeters) in thickness, each layer being spaded along the form faces and thoroughly tamped into a dense and compact mass. If internal vibrators are used, the full specified thickness may be placed in one operation.

After the concrete has been placed and tamped, the upper surface shall be struck off to the specified grade.

613.03.08 JOINTS: Joints in concrete curb, gutter, and walk shall be designated as expansion joints and weakened plane joints.

613.03.09 EXPANSION JOINTS: Expansion joints shall be constructed in curbs, walk and gutter as shown on the plans, Standard Drawings or as specified herein. Such joints shall be filled with pre-molded joint filler conforming with the requirements prescribed in Section 707. No such joints shall be constructed in cross gutters, alley intersections or driveways except as may be approved by the Engineer.

One-half inch (1.3 centimeters) joints shall be constructed in curb and gutter at the end of all returns except where cross gutter transitions extend beyond the curb return, in which case they shall be placed at the ends of the cross gutter transition. No joints shall be constructed in returns. Where monolithic curb and gutter is constructed adjacent to concrete pavement, no expansion joints will be required except at E.C. and B.C. of curb returns.

Expansion joint filler one-half (1/2) inch (1.3 centimeters) thick shall be placed in walk at the E.C. and B.C. of all walk returns, around all utility poles which may project into the concrete along the line of the work, and in walk returns between the walk and the back of curb returns when required by the Engineer. At the E.C. and B.C. and around utility poles, the joint filler-strips shall extend the full depth of the concrete placed. Joint filler strips between walk and curb shall be the depth of the walk plus one (1) inch (2.5 centimeters) with the top set flush with the specified grade at the top of curb.

All expansion joint filler strips shall be installed vertically, and shall extend to the full depth and width of the work in which they are installed, and be constructed perpendicular to straight curb or radially to the line of the curb constructed on a curve. Expansion joint filler materials shall completely fill these joints to within one-fourth (1/4) inch (0.6 centimeters) of any surface of the concrete. Excess filler material shall be trimmed off to the specified dimension in a neat and workmanship manner. During the placing and tamping of the concrete, the filler strip shall be held rigidly and securely in proper position.

613.03.10 WEAKENED PLANE JOINTS: Weakened plane joints shall be straight and constructed in accordance with paragraphs (a) or (b) below, unless otherwise shown on the plans.

In walk, joints shall be transverse to the line of work and at regular intervals not exceeding ten (10) feet (3 meters). At curves and walk returns, the joints shall be radial.

In gutter, including gutter integral with curb, joints shall be at regular intervals not exceeding ten (10) feet (3 meters). Where integral curb and gutter is adjacent to concrete pavement, the joints shall be aligned with the pavement joints where practical.

(a) **Control Joint.** After preliminary trowelling, the concrete shall be parted to a depth of two (2) inches (5 centimeters) with a straightedge to create a division in the coarse aggregate. The concrete shall be refloated to fill the parted joint with mortar. Headers shall be marked to locate the weakened plane for final joint finishing, which shall be accomplished with a jointer tool having a depth of one-half (1/2) inch (1.3 centimeters) and a radius of one-eighth (1/8) inch (0.3 centimeters). The finished joint opening shall not be wider than one-eighth (1/8) inch (0.3 centimeters).

(b) **Plastic Control Joint.** The joint material shall be a T-shaped plastic strip at least one (1) inch (2.5 centimeters) deep, having suitable anchorage to prevent vertical movement, and having a removable stiffener with a width of at least three-fourths (3/4) inch (1.9 centimeters). After preliminary trowelling, the concrete shall be parted to a depth of two (2) inches (5 centimeters) with a straightedge. The plastic strip shall be inserted in the impression so that the upper surface of the removable stiffener is flush with

the concrete. After floating the concrete to fill all adjacent voids, the removable stiffener shall be stripped. During final trowelling, the edges shall be finished to a radius of one-eighth (1/8) inch (0.3 centimeters) using a slit jointer tool.

613.03.11 FINISHING: Finishing shall be completed as specified herein for the type of work being performed.

613.03.12 CURB: The front forms may be stripped as soon as the concrete has set sufficiently.

The face and top of the curb shall be carefully trowelled to a smooth and even finish; the top being finished to a transverse slope of one-fourth (1/4) inch (0.6 centimeters) toward the gutter, with both edges rounded to a radius of three-fourths (3/4) inch (1.9 centimeters). The trowelled surface shall be finished with a fine hair broom applied parallel with the line of the work. The edge of the concrete at all expansion joints shall be rounded to a one-fourth (1/4) inch (0.6 centimeters) radius. The surface of the work shall be finished as prescribed; after which the name of the Contractor, together with the year in which the improvement is constructed, shall be stamped therein to a depth of one-fourth (1/4) inch (0.6 centimeters), in letters not less than three-fourths (3/4) inch (1.9 centimeters) high, at B.C. and E.C. curb returns.

613.03.13 WALK: The forms shall be set to place the finished surface in a plane sloping up from the top of curb at a rate of one-fourth (1/4) inch to one (1) foot (0.6 to 30 centimeters) when measured at right angles to the curb.

Following placing, the concrete shall be screeded to the required grade, tamped to consolidate the concrete and to bring a thin layer of mortar to the surface, and floated to a smooth, flat, uniform surface. The concrete shall then be edged at all headers, given a preliminary trowelling and provided with weakened plane joints.

Walk shall be steel trowelled to a smooth and even finish. All formed edges shall be rounded to a radius of one-half (1/2) inch (1.3 centimeters). Edges at expansion joints shall be rounded to a radius of one-eighth (1/8) inch (0.3 centimeters). Preliminary trowelling may be done with a long-handled trowel or "Fresno", but the finish trowelling shall be done with a hand trowel. After final trowelling, walk on grades of less than 6% shall be given a fine hair broom finish applied transverse to the centerline. On grades exceeding 6%, walk shall be finished by hand with a wood float. Walk shall be remarked as necessary after final finish, to assure neat uniform edges, joints, and weakened plane lines.

Weakened plane lines, where required, shall have a minimum depth of one and one-half (1-1/2) inch (3.8 centimeters) and a radius of one-eighth (1/8) inch (0.3 centimeters). When longitudinal weakened plane lines are required, they shall be parallel to, or concentric with, the lines of the work. Walks twenty (20) feet (6.1 meters) or more in width shall have a longitudinal center weakened plane line. In walk returns, one weakened plane line shall be made radially midway between the B.C.R. and E.C.R. When directed by the Engineer, longitudinal and transverse weakened plane lines shall match the adjacent walk. The Contractor shall have sufficient metal bars, straightedges, and joint tools on the project.

Headers shall remain in place for at least sixteen (16) hours after completion of the walk but must be removed before the work is accepted.

The name of the Contractor, together with the year in which the improvement is constructed, shall be stamped therein to a depth of 1/4 of an inch, in letters not less than 3/4 of an inch, at intervals of not less than 200 feet. A metal identification plate with the exposed face set flush with the finished surface of the concrete, anchored to a depth of not less than 1-1/2 inches, may be substituted for the stamping in the concrete. At least one such stamping or identification plate shall be made on each cement concrete job at the project.

613.03.14 GUTTER: After the concrete has been thoroughly tamped in such manner as to force the larger aggregate into the concrete and bring to the top sufficient free mortar for finishing, the surface shall be worked to a true and even grade by means of a float, trowelled with a long-handled trowel (or "Fresno") and wood float finished. The flow line of the gutter shall be trowelled smooth for a width of approximately four (4) inches (10 centimeters) for integral curb and gutter and four (4) inches (10 centimeters) on either side of the flow line on cross and longitudinal gutters. The outer edges of the gutter shall be rounded to a radius of one-half (1/2) inch (1.3 centimeters).

Side forms shall remain in place for at least twenty-four (24) hours after completion of the gutter, but must be removed before the work will be accepted.

Median island paving shall be as shown on the Standard Drawings.

613.03.15 CURING: Immediately after finishing operations are completed, the exposed surfaces shall be cured in accordance with Section 502, "Concrete Structures."

613.03.16 REPAIRS AND REPLACEMENTS: Any new work found to be defective or damaged prior to its acceptance shall be repaired or replaced by the Contractor at no expense to the Contracting Agency and in accordance with Subsection 105.12, "Removal of Unacceptable Work."

613.03.17 BACKFILLING AND CLEANUP: Backfilling to the finished surface of the newly constructed improvement must be complete before acceptance of the work.

Upon completion of the work the surface of the concrete shall be thoroughly cleaned and the site left in a neat and orderly condition.

MEASUREMENT

613.04.01 MEASUREMENT: The quantity of curb, gutter, and combination curb and gutter measured for payment will be the number of linear feet (meters) along the base of the curb face or along the flow line of the gutter.

The quantity of sidewalk, driveway, and alley intersections shall be measured for payment by area in square feet (square meters).

In the case of integral curb and walk, the width of the walk shall extend to the back face of the curb.

All quantities measured for payment herein will be complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

613.05.01 PAYMENT: The accepted quantities of concrete measured as provided in Subsection 613.04.01, "Measurement," will be paid for at the contract unit price bid per linear feet (meter) for curb, gutter, curb and gutter and per square foot (square meter) for sidewalks, driveway or alley intersection as the case may be.

All excavation and base course work required for and performed during construction of the items of this section will be paid for as provided in the respective sections of the specifications; however, when the contract does not provide bid items for excavation or base course, such work required and performed will be considered subsidiary to the pay item contained herein and no further payment will be made therefor.

Any excavation or backfill required other than roadway quantities will be considered subsidiary to the major items of work and no further payment will be made therefor.

Reinforcing steel placed in curbs and gutters as shown on the plans or ordered by the Engineer will not be paid for directly but the cost thereof shall be considered as included in the contract bid prices for other items of work.

All payments shall be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Type A Curb	Linear Foot (Meter)
Type L Island Curb and Gutter	Linear Foot (Meter)
Type L Curb and Gutter	Linear Foot (Meter)
Concrete Sidewalk	Square Foot (Square Meter)
Concrete Driveway	Square Foot (Square Meter)
Concrete Sidewalk and Driveway	Square Foot (Square Meter)
Concrete Alley Intersection	Square Foot (Square Meter)
Concrete Valley Gutter	Square Foot (Square Meter)
Concrete Commercial Driveway	Square Foot (Square Meter)

SECTION 614

PAINTING

DESCRIPTION

614.01.01 GENERAL: This work shall consist of the preparation of surfaces to be painted and the application, protection, and drying of the required number of coats of paint of the kinds and at the points specified or ordered by the Engineer.

MATERIALS

614.02.01 GENERAL: Materials shall meet or exceed the minimum standards hereinafter set forth:

(a) **Materials.** The raw materials for use in the various paint formulas shall conform to the specifications designated by Federal or Military serial number or paint material code number under the various paint classifications hereinafter specified. Subsequent amendments to the specifications quoted shall apply to all raw materials and finished products. No "or equal" substitutions for any specified material shall be made without written consent of the Engineer.

(b) **Manufacturing and Packaging.** All manufactured paint shall be prepared at the factory ready for application. The addition of thinner or other material to the paint after the paint has been shipped will not be permitted, unless so specified.

The finished paint shall be furnished in new, round steel containers of not more than 6 gallon capacity and of metal not thinner than 0.024 inch nominal thickness. The containers shall have lug type crimp lids with ring seals and be equipped with ears and bails. The containers shall meet U.S. Department of Transportation Hazardous Material Shipping Regulations. The container shall be lined if necessary to prevent attack by the paint. The lining shall not come off the can as skins.

No finished paint shall be used until at least 7 days have elapsed from the date of its manufacture.

All containers of paint shall be labeled showing the exact title of the paint specification, California State specifications number, manufacturer's name, date of manufacture, and manufacturer's batch number.

Precautions concerning the handling and the application of paint shall be shown on the label of paint and solvent containers.

614.02.02 NUMBER OF COATS: Unless otherwise required in the contract documents, the number and kinds of coats of paint shall be as set forth in Section 714, "Paint."

The timber or lumber shall be submerged in the cold solution as previously described. The temperature shall be slowly increased for a period of not less than five (5) hours to a minimum temperature of one hundred eighty (180) degrees Fahrenheit (82 degrees Celsius) and not exceeding two hundred ten (210) degrees Fahrenheit (99 degrees Celsius). After five (5) hours and attaining the minimum specified temperature, the timber or lumber shall be permitted to cool in the solution until such time as the minimum specified quantity of preservative is absorbed by the wood.

Timber for minor irrigation structures, unless otherwise shown on the plans, shall be the No. 1 Common Grade of the species permitted, and shall be treated in accordance with the Hot-Cold Soak Process. The species permitted and the minimum retention in pounds per cubic foot (kilograms per cubic meter) required are as follows:

Species	Minimum Retention Per Cubic Foot (Pounds)	Minimum Retention Per Cubic Meter (Kilograms)
Douglas Fir (Rocky Mt., Inland, Coast)	2.0	32
Pine, Yellow (Pinus Ponderosa)	4.0	64.1
Pine, Lodge Pole (Pinus Contorta)	4.0	64.1
Cottonwood, Northern Black (Populus Trichocarpa Hastata)	4.0	64.1

615.03.04 INSPECTION: All timber and piling, untreated or to be treated, shall be inspected before treatment by an inspector designated by the Engineer. The inspector shall stamp each piece of timber accepted with a stamp making a legible mark designating the inspector.

All timber and piling shall be inspected after treatment by an inspector designated by the Engineer. The inspector shall stamp each piece accepted with a stamp making a legible mark designating the inspector.

All materials and processes used in the manufacture of material shall be subject to inspection, acceptance, or rejection at the manufacturer's plant, which shall be equipped with all the necessary gages, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications have been fulfilled.

The treated timber and piling shall be free from heat checks, water bursts, excessive checking, results of chafing or from other damage of defects which would impair its usefulness or durability.

BASIS OF PAYMENT

615.05.01 PAYMENT: Full compensation for treatment of lumber, timber, and piles as herein specified shall be considered as included in the price paid for particular item of work in which the treated lumber, timber, or piling is used and no additional allowance will be made therefor.

SECTION 616

FENCING

DESCRIPTION

616.01.01 GENERAL: This work shall consist of furnishing and erecting new standard fence, chain-link fence, gates, or reconstructing fences previously removed, in conformity with these specifications and the plans.

New standard fence shall consist of galvanized barbed wire, galvanized farm fence or both, fastened to wood posts or metal posts or to a combination of the two-kinds of posts as shown on the standard plans.

Chain-link fence shall consist of galvanized or aluminum-coated chain-link fabric attached to metal posts and fastened to a top tensioning cable and a bottom tensioning wire. The height of chain-link fences shall be as designated in the contract documents.

MATERIALS

616.02.01 GENERAL: Materials shall conform to the requirements specified in Section 724, "Fence Materials" and 501, "Portland Cement Concrete."

CONSTRUCTION

616.03.01 GENERAL: All trees, brush, and other obstructions which interfere with proper construction of fences shall be removed and disposed of in accordance with the requirements of Section 201, "Clearing and Grubbing," of these specifications except that no payment will be made for such work. When constructing chain-link fence, rocks and other surfaces irregularities that require moving in order to maintain a nearly smooth surface, shall be removed and no direct payment will be made therefore.

Fence construction operations shall be so conducted as to prevent the escape of livestock. Existing cross fences shall be connected to the new fence. Corner posts, with braces for each direction of strain, shall be placed at the junction with existing fences and the wire in both fences properly fastened to the posts. At bridges and cattle passes, and at culverts if shown on the plans or ordered by the Engineer the new fence shall be connected to the structure in such a manner as to permit the free passage of livestock through or under the structure.

Barbed wire, farm fence, and chain-link fence fabric shall be fastened on the side of the posts opposite the highway centerline unless otherwise directed by the Engineer.

Post holes for metal posts that are drilled or dug shall be backfilled with concrete.

Galvanized pipe brace rail shall not be spliced.

The first line of barbed wire above wire mesh shall be tied to the top wire of the wire mesh, midway between posts, with 12-gage galvanized steel wire or 9-gage aluminum hog rings.

Intermediate Braced Post Assemblies - Timber: The horizontal brace shall be placed six (6) inches (15 centimeters) below the tops of the brace posts and properly fitted and connected to them by two 3/8" by 4" (0.95 x 10 centimeters) steel dowels. The dowel pins shall extend two (2) inches (5 centimeters) into each brace and brace post. Two strands of 8-gage galvanized wire shall be run as a brace diagonally from four (4) inches (10 centimeters) above ground line on each brace post to four (4) inches (10 centimeters) below the top of the other

brace post. An extra loop shall be made around each post at the point of attachment and the wire firmly stapled to the post. These brace wires shall then be twisted until the assembly is rigid.

Corner post assemblies shall be constructed as indicated on the standard fence details and the end post assemblies shall be composed of end posts and brace posts installed and braced as indicated for timber corner braces.

At the option of the Contractor, timber line posts may be installed by tamping firmly in place in drilled or dug holes or by driving, provided the method of driving does not damage the posts or cause the posts to be deflected from line and plumb. All other timber posts shall be installed in drilled or dug holes and tamped firmly in place. Round timber posts installed in drilled or dug holes shall have the butt end placed downward. Timber line posts which are to be driven, shall be machine pointed at the plant before being treated. The small end of driven round timber posts shall be pointed.

Each strand of barbed wire shall be securely fastened to a corner post, end post, or intermediate braced post assembly by wrapping twice around the post and securing to that part of the same wire stretched between the posts. The remaining wire shall be cut off and the tie shall present a neat and workmanlike appearance.

Staples shall be set so as to hold the wire securely, but should not be buried in the post in such a manner as to severely nick or bend the wire.

616.03.02 STANDARD FENCE: Standard fencing shall be designated by types as follows: Metal posts - Type A; Wood posts - Type B; Combination metal and wood posts - Type C. The type of fence construction shall be as shown on the plans and indicated in the proposal. Posts shall be firmly set or driven into the ground and spaced as indicated on the plans. Each end, corner, and gate post shall be firmly braced and shall be set in concrete when required. Posts shall be braced as indicated in the plans.

Standard fencing will be designated not only by type, but also by a symbol indicating the fencing required. Thus (Type A-832-3B) will be used to designate a fence composed of metal posts, thirty-two (32) inch (81 centimeters) woven wire (farm fencing) and three barbed wires; (Type C-726-4B) to designate a fence composed of a combination of metal and wood posts twenty-six (26) inch (66 centimeters) woven wire and four barbed wires, etc. The figures 832, etc., when they appear in the symbol, correspond to design numbers set forth in the standard plan.

In general, in determining the post spacing, measurements will be made parallel to the slope of the natural ground, and all posts shall be placed in vertical position except in usual locations where in the opinion of the Engineer it would be more satisfactory to place the posts perpendicular to the slope of the ground. All intervals shall be measured center to center of adjacent posts.

Changes in line where the angle of deflection is thirty (30) degrees or more shall be considered as corners and corner posts shall be installed. Changes in line where the angle deflection is more than fifteen (15) degrees and less than thirty (30) degrees shall be considered as alignment angles and adjacent posts shall be made fast to the angle posts by means of wire, or if such method is impracticable in the opinion of the Engineer, such posts shall be braced as above specified for bracing gate, end and corner posts.

At all grade deflections and alignment angles where stresses tend to pull the posts from the ground, the fencing shall be snubbed or guyed at the critical point by means of a double strand of nine (9) gage galvanized wire connected to each horizontal line of barbed wire or to the top and bottom of wire mesh fabric, and to a deadman weighing approximately one hundred (100) pounds, buried in the ground not less than (2) feet (0.6 meters). The fencing shall be pulled snug close to the ground before being snubbed or guyed.

Barbed wire and farm fence fabric (woven wire) shall be stretched taut and securely fastened to each post by means of suitable devices approved by the Engineer.

616.03.03 CHAIN-LINK FENCE: All posts shall be of a total length of not less than the depth of the concrete footing as shown on the plans, plus the length required above ground.

Changes in line where the angle of deflection is thirty (30) degrees or more shall be considered as corners and corner posts shall be installed.

Between posts, chain-link fences shall be fastened to a bottom tension wire and a top tension cable. The bottom tension wire shall be at least seven (7) gage galvanized coil spring wire of good commercial wire. The top tension cable shall be at least three-eighths (3/8) inch (0.95 centimeters) diameter galvanized seven strand cable conforming to the requirements of the current ASTM Designation A 475 common grade.

Line posts shall be spaced at not more than ten (10) foot (3 meters) intervals, measured from center to center of posts. In general, in determining the post spacing, measurements will be made parallel to the slope of the natural ground and all posts shall be placed in a vertical position except in unusual locations where in the opinion of the Engineer it would be more satisfactory to place the posts perpendicular to the slope of the ground.

All metal posts shall be set in a Portland cement concrete footing crowned at the top to shed water. Depths of footings shall be as shown on the plans.

End, corner, and gate posts shall be braced with galvanized braces used as compression members and galvanized steel truss rods with truss tighteners used as tension members. Line posts, at intervals of five hundred (500) feet (152 meters), shall be braced and trussed in both directions as shown on the plans.

The fabric shall be stretched taut and securely fastened to the posts, and between posts the top edge of the fabric shall be fastened to the top tension cable and the lower edge fastened to the bottom tension wire. Tension cable and wire shall be stretched tight with truss tightener as shown on the plans. The bottom tension wire shall be installed on a straight grade between posts by excavating the high points of the ground and in no case will filling of depressions be permitted.

The fabric shall be fastened to the end, corner, and gate posts with one-fourth by three-fourths inch (1/4" x 3/4" (0.64 x 1.91 centimeters) steel stretcher bars and not less than one-eighth by three-fourths inch (1/8" x 3/4") (0.32 x 1.91 centimeters) steel stretcher bar bands placed at one (1) foot (30 centimeters) intervals, and to line posts tension cable and tension wires with tie wires or metal bands. Tie wires or metal bands shall be spaced on line posts at intervals of approximately fourteen (14) inches (36 centimeters) and on tension cable and tension wires approximately eighteen (18) inches (46 centimeters).

All posts shall be fitted with tops designed to fit securely over the posts, and carry the top tension cable, except that the top of the C-Section posts may be open-slotted to securely hold the top tension cable in position without vertical movement. Such slotting shall allow removal and replacement of a post without disturbing the top tension cable. Tubular posts shall be fitted with watertight tops.

616.03.04 RECONSTRUCT FENCE: Reconstructed fences shall be carefully erected, using salvaged materials and shall be similar in type to the original construction. Any new materials necessary to rebuild the fence shall be furnished by the Contractor, shall be of the same kind as those in the original fence, and the cost thereof shall be included in the contract price for the work. The resulting reconstructed fence shall be equal to or better than before removed. In reconstructed fences, the Contracting Agency reserves the right to furnish the Contractor with such new materials as it deems advisable, and these materials shall be used in the reconstruction of the fence in lieu of salvaged materials which they replaced.

616.03.05 GATES: The width of drive gates shall be as shown on the plans and as indicated in the proposal and the height shall be suited to the fencing but shall not be more than seventy-two (72) inches (1.83 meters) nor

less than forty-eight (48) inches (1.22 meters). The wire mesh filler shall be rectangular or two (2) inch (5 centimeters) diamond mesh for standard fencing and chain-link fence fabric for chain-link fencing.

Walk gates shall be of the width shown on the plans or in the special provisions and of a height corresponding to the adjacent fence height.

The gates shall be hung by steel or malleable iron hinges so designed as to securely fasten to the gate posts and permit the gate to swing back against the fence.

Gates shall be provided with a combination steel or malleable iron catch and locking-in attachment of approved design. A center rest with catch shall be provided where required.

Missouri gates shall be constructed as shown on the standard plans.

METHOD OF MEASUREMENT

616.04.01 MEASUREMENT: The quantity of new fence measured for payment will be the number of linear feet (meter), exclusive of gates and cattle guards, complete and in place.

The quantity of reconstructed fence measured for payment will be the number of linear feet (meter), including used gates complete and in place.

The quantity of new gates measured for payment will be the number of gates complete and in place. If more than one size or type of gate is involved, separate measurement will be made for each size and type given.

Missouri gates, regardless of width, shall be measured for payment as units.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

616.05.01 PAYMENT: The accepted quantity of new and reconstructed fence measured as provided in Subsection 616.04.01, "Measurement," will be paid for at the contract unit price bid per linear foot (meter) for the types and sizes specified.

The accepted quantity of new gates measured as provided in Subsection 616.04.01, "Measurement," will be paid for at the contract unit price bid per each for types and sizes specified.

The above prices shall be full compensation for furnishing hardware, cement concrete, framing, erecting, connecting fence, and all incidentals necessary to complete the work.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Type ( ) Fence	Linear Foot (Meter)
(Size) Chain-Link Fence	Linear Foot (Meter)
(Size) Metal Drive Gate	Each
(Size) Timber Drive Gate	Each
(Size) Metal Walk Gate	Each
(Size) Timber Walk Gate	Each
Reconstruct Fence	Linear Foot (Meter)
Missouri Gate	Each

SECTION 617

CATTLE GUARDS

DESCRIPTION

617.01.01 GENERAL: This work shall consist of furnishing and constructing standard steel cattle guards and cattle guard wings of the design and at points shown on the plans ordered by the Engineer.

MATERIALS

617.02.01 GENERAL: All materials shall conform to the requirements specified in the following sections:

Portland Cement Concrete	Section 501
Reinforcing Steel	Section 505
Steel Structures	Section 506
Hardware	Section 723
Painting	Section 614
Paint	Section 714
Timber	Section 718

All hardware shall be galvanized steel.

All lumber and timber shall be Douglas Fir, No. 2 joist and plank or No. 1 structural posts and timber. Any commercial grading rules that will provide material of an equal or greater stress value may be used.

CONSTRUCTION

617.03.01 EARTHWORK: Structure excavation and backfill shall conform to the applicable requirements of Section 206, "Structure Excavation" and 207, "Backfill."

617.03.02 GENERAL: Cattle guards shall be constructed in accordance with the details and dimensions shown on the plans.

Concrete and metal reinforcement construction shall conform to the applicable requirements of Sections 502, "Concrete Structures" and 505, "Reinforcing Steel," respectively.

Steel members connections shall be welded and the construction thereof shall conform to Section 506, "Steel Structures."

The wing posts and wheel guards shall be given a preservative treatment conforming to the requirements of Section 719, "Timber Preservatives." Treated timber and lumber is not to be painted.

Timber and lumber shall be assembled and placed in conformance to the applicable requirements of Section 507, "Timber Structures."

Painting shall be in accordance with recognized high standards of workmanship and in conformance with the applicable requirements of Section 614, "Painting."

METHOD OF MEASUREMENT

617.04.01 MEASUREMENT: The quantity to be measured for payment will be the number of cattle wings and steel cattle guards complete and in place. If more than one size of cattle guard is involved, separate measurement will be made of each size given.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

617.05.01 PAYMENT: The accepted quantity of cattle guards measured as provided in Subsection 617.04.01, "Measurement," will be paid for at the contract unit price bid per each for the sizes specified. The cost of cattle guard wings shall be included in the contract unit price for cattle guards, however, where wings alone are required, they will be paid for at the contract unit price each for cattle guard wings. The above prices shall be full compensation for furnishing hardware, cement concrete, steel, timber and lumber, structure excavation and backfill, furnishing and applying paint, framing, erecting, adjusting fence, and all incidentals necessary to complete the work.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
(Size) Steel Cattle Guard	Each
Cattle Guard Wings	Each

SECTION 618

GUARDRAIL

DESCRIPTION

618.01.01 GENERAL: This work shall consist of furnishing and erecting new guardrail, end anchor assemblies, guardrail expansion joints, breakaway cable terminals and additional guardrail beam elements required for constructing double beam rail, or reconstructing guardrail previously removed, in conformity with these specifications and of the types and at the points shown on the plans or ordered by the Engineer. This item shall also consist of furnishing and installing reflector plates as shown on the plans.

MATERIALS

618.02.01 GENERAL: All material shall conform to the requirements specified in the following sections:

Timber	Section 718
Timber Preservatives	Section 719
Guardrail Materials	Section 720
Galvanizing	Section 715

Guardrail posts and blocks shall be rough construction grade and shall comply with the grading requirements of Subsection 718.03.02.

Cable end anchor assemblies for metal beam guard railing shall be constructed as shown on the plans and shall conform to the requirements set forth in Subsection 720.03.04.

Each post shall be given a preservative treatment by pressure processes with one of the following in accordance with the provisions of Section 615, "Preservative Treatment for Timber."

The minimum retention of preservative in pounds per cubic foot (grams per cubic centimeter) of wood shall be as follows:

(a) Creosote - 8 pounds (0.128 grams per cubic centimeter).
(b) Creosote-Petroleum - 8 pounds (0.128 grams per cubic centimeter).
(c) Pentachlorophenol - 8 pounds (0.128 grams per cubic centimeter).

Guardrail quantities shown on the plans are approximate. As construction progresses the Engineer will review the need for guardrail and will, at the completion of this review, provide the Contractor with the revised amount of guardrail required. Should the Contractor elect to order guardrail materials prior to receiving this revised list from the Engineer he shall be completely responsible for furnishing the amount of guardrail and appurtenances required by said list. Should additional quantities be required to meet the requirements of the list there shall be no additional compensation allowed above the unit price and no compensation shall be allowed for surplus materials in excess of the requirements of the list.

618.02.02 REFLECTORS: Reflector plates for guardrail shall be fabricated from eleven (11) gage (0.30 centimeters) steel sheet. Nails for fastening reflector plates to the guardrail post shall be either galvanized metal

or aluminum. Steel reflector plates shall be galvanized. Reflectorized material for reflector plates shall conform to the requirements of Subsection 721.03.03, "Reflectors."

Reflector plates shall be constructed and erected on guardrail in accordance with the details shown on the plans and in the Standard Specifications and shall be spaced as follows:

(a) 50 feet (15 meters) on tangents and curves of 700 feet (213 meters) radius or greater.
(b) On curves with less than 700 feet (213 meters) radius, markers shall be placed on the post nearest the spacing shown for guide posts in Table 1, as shown in the plans.
(c) At interchanges, guardrail markers with amber reflectors shall be installed at a maximum spacing of 50 feet (15 meters) along acceleration and deceleration lanes, and in accordance with paragraph (b) on turning ramps and roadways.

Reflectors shall be white except as noted in (c) above.

CONSTRUCTION

618.03.01 GENERAL: Unless otherwise specified, guardrail shall be constructed with either treated Douglas Fir, West Coast Hemlock, or Western Larch posts, beam-type plates and fittings, as shown on the plans. Post spacing shall be as shown and guardrails shall be constructed in accordance with the design shown on the plans. The use of more than one type of guardrail on a single project will not be approved unless so provided in the special provisions or appearing as a contract item in the proposal.

Posts shall be set plumb, except on superelevated curves where they shall be set perpendicular to the roadbed. Front faces of posts shall form a straight line, except on curves where they shall be a uniform distance from the centerline of the roadway. Post holes shall be backfilled in layers with approved material thoroughly rammed with an iron tamping tool in such manner as not to displace the bottom of posts from correct alignment.

Guardrail beam elements may be furnished in 12 foot, 6 inch (3.8 meters) or 25 foot (7.6 meters) lengths at the option of the Contractor, and shall conform to the AASHTO requirements for "Corrugated Steel Beams for Highway Guardrail" designation M 180-74, for Class A, Type 2 guardrail.

Cable end anchor assemblies for metal beam guard railing shall be constructed as shown on the plans and as specified herein.

Cable clips and a cable thimble shall be used to attach cable to the anchor rod.

After installation and before backfilling, the portion of the anchor rod to be buried in earth shall be coated with a minimum 20-mil (0.05 centimeters) thickness of coal tar enamel conforming to AWWA Standard C 203.

Metal components of the anchor assembly shall be fabricated in conformance with good shop practice and shall be hot-dip galvanized in accordance with the provisions in Section 715.

Anchor blocks shall be constructed of concrete conforming to the provisions in Sections 501 and 502.

Concrete shall be placed against undisturbed material of the excavated holes for anchor blocks. The top 12 inches (30 centimeters) of holes shall be formed, if required by the Engineer.

Surplus excavated material remaining after the guard railing has been constructed shall be disposed of in a manner satisfactory to the Engineer.

The overall length of each anchor cable assembly shall be a minimum of 10 feet (3 meters).

Framing shall be done and fittings attached in such manner that the rail, after erection, shall be true to line and grade and shall have the proper tension in the rail plates. Care shall be taken to prevent the disturbance of

posts during the erection of the rail, and, when necessary, temporary braces shall be installed to insure against post displacement.

618.03.02 PAINTED GUARDRAIL:

(A) **Field Painted:** After the posts are set, the exposed portions shall be wrapped or otherwise protected to the satisfaction of the Engineer so that they shall remain free from paint, road oil, and other objectionable material. After all other work is completed and prior to the semi-final inspection, the wrapping or protection shall be removed. All posts that have paint, road oil, or other objectionable materials on the exposed surface or that do not otherwise meet the required specifications shall be cleaned or removed as the case may require, at the Contractor's expense.

All exposed surface of the metal guardrail that has become soiled or marred shall be cleaned or repainted at the expense of the Contractor as required by the Engineer.

After the rail has been painted as specified, nuts fastening rail plate to springs shall be backed off slightly so that the connection is firm but not tight and will permit the slight movement necessary to absorb expansion and contraction of the rail.

New guardrail beam elements shall be galvanized both sides, cleaned primed and painted on the side facing traffic.

After erection, all metals parts and fittings, free from coatings of any kind, including dirt, rust, and oil and grease, shall be given three coats of paint as specified in Section 714, "Paint." Parts shop prime coated by the manufacturer shall conform to Subsection 614.03.04, "Painting Structural Steel," and Section 714, "Paint."

Posts shall not be painted.

All beams shall be cleaned prior to priming by wiping down the surface with solvents such as naphtha, white (lead-free) gasoline, or detergent. Detergents may be of the type commonly used in washing machines; however, if detergent is used, it shall be thoroughly rinsed from the rail with clear water.

All loose white deposit shall be removed with a stiff brush (not steel), steel wool, or sandpaper. Care shall be exercised so as not to remove zinc coating.

Prime coat may be applied in the field and shall conform to California State Specification 701.80.52, "Pre-Treatment Vinyl Wash Primer."

Intermediate and finish coats shall conform to California State Specification 741.80.10, "Exterior White Metal Enamel." Surfaces to be painted shall be dry and the temperature during priming, painting, and for six (6) hours hereafter shall not be below fifty (50) degrees Fahrenheit (10 degrees Celsius).

SECTION 620

RIGHT-OF-WAY MARKERS

DESCRIPTION

620.01.01 GENERAL: This work shall consist of furnishing and erecting metal posts and plates for right-of-way markers conforming to these specifications and of the design shown on the plans or ordered by the Engineer.

MATERIALS

620.02.01 GENERAL: All materials shall conform to the requirements specified in the following sections:

Object Markers and Guide Posts . . . . . Section 721

CONSTRUCTION

620.03.01 GENERAL: Right-of-way markers shall be constructed in accordance with the details and dimensions shown on the plans. The markers shall be set plumb.

The exact location of posts will be staked by the Engineer.

METHOD OF MEASUREMENT

620.04.01 MEASUREMENT: The quantity of right-of-way markers measured for payment will be the number of markers complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

620.05.01 PAYMENT: The accepted quantity of right-of-way markers measured as provided in Subsection 620.04.01, "Measurement," will be paid for at the contract unit price bid per each.

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Right-of-way Markers	Each

SECTION 621

MONUMENTS

DESCRIPTION

621.01.01 GENERAL: This work shall consist of furnishing and installing permanent survey monuments, constructed in accordance with the design and drawings shown on the plans or ordered by the Engineer.

Bronze discs as specified by the Contracting Agency shall be installed and inscribed in the monuments under the direct supervision of a Registered Land Surveyor. The Contractor shall coordinate his work with the Registered Land Surveyor.

MATERIALS

621.02.01 GENERAL: Monuments shall be constructed of Portland cement concrete, and shall be of Type I, Type II, Type III, or Type IV as shown in the Standard Drawings.

CONSTRUCTION

621.02.02 INSTALLATION: These monuments shall be set to assist in reestablishment of the center line for future use and shall be set at the beginning and end of each project, at the beginning and end of each curve, at any angle point, at street intersections and to replace or reference Section Corners or other Government Land Corners. These monuments may perpetuate a point or reference a point.

An as built set of plans for the project, showing the exact location of all monuments set shall be prepared by a Registered Land Surveyor and filed with the County Surveyor prior to acceptance of the project.

METHOD OF MEASUREMENT

621.04.01 MEASUREMENT: The quantity of monuments measured for payment will be the number of units complete and in place.

BASIS OF PAYMENT

621.05.01 PAYMENT: The accepted quantity of monuments measured as provided in Subsection 621.04.01 will be paid for at the contract price bid per each.

Payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Monuments	Each

623 G.03.03 SAFETY PRECAUTIONS: Before starting work on existing series street lighting circuits, the Contractor shall obtain daily a safety circuit clearance from the responsible local agency. By-pass shall be switched to the "off" position, fuses shall be removed, and signs posted at the switch box before any work is done.

623 G.03.04 EXCAVATING AND BACKFILLING: Excavations required for the installation of conduit, foundations and other facilities, shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements. Excavations shall not be larger than necessary for the proper installation of conduit, electrical facilities and foundations. Excavating shall not be performed until immediately before installation of conduit, facilities, and foundations.

The material from the excavation shall be placed in a position where the least disruption and obstruction to vehicular and pedestrian traffic will be realized and the least interference with surface drainage will occur.

Surplus excavated material shall be removed and disposed of by the Contractor outside of the right-of-way.

At the end of each day's work, and at other times when construction operations are suspended, equipment and other obstructions shall be removed from the right-of-way.

Structural excavation and backfill shall conform to the requirements of Section 206, "Structure Excavation" and 207, "Structure Backfill."

Trench excavations shall be backfilled in conformance with the requirements of Section 208, "Trench Excavation and Backfill."

Backfilled excavations shall be kept well filled and maintained in a smooth and well-drained condition, until permanent resurfacing is completed as specified in Subsection 208.03.05, "Cutting and Restoring Street Surfacing."

Unless otherwise specified in the Special Provisions, excavation in the street and highway shall be performed in such a manner that not more than one lane of traffic is restricted in either direction at any time, unless otherwise approved by the Engineer.

All streets upon or within which any work is being done shall be kept open to all traffic by the Contractor, as specified in Subsection 104.04, "Maintenance of Traffic," unless otherwise provided in the Special Provisions, or as approved by the Engineer.

Barricading shall conform to the latest editions of the Traffic Control Plans for Highway Work Zones for the Clark County Area and the Manual On Uniform Traffic Control Devices.

623 G.03.05 REMOVING AND REPLACING IMPROVEMENTS: Improvements, such as sidewalks, curbs, gutters, Portland cement concrete and asphalt concrete pavement, bituminous surfacing, base material and other improvements removed, broken or damaged by the Contractor, shall be replaced or reconstructed in compliance with the applicable sections of these specifications.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, it shall be repaired in accordance with Subsection 202.03.02, "Removal of Structures and Obstructions."

The outline of all areas to be removed in Portland cement concrete sidewalks and in pavements shall be cut to a minimum depth of 1-1/2 inches (38 millimeters) with an abrasive type saw prior to removing the sidewalk and pavement material. Cut for the remainder of the required depth may be made by any method satisfactory to the Engineer. Cuts shall be neat and true with no shatter outside the removal area.

623 G.03.06 FOUNDATIONS: Foundations for posts, standards, and pedestals shall be concrete conforming to the applicable requirements of Section 501, "Portland Cement Concrete."

For posts, standards, and pedestals, a topping of four (4) inches (100 millimeters) minimum shall be poured after the post, standard, or pedestal is in proper position. Arms shall be considered live load and may be mounted only

after complying with Subsection 502.03.19. The exposed portions shall be formed to present a neat appearance. The bottom of concrete foundations shall rest on firm undisturbed ground. In addition, for traffic signal installations, the bottom two-thirds (2/3) minimum of the concrete foundation shall be poured against undisturbed soil. If signal foundation is to be placed in area which has been filled, fill shall meet compaction requirements as specified in the Standard Specifications or special provisions and bottom two thirds (2/3) minimum of the foundation shall be poured in drilled compacted fill and/or undisturbed soil.

Forms shall be true to line and grade. Tops of footings for posts and standards, except special foundations, shall be finished one (1) inch (25 millimeters) above grade of curb or sidewalk or as ordered by the Engineer.

Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be held in place by means of a template until the concrete sets. Both forms and ground which will be in contact with the concrete shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.

Ordinary surface finish shall be applied to exposed surfaces of concrete. Where the edge of a concrete foundation extends within eighteen (18) inches (450 millimeters) of any existing concrete improvement, a slab with a minimum thickness of four (4) inches (100 millimeters) shall be extended to meet said existing improvement.

Concrete for Type XX poles and/or XX-A poles shall set for a minimum of ten (10) days unless otherwise approved by the Engineer. Concrete for smaller bases shall set for a minimum time of seventy-two (72) hours.

623 G.03.07 WIRING: Wiring shall conform to appropriate articles of the National Electrical Code. Wiring within cabinets, junction boxes, etc., shall be neatly arranged and laced. Powdered soapstone, talc, or other approved lubricant shall be used when installing conductors in conduit.

Each conductor shall have eighteen (18) inches (450 millimeters) of slack coiled within each standard and at least two feet (600 millimeters) of slack coiled in each pull box.

Series lighting cable shall be installed without splices from luminaire to luminaire and from service to luminaire unless otherwise specified. Multiple lighting conductors may be spliced in the base of standards or in pull boxes adjacent thereto. Signal cable shall run from terminal to terminal without splices unless otherwise indicated on the plans.

Conductors shall be joined by the use of a connector approved by the Engineer.

Conductor insulation shall be well penciled, trimmed to conical shape, and roughened before applying splice insulation. Splice insulation shall be designated by the Engineer.

When conductors and cables are pulled into the conduit, all ends of the conductors and cables shall be taped to exclude moisture. Ends of spare conductors shall be taped. When new conduit is installed for future use, it shall have a #8 green (stranded) pull which is secured at both ends.

The ends of all conduits shall be well reamed to remove burrs and rough edges. Field conduit cuts shall be made square and true so that the ends will butt or come together for the full circumference in the couplings or adapters. Slip joints or running threads shall not be permitted for coupling metal conduit.

When a standard coupling can not be used, an approved union coupling shall be used.

Couplings for steel conduit shall be tightened until the ends of the conduits are brought together, so that a good electrical connection will be made throughout the entire length of the conduit run.

Conduit ends shall be threaded and capped with standard pipe caps until wiring is started. When caps are removed, the threaded ends shall be provided with approved conduit bushings.

Manual or power-operated equipment normally used for cutting rigid steel conduit is acceptable for use in cutting P.V.C. coated rigid steel conduit. P.V.C. shall not be peeled back before cutting and all cuts shall be reamed. Threading shall be the same as for non-coated rigid conduit. All scarred and grip marked areas shall be

(3) Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water working pressure.

(4) Unless otherwise specified, all interior bronze parts of valves except gate valve stems, shall conform to the requirements of the "Specifications for Composition Bronze or Ounce Metal Castings" (ASTM B 62). Gate valve stems shall be of bronze containing not more than 5% of zinc nor more than 2% of aluminum, and shall have a minimum tensile strength of 60,000 psi (413.8 MPa), a yield strength of 40,000 psi (275.8 MPa), and an elongation of at least 10% in 2 inches (5 centimeters), as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.

(5) Shop drawings on all valves shall be furnished in accordance with Subsection 629.01.03.

(b) **Butterfly Valves.**

(1) Butterfly valves shall conform to the "AWWA Standard for Rubber-Seated Butterfly Valves" (AWWA C 504), subject to the following requirements; Valves shall be Class 150-B. Valves shall be furnished with flanges faced and drilled to 125 pound (0.86 MPa) American Standard dimensions, and, unless otherwise shown, may be either short-bodied or long-bodied. Shaft seals shall be designed for use with standard split-V type packing. Valve discs shall be manufactured of any material listed in Section 8.2 of the above referenced AWWA standard except bronze. The metal surface seating against the rubber seat, or the surface in contact with the rubber disc edge, shall be type 18-8 stainless steel. For valves 12 inches (30 centimeters) and larger, the rubber seat shall be attached to the valve body and not to the disc. For valves 10 inches (25 centimeters) and smaller, the rubber seat may be attached to the body or the disc. Valves 10 inches (25 centimeters) and smaller shall be "450" as manufactured by Dresser Industries, or approved equal. Valves 12 inches (30 centimeters) and larger shall be Series 650 as manufactured by BIF Industries, "Triton" as manufactured by Henry Pratt Company, or approved equal.

(2) **Operators.**

(a) Except as otherwise provided herein, valves shall be provided with watertight manual operators. The operating torque of each valve and operator shall be computed in accordance with Appendix A of AWWA Standard C 504 for the pressure as indicated and a velocity of 16 fps (4.9 meters per second). Operation shall be through totally enclosed permanently lubricated and sealed gear reducers which provide at least 40 revolutions of the operator input shaft to open or close valve. Gear reducers shall have self-locking worm gearing. Open and close stops shall be provided to limit valve disc travel. Traveling nut operators will not be permitted for valves 24 inches (61 centimeters) in diameter and larger.

(b) Unless otherwise specified valves in vaults shall be provided with manual handwheels, and position indicators. The position of the handwheel will be specified at the time shop drawings are submitted. All valves shall be provided with a counterclockwise opening, 2 inch (5 centimeters) square operating nut with a horizontal valve shaft.

(c) **Gate Valves.** Except as otherwise provided herein, gate valves shall conform to the "Standard for Gate Valves for Ordinary Water Works Service" (AWWA C 500). Valves shall be of the iron bodied, bottom-wedging double-disc type with non-rising stem, except as otherwise shown, counterclockwise opening, and provided with a 2 inch (5 centimeters) square operating nut, or handwheel, as shown. Valves with non-rising stems shall have O-ring seals. Valves with outside screw and yoke shall be provided with stuffing boxes. Unless otherwise specified all interior parts of gate valves, including discs, shall be constructed of bronze conforming to the requirements contained in Subsection 629.02.23(a)(4). Gate valves shall be furnished with flanged ends, hub ends, or with "Ring-Tite" or approved equal ends as shown. Gate valves 14 inches (36 centimeters) and larger in diameter shall be furnished with valved bypass. Gate valves shall be as manufactured by Mueller, Iowa M & H, Rich, or approved equal.

(d) **Angle Valves.** Angle valves shall be designed for a water working pressure equal to design pressure of the pipeline, shall be bronze trimmed, and Crane No. 353, Powell No. 308, or approved equal.

(e) **Miscellaneous Small Valves.** Miscellaneous small valves shall be as shown. Where plug valves are indicated and where valves smaller than 4 inches (10 centimeters) are not specifically labeled or otherwise specified, the valves shall be iron-bodied, lever-operated, rubber faced, eccentric plug valves, Dezurik, Series 100 or approved equal.

629.02.24 CONCRETE: All concrete shall be portland cement concrete conforming to the requirements of Section 501, "Concrete", of the Standard Specifications.

629.02.25 REINFORCING STEEL: Reinforcing steel shall be deformed steel bars or cold-drawn steel wire, or fabricated forms of those materials, as required by the applicable drawings and specifications. Materials shall conform in quality to the requirements of "Reinforcement," Section 713 of the Standard Specifications.

629.02.26 PAINTINGS AND COATINGS:

(a) **General.** The Contractor shall furnish all labor, material and equipment necessary to complete the painting and to provide protective coatings as specified or required. All coating thickness described herein refer to dry-film thickness.

(b) **Epoxy Coating.**

(1) **General.** Where specified or shown, an epoxy coating shall be applied as specified herein.

(2) **Material.** Except as otherwise provided herein, the material used shall be 100% powder epoxy and shall be 3-M Company "Scotchcoat," Michigan Chrome and Chemical Company "Miccron 650 or 651," or approved equal. Where in the Engineer's opinion, because of the nature of the item being coated, it would be impossible to use the powder epoxy method without causing damage to the item, the use of a liquid epoxy will be permitted. Said liquid epoxy shall be 3-M Company No. 306, Keysite 740, or approved equal.

(3) **Surface Preparation.** The surface shall be blast-cleaned in accordance with SSPC-SP-5 (White Metal Blast Cleaning). The grit size used shall be as recommended by the epoxy manufacturer. All joints shall be ground smooth before blasting.

(4) **Application.** Application of the epoxy coating shall be in accordance with the manufacturer's instructions; provided that, if liquid epoxy is permitted, it shall be applied in not less than 3 spray coats to give the required total thickness.

(5) **Thickness of Coating.** The minimum dry coating thickness shall be 8 mils, provided, however, that the thickness of coating in the grooves or valves or fittings designed to receive a rubber gasket shall be approximately 5 mils.

(6) **Inspection.** Coating thickness shall be checked with a non-destructive magnetic type thickness gage. Coating integrity shall be tested with a sponge testing unit operating at approximately 60 volts. All pinholes shall be marked, repaired, and retested. No pinholes or other irregularities will be permitted in the final coating.

(7) **Field Repairs.** If small local repairs are necessary, they shall be made using the same liquid epoxy with which the item was initially coated. The surface must first be hand tool-cleaned in accordance with SSPC-SP-2 (Hand Tool Cleaning). The repair epoxy material shall be applied in accordance with the manufacturer's instructions.

(c) **Buried Galvanized Steel Pipe.** Buried galvanized steel pipe and be cleaned and wrapped with PVC tape in accordance with these specifications.

(1) **Surface Preparation.** Surfaces shall be cleaned in accordance with SSPC-SP-3 (Power Tool Company).

(2) **Wrapping.** Prior to wrapping the pipe with PVC tape, the pipe shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20 mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils. Application shall be in accordance with the tape manufacturer's instructions.

(d) **Buried Miscellaneous Ferrous Surfaces, Valves and Joints.**

(1) **Surface Preparation**. Surfaces shall be cleaned in accordance with SSPC-SP-3 (Power Tool Cleaning) or SSPC-SP-2 (Hand Tool Cleaning).

(2) **Coating.** Unless otherwise specified or shown, surfaces shall be field-coated with not less than 2 coats of 3-M Company's EC 244 or approved equal. Application shall be in accordance with the manufacturer's instructions. After drying, the coating shall not be less than 1/8 of an inch in thickness over all surfaces.

(3) Joints will be wrapped with two layers of 6 mil thickness polyethylene film and tightly sealed.

(e) **Exposed Ferrous Metal.**

(1) **Area of Application.** All ferrous metal, not buried (excluding stainless steel) shall be painted or coated.

(2) **Surface Preparation.** Sandblasting per SSPC-SP-6 (Commercial Blast Cleaning), except that SSPC-SP-3 (Power Tool Cleaning) or SSPC-SP-2 (Hand Tool Cleaning) will be permitted if the Engineer determines that sandblasting is inappropriate or will damage adjacent work.

(3) **Coating.**

(a) **Amercoat Alternate**. Prime coat Amercoat 25 or 38 (2 mils). First finish coat Amercoat 52 (2 mils). Second finish coat Amercoat 52 (2 mils). Total thickness of system (6 mils). Finish color will be selected by the Engineer.

(b) **Engard Alternate.** Prime coat Engard 126 (3 mils). First finish coat Engard 214 (1-1/2 mils). Second coat Engard 214 (1-1/2 mils). Total thickness of system (6 mils). Finish color will be selected by the Engineer.

(c) **Mobil Alternate.** Prime coat Mobil 13-Y-5 (2 mils). First finish coat Mobil 12-F-17 (2 mils). Second finish coat M 12-Series (2 mils). Total thickness of the system (6 mils). Finish color will be selected by the Engineer.

CONSTRUCTION

629.03.01 GENERAL: The Contractor shall perform all work required for construction of water mains and appurtenances as shown.

629.03.02 EXCAVATION: Excavation shall be as specified in Section 208. "Trench Excavation and Backfill."

629.03.03 PIPE BEDDING: Pipe bedding shall be as specified in Section 208, "Trench Excavation and Backfill."

629.03.04 TRENCH BACKFILL: Trench backfill shall be as specified in Section 208, "Trench Excavation and Backfill" except that trenches shall be backfilled in at least two lifts for pipe sizes of 12 inches (300 millimeters) and larger unless otherwise approved by the Engineer.

629.03.05 SOILS TEST: Soils tests shall be as specified in Subsection 208.03.04, "Soils Test."

629.03.06 CUTTING AND RESTORING STREET SURFACING: Cutting and restoring street surfacing shall be as specified in Subsection 208.03.05, "Cutting and Restoring Street Surfacing."

629.03.07 BACKFILL AROUND STRUCTURES: Backfill around structures shall be as specified in Section 207, "Structure Backfill."

629.03.08 CONCRETE: This work shall consist of furnishing and placing Portland cement concrete as specified in Section 502, "Concrete Structures."

629.03.09 CONNECTIONS TO EXISTING FACILITIES: The Contractor shall make connections to existing pipelines as shown. Dry connections to existing facilities shall be made at times which will cause the least inconvenience to the water consumers, and shall be planned in such a manner that the duration of any shutdown will be kept to a minimum. No additional compensation shall be paid for overtime which may be necessary in the making of connections to existing facilities. The Contractor shall notify the Engineer at least 3 days in advance of the date on which he proposes to begin to make connections to the existing facilities. When a connection to an existing main is made, about 4 ounces of HTH shall be placed in the pipe at each point where the existing main is cut. All new pipe and fittings at such connections shall be swabbed internally with an approved chlorine solution. All connections shall be made in the presence of the Engineer. After the new main is completed it shall be tested and sterilized before the valve between the new main and the old main is opened. Time and duration of shutdown shall be as specified by the Contracting Agency.

629.03.10 INSTALLATION OF VALVES: Unless otherwise noted all buried gate valves shall be installed with the stems in a vertical position and all buried butterfly valves shall be installed with the shafts in a horizontal position. Valve boxes shall be centered over the operating nuts and shall be set plumb.

629.03.11 INSTALLATION OF ASBESTOS CEMENT PIPING:

(a) **General.**

(1) The Contractor shall install all pipe, fittings, valves, and appurtenances shown and specified herein including pipe supports, bolts, nuts, gaskets, couplings and jointing materials. All exposed piping shall be adequately supported with devices of appropriate design.

(2) Prior to commencing excavation for pipelines, the Contractor shall have materials, labor and equipment on the job site which are suitable for making emergency repairs to the existing water system, should the existing facilities be damaged by the Contractor's operations.

(3) The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, and shall assume full responsibility for any damage due to this cause and shall at his own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the Contracting Agency.

(4) Trenches shall be in a reasonably dry condition when the pipe is laid. Necessary facilities shall be provided for lowering and properly placing the pipe sections in the trench without damage. The pipe shall be laid carefully to the lines and grades shown, or to the minimum depths indicated on the

drawings, and the sections shall be closely jointed to form a smooth flow line. Exceptional care shall be taken in placing the pipe and making the field joints. Concrete thrust blocks shall be provided at the locations and of the sizes shown or indicated.

(b) **Laying and Jointing Asbestos Cement Water Pipe.**

(1) **General.** Asbestos cement pipe shall be installed in accordance with the "Standard for Installation of Asbestos Cement Water Pipe" (AWWA C 603), except as otherwise provided herein or shown.

(2) **Inspection.** Prior to installation in the trench, asbestos cement pipe and couplings and rubber rings shall be inspected for damage and defects in material and workmanship. Damaged or defective materials shall be rejected and removed from the job site.

(3) **Jointing to Cast Iron.** Unless otherwise shown, joints made between asbestos cement pipe and cast iron valves and fittings shall be "Ring-Tite" joints, or approved equal, sealed with a rubber ring gasket. After assembling the joint, the position of the rubber ring gasket shall be checked with a suitable gage. Rubber ring gaskets shall be located an even distance from the face of the valve or fitting, for the full circumference of the pipe. Precaution shall be taken while jointing to prevent from entering the joint space.

(4) **Cover.** A minimum of 48 inches (122 centimeters) of cover shall be maintained over all asbestos cement pipe where there is not established street grade, unless otherwise shown on the drawings. A minimum of 36 inches (90 centimeters) of cover shall be maintained over pipe 12 inches (30 centimeters) in diameter and smaller, 42 inches (106 centimeters) of cover over pipe 14 inches (36 centimeters) and 16 inches (41 centimeters) in diameter where there is an established street grade, unless otherwise shown on the drawings.

629.03.12 TESTING: The Contractor shall test the pipeline in conformance with AWWA C 603 and as specified by the Contracting Agency.

629.03.13 DISINFECTION:

(a) **General.** Disinfection shall be accomplished by chlorination either at the same time or after the pipe has been tested, but the disinfection shall be completed before the pipe has been connected to the existing system.

(b) **Chlorination.** The chlorine solution shall be applied in such a manner that as the pipeline is filled with water the dosage applied to the water entering the pipe shall not exceed 50 ppm. Care shall be taken to prevent the strong chlorine solution in the line being treated from flowing back into the line supplying the water.

(c) **Retention Period.** Chlorinated water shall be retained in the pipeline long enough to destroy all nonsporeforming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has

been retained for the required time, the chlorine residual at the pipe extremities and at other representative points shall be at least 10 ppm.

(d) **Chlorinating Valves.** During the process of chlorinating the piping and pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with a heavily chlorinated water.

(e) **Final Flushing.** Following chlorination, all treated water shall be thoroughly flushed from the piping and pipelines at their extremities. Should the initial treatment fail to produce satisfactory disinfection of the piping and pipelines, as evidenced by the chlorine residual, the chlorination procedure shall be repeated until acceptable results are obtained.

(f) **Refilling With Water.** Following final flushing, the pipeline shall be filled with water and left full.

(g) **Bacteriological Tests.** The Contractor shall be responsible for providing connections and apparatus necessary to obtain samples of water from the pipeline after final flushing is complete, but before the pipeline is placed into service. Bacteriological analyses will be performed by the District Health Department. Should the initial treatment fail to produce satisfactory disinfection of the pipeline as evidenced by the bacteriological tests, the chlorination procedure shall be repeated until acceptable results are obtained.

629.03.14 FIRE HYDRANT INSTALLATIONS: Fire hydrants, assemblies, and the installation thereof, consisting of the hydrant, lateral and valve at the main, shall consist of materials approved by the applicable Fire Department and shall be installed and painted in accordance with Fire Department specifications or requirements.

All fire hydrants shall be for use with "Fluid-Tite" or "Ring-Tite" asbestos cement pipe. They shall have 2-1/2" NST nozzles higbee cut, and one 4" NST pumper nozzle breakway coupling at ground level; 4" valve opening; 6" "Ring-Tite" inlet connection. All hydrants shall be of the compression type; 150 psi working pressure, 300 psi test; hydrants shall be able to deliver 250 gallons per minute from each 2-1/2" outlet with a pressure loss of not more than 1-3/4 pounds for two-way, 2-1/2 pounds for three-way. There shall be an O-ring between the hydrant barrel and bonnet. Hydrants shall be bury type; 1-1/8" pentagon operating nut; counterclockwise opening, and painted in accordance with Fire Department specifications or requirements.

629.03.15 ABANDONING OF VALVES: Valves shown or specified to be abandoned, shall have the valve box removed a minimum of 12 inches (30 centimeters) below the surface, and backfilled with Asphaltic Concrete if in a paved area. If not in a paved area backfill may be native material.

629.03.16 INSTALLATION OF PIPE CASING:

(a) **General.** The Contractor shall furnish and install all pipe casing as specified herein and as shown on the drawings. The casing shall be laid true to grade and line with no bends or changes in grade or the full length of the casing.

(b) The pipe shall be supported at each end of each joint with 4" x 4" x 3" (10 x 10 x 91 centimeters) skids minimum. The annular space between the pipe and the casing shall be backfilled with sand. After installation of the pipe, and the casing shall be sealed at both ends with mortared brick or cement block.

METHOD OF MEASUREMENT

629.04.01 MEASUREMENT: The method of measurement shall be as specified by the Contracting Agency.

BASIS OF PAYMENT

629.05.01 PAYMENT: Payment shall be as specified by the Contracting Agency.

dimensions of structure backfill behind the wall shall be the same as those prescribed in Subsection 207.03.01 for walls and abutments, or as otherwise shown on the plans.

660.03.03 ASSEMBLY: In the construction of a wall on a curve the proper curvature for the face shall be obtained by the use of shorter stringers in the front or rear panels of retaining walls as designated in the plans or by the Engineer.

The wall height and depth may be varied. Two or more designs of retaining walls may be incorporated in the same wall by the use of standard split columns to make the connection of the step-back.

The units shall be erected as shown on the plans. Members shall be handled carefully and any which are damaged shall be removed and new members substituted at the Contractor's expense.

METHOD OF MEASUREMENT

660.04.01 MEASUREMENT: The quantity of metal bin-type retaining wall measured for payment will be the number of square feet (square meters) shown on the plans for each design type of wall, complete and in place.

All measurements will be made in accordance with Subsection 109.01, "Measurement of Quantities."

BASIS OF PAYMENT

660.05.01 PAYMENT: The accepted quantities of metal bin-type retaining walls measured as provided in Subsection 660.04.01, "Measurement," shall be paid for at the contract unit price bid per square foot (square meter) for the type specified.

Structure excavation and structure backfill will be paid for in accordance with Sections 206, "Structure Excavation" and 207 "Backfill."

All payments will be made in accordance with Subsection 109.02, "Scope of Payment."

Payment will be made under:

PAY ITEM	PAY UNIT
Metal Bin-Type Retaining Wall (type)	Square Foot (Square Meter)

DIVISION III

MATERIALS DETAILS

NOTE: Where pertinent a "Manufacturer's Certificate of Compliance" covering materials as specified in this Division may be required and shall be furnished by the Contractor, when requested by the Engineer, at no cost to the Contracting Agency.

SECTION 701

PORTLAND CEMENT

SCOPE

701.01.01 MATERIALS COVERED: This specification covers the five types of Portland cement as required under pertinent sections of these specifications and Type I-P. Unless otherwise provided, the cement to be used for all Portland cement concrete, mortar, cement-treated base, and cement-treated subgrade shall be in accordance with the following table:

Type of Cement Permitted	Minimum Sacks of Cement Per Per Cubic Yard	Maximum Water Cement (Plus Fly Ash) Ratio
Type II & Fly Ash	6.5[1,2]	0.45
Type 1-P (MS)	6.5	0.45
Type V	6.5[2]	0.45
Type V & Fly Ash	6.0[1,3]	0.45

Note: [1] - Sacks per cubic yard before replacement with fly ash.
[2] - 6.0 sacks per cubic yard for precast products, pipe and box, with zero slump mix design.
[3] - 5.5 sacks per cubic yard for precast products, pipe and box, with zero slump mix design.

MATERIALS

701.02.01 GENERAL: Unless otherwise specified the type of cement used is to be at the Contractor's option based on availability, and no additional compensation will be allowed for substitution of any type of cement for another.

Portland cement concrete shall be subject to the requirements of Section 501, Table 1, except as herein noted.

Cement to be removed and replaced with fly ash shall be 13% to 20% of the weight of cement. Fly ash added at the mixer shall be in a proportion of 1.2 minimum to the weight of cement removed.

Class F fly ash conforming to the requirements of Section 729, "Fly Ash," shall be used.

SECTION 705

AGGREGATES FOR BITUMINOUS COURSES

SCOPE

705.01.01 MATERIALS COVERED: This specification covers the quality and size of local mineral materials and commercial mineral fillers used in bituminous base and surface courses.

REQUIREMENTS

705.02.01 GENERAL: The mineral aggregate shall be the crushed and screened product of approved deposits. The Engineer reserves the right to prohibit the use of aggregates from any source when:

(a) The character of the material is such, in the opinion of the Engineer, as to make improbable the furnishing of aggregates conforming to the requirements of these specifications.

(b) The character of the material is such, in the opinion of the Engineer, that undue additional costs may be accrued by the Contracting Agency.

(c) The maximum allowable water absorption of either coarse or fine aggregate shall not exceed 2.5 percent when tested in accordance with ASTM C127 (coarse aggregate) and ASTM C128 (fine aggregate).

The mineral aggregate shall be clean, hard, durable, free from frozen lumps, deleterious matter, and harmful adherent coatings.

When producing plantmix aggregate, all natural fines passing the No. 4 sieve shall be screened from the coarse aggregate and may be reintroduced into the mix at a rate not to exceed twenty (20) percent by dry weight of the combined aggregates.

The natural fines may be used only when all applicable mix design criteria have been met.

705.02.02 DEFICIENCIES: If the product of any deposit is deficient in the fraction passing the No. 50 sieve, additional filler from other approved deposits meeting the physical requirements may be added. The added material shall be fed to the drier in a uniform manner from a separate stockpile. If the added material is a commercial mineral filler, it shall be uniformly fed directly to the plant. This is not to be construed as a waiver of any of the requirements contained herein.

PHYSICAL PROPERTIES AND TESTS

705.03.01 PLANTMIX AND ROADMIX BITUMINOUS BASE AND SURFACE AGGREGATE, TYPES TWO FINE AND COARSE AND THREE: The aggregate shall conform to the following requirements:

	Percent By Weight Passing Sieve		
Sieve Sizes	**Type 2 Coarse Arterials**	**Type 2 Fine Residential/ Collector**	**Type 3**
1 Inch	100	100	-----
3/4 Inch	84-97	90-100	-----
½ Inch	66-82	78-94	100
3/8 Inch	56-72	68-84	90-100
No. 4	35-50	50-65	55-85
No. 8	23-38	30-49	32-67
No. 50	5-19	7-25	7-27
No. 200	2-7	2-9	2-10

Project Tests	**Test Methods**	**Requirements**
Sieve Analysis	AASHTO T 27	Above
Sampling Aggregate.	ASTM D 75	-----
Fractured Faces	NEV. T 230	[3]90%(2 Fractures min.)/95% Min. (1 fracture min.) for Traffic Category I 35% Min. (2 Fractures min.) for Traffic Category II
Plasticity Index.	ASTM D 4318[1]	6 Maximum All TC[2]
Liquid Limit.	ASTM D 4318	35 Maximum All TC
[3]Methylene Blue Test.	AASHTO TP57	10 Max.
[3]Fine Aggregate Angularity.	AASHTO T 33	45% TC I

Source Tests	**Test Methods**	**Requirements**
[3]Stripping Test	ASTM D 1664	Satisfactory
Percentage of Wear (500 REV). .	ASTM C 131	[3]35% Max. All TC
[3]Elongation @ 5:1	ASTM D 4791	10% Max. TC I
[3]Soundness Test	ASTM C 88	8% Max. TC
[3]Deleterious Materials	ASTM C 142	0.3% Max. All TC

[1] Test Specimens shall be prepared following dry preparation procedure described in Sections 10.2 through 10.2.5 of ASTM D4318.
[2] TC = Traffic Category
[3] Test requirements shall become effective January 1, 2002.

SECTION 706

AGGREGATES FOR PORTLAND CEMENT PRODUCTS

SCOPE

706.01.01 MATERIALS COVERED: This specification covers the quality and size of aggregates used in Portland cement products.

REQUIREMENTS

706.02.01 GENERAL: The mineral aggregate shall be the product of approved deposits. The Engineer reserves the right to prohibit the use of aggregates from any source when:

(a) The character of the material is such, in the opinion of the Engineer, as to make improbable the furnishing of aggregates conforming to the requirements of these specifications.
(b) The character of the material is such, in the opinion of the Engineer, that undue additional costs may be accrued by the Contracting Agency.

Thirty-two (32) days before beginning concrete work, the Contractor shall submit in writing to the Engineer the proposed concrete mix design, giving the cement factor in sacks per cubic yard (kilograms per cubic meters) indicating the proportions of cement, water, admixtures and the gradation of the primary aggregate nominal sizes which he proposes to furnish or select a qualified mix design as indicated on the Internet page, **www.countyworks.net/IQAC.HTM**. When the primary coarse aggregate is separated into two sizes, the gradation shall consist of the gradation for each individual size and the proposed proportions of each individual size, combined mathematically with the fine aggregate to indicate one proposed gradation. Such gradation shall meet the grading requirements shown in the following table. (Not applicable to lightweight concrete.)

GRADING LIMITS OF COMBINED AGGREGATES

Sieve Size	Percentage Passing	
	1-1/2" Max.	3/4" Max.
2	100	---
1-1/2	87-100	---
1	65-97	100
3/4	48-91	80-100
3/8	39-70	46-74
4	30-54	34-54
8	23-50	24-50
16	15-37	17-38
30	8-28	10-29
50	4-15	5-19
100	1-7	2-9
200	0-5	0-5

If the Contractor proposes to use an admixture other than an air-entraining agent, he shall state the complete brand name and the quantity proposed to be used per sack of cement.

Should the Contractor change his source of supply, he shall submit in writing to the Engineer the new gradation before their intended use.

PHYSICAL PROPERTIES AND TESTS

706.03.01 COARSE AGGREGATE: The aggregate shall conform to the following chart (requirements):

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