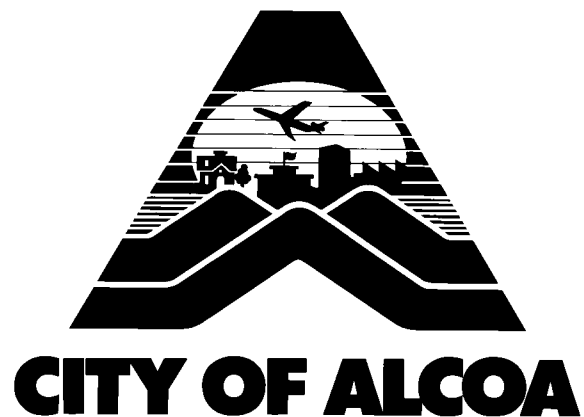


STREET & DRAINAGE - CONSTRUCTION SPECIFICATIONS

July 1999 Edition

THE CITY OF ALCOA, TENNESSEE

PUBLIC WORKS & ENGINEERING DEPARTMENT



Kenneth D. Wiggins, P.E.
Director of Engineering & Public Works

FOREWORD

These specifications have been compiled to assist in the orderly design and construction of Alcoa's street and storm sewer systems. Combined with the construction specifications for the water distribution and wastewater collection systems, documented procedures have been established that will benefit City of Alcoa staff, City Commission, Regional Planning Commission, and other City committees in the construction, operation, and maintenance of the City's infrastructure system. Just as important, these specifications provide a framework for developers, engineers, and others that are involved with the construction of street, drainage, water and sanitary sewer system improvements in private developments.

The development of these specifications was a combined effort. First, the basis for the street and drainage standards was the Local Government Public Works Standards and Specifications, compiled by Ed Archer, Public Works/Engineering Consultant, of the University of Tennessee Municipal Technical Advisory Service. Using that document, City staff reviewed and modified the requirements to closely fit the practices desired for the City of Alcoa service area. Key staff members involved in that work were:

- ❖ Helen Law, Engineering Technician; and
- ❖ Andrew Sonner, Civil Engineer, EIT.

The City's draft standards were then distributed internally within the Public Works & Engineering Department and Planning & Codes Department. Input was also sought from the local development community. Valuable comments were provided by:

- ❖ Phil Large, P.E., City of Maryville Director of Engineering & Planning;
- ❖ Landon Lawson, Harrison Construction Co.;
- ❖ Gary Loflin, P.E., Harrison Construction Co.;
- ❖ Melanie Reese, P.E., Sterling Engineering, Inc.; and
- ❖ Charles Sterling, P.E., Sterling Engineering, Inc.

The assemblage of comments and suggestions from each of these individuals resulted in these Street & Drainage – Construction Specifications for the City of Alcoa Public Works & Engineering Department.

CONSTRUCTION STANDARDS & SPECIFICATIONS
GENERAL REQUIREMENTS

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02485.....	Lawn and Grass Landscaping
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02528.....	Concrete Curbs, Gutters, & Sidewalks
02577.....	Pavement Marking
02721.....	Storm Drainage Systems
03001.....	Concrete Work
04001.....	Design Criteria – Drainage Systems
05001.....	Design Criteria – Streets

SECTION 01000

ENFORCEMENT

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Deviations from these standards, the Construction Standards of the City of Alcoa Public Works Department, or failure to comply with any requirements established shall constitute a violation subject to a "Stop Work Order" being issued to the contractor or any other person responsible for the work being performed. The "Stop Work Order" shall be issued by the Engineer or his designee.

SECTION 01005

AMENDMENTS TO GENERAL REQUIREMENTS

PART 1 - GENERAL

References to “the Engineer” in these Construction Standards and Specifications shall refer to the Engineer as referenced in the Contract Documents.

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS/REQUIREMENTS INCLUDED

- A. The Work of this Contract comprises the general construction of:

located _____
for _____.

1.02 RELATED REQUIREMENTS

- A. General and Supplementary Conditions.

1.03 CONTRACTS

- A. Construct the Work under a single unit-price or lump sum contract, as shown on the Bid Form.

1.04 WORK BY OTHERS

- A. Work on the Project which will be executed prior to the start of Work of this Contract, and which is excluded from this Contract, if any, as follows:

1. _____
2. _____
3. _____

- B. Work on the Project which will be executed after completion of the Work of this Contract, and which is excluded from this contract, if any, as follows:

1. _____
2. _____
3. _____

1.05 FUTURE WORK

- A. The project is designed for future, if any, _____
_____.
- B. Insure that Work is clear of encroachment into areas required for future work, if any.
- C. _____

1.06 WORK SEQUENCE

- A. Construct the Work in stages to accommodate the Owner's use of the premises during the construction period; coordinate the construction schedule and operations with the Owner's Representative.
- B. Construct the Work in stages to provide for public convenience.
 - 1. Do not close off public use of facilities until completion of one stage of construction will provide alternative usage.
 - 2. Stages of construction are those indicated on drawings.
- C. It is intended that the Work covered by this contract will be completed with minimum interference with the daily use and operation of _____ by _____. The manner in which shutdowns or _____ are made will be subject to the approval of the OWNER through the ENGINEER. Although every attempt will be made to cause the minimum amount of interference with the CONTRACTOR'S work, the interest of the City of Alcoa with respect to maintaining _____ and access by emergency personnel shall take precedence over the Work of this contract.

1.07 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit his use of the premises for Work and for storage, to allow for:
 - 1. Work by other Contractors.
 - 2. Owner occupancy.
 - 3. Public use.
- B. Coordinate use of premises under direction of Owner's representative.
- C. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the site.
- D. Move any stored Products, under Contractor's control, which interfere with operations of the Owner or separate contractor.
- E. Obtain and pay for the use of additional storage or work areas needed for operations.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

PART 4 – WARRANTY

4.01 WARRANTY

- A. All labor, materials and equipment used in the execution of the work described herein and as shown on the project plans, as amended by appropriate addenda, change orders, and/ or field orders shall be warranted for a minimum of twelve (12) months following the date of acceptance by the Owner. This does not preclude any additional warranties that may be described elsewhere herein, on the project plans, or as provided by the manufacturers of the materials and equipment installed under this contract.

SECTION 01045

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Contractor shall be responsible for all cutting, fitting, and patching, including attendant excavation and backfill, required to complete the Work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the Work to provide for installation and ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

1.02 RELATED DOCUMENTS

- A. Section 01010: Summary of Work.
- B. Section 02210: Excavating and Backfilling.

1.03 SUBMITTALS

- A. Submit a written request to Engineer well in advance of executing any cutting or alteration which affects:
 - 1. Work of the Owner or any separate contractor.
 - 2. Structural Value of integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance, or safety of operational elements.
 - 5. Visual qualities of sight-exposed elements.
- B. Request shall include:
 - 1. Identification of the Project.
 - 2. Description of affected work.
 - 3. Necessity for cutting, alteration, or excavation.
 - 4. Effect on work of Owner or any separate contractor, or on structural or weatherproof integrity of Project.
 - 5. Description of proposed work:
 - a. Scope of cutting, patching, alteration, or excavation.

- b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 - 6. Alternatives to cutting and patching.
 - 7. Cost proposal, when applicable.
 - 8. Written permission of any separate contractor whose work will be affected.
- C. Should conditions of Work or the schedule indicate a change of products from original installation, Contractor shall submit request for substitution.
- D. Submit written notice to Engineer designating the date and the time the work will be uncovered.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with specifications and standards for each specific product involved.

PART 3 - EXECUTION

3.01 INSPECTIONS

- A. Inspect existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of work.
- C. Report unsatisfactory or questionable conditions to Engineer in writing; do not proceed with work until Engineer has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of Project from damage.
- C. Provide protection from elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water.

3.03 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

- B. Executed excavating and backfilling by methods which will prevent settlement or damage to other work.
- C. Employ original Installer or Fabricator to perform cutting and patching for:
 - 1. Weather-exposed or moisture-resistant elements.
 - 2. Sight-exposed finished surfaces.
- D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.
- F. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through the surfaces.
- G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish entire unit.

SECTION 01050

FIELD ENGINEERING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and pay for field engineering services required for the Project.
 - 1. Survey work required in execution of Project.
 - 2. Civil, structural, or other professional engineering services specified, or required to execute Contractor's construction methods.
- B. Owner's Representative will identify existing control points and property line corner stakes indicated on the drawings, as required.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01010: Summary of Work.
- C. Section 01720: Project Record Documents.

1.03 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. Qualified engineer or registered land surveyor, acceptable to Contractor and Owner.
- B. Registered professional engineer of the discipline required for the specific service on the project, if required, licensed in the state of Tennessee, in which the project is located.

1.04 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the Project are those designated on drawings.
- B. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.
 - 1. Make no changes or relocations without prior written notice to Engineer.
 - 2. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. Require surveyor to replace project control points which may be lost or destroyed.
 - a. Establish replacements based on original survey control.

1.05 PROJECT SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent bench marks on site, when not present, referenced to data established by survey control points.
 - 1. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means:
 - 1. Site improvements.
 - a. Stakes for grading, fill, and topsoil placement.
 - b. Utility slopes and invert elevations.
 - 2. Batter boards for structures.
- C. From time to time, verify layouts by same methods.

1.06 RECORDS

- A. Maintain a complete, accurate log of all control and survey work, if required, as it progresses.

1.07 SUBMITTALS

- A. Submit name and address of Surveyor and/ or professional engineer to Engineer.
- B. On request of Engineer, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Abbreviations and acronyms used in Contract Documents to identify reference standards.

1.02 QUALITY ASSURANCE

- A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. Publication Date: The publication is in effect on the date of issue of Contract Documents, except when a specific publication date is specified.

1.03 ABBREVIATIONS, NAMES, AND ADDRESSES OF ORGANIZATIONS

- A. Obtain copies of referenced standard direct from publication source when needed for proper performance of Work, or when required for submittal by Contract Documents.

AASHTO American Association of State Highway and
Transportation and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001

ANSI American National Standards Institute
(Formerly American Standards Association--ASA)
11 W. 42nd Street
New York, NY 10036

AREA American Railway Engineering Association
50 F Street, N. W. , Suite 7702
Washington, DC 20001

ASCE American Society of Civil Engineers
345 East 47th Street
New York, NY 10017

ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103-1187
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235
CLFMI	Chain Link Fence Manufacturing Institute 1776 Massachusetts Avenue, N. W. , #500 Washington, D. C. 20036
FHWA	Federal Highway Administration 249 Cumberland Bend Drive Nashville, TN 37228
FSS	Federal Supply Service Bureau Specification Section 470 East L'Enfant Plaza, S. W. Suite 8100 Washington, DC 20407
TDEC	Tennessee Department of Environment and Conservation L&C Tower 401 Church Street Nashville, TN 37243
TDOT	Tennessee Department of Transportation James K. Polk Building, 7th Floor Nashville, TN 37243-0349

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01152

APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit Application for Payment to Engineer in accord with the schedule established by Conditions of the Contract and Agreement between Owner and Contractor.

1.02 RELATED REQUIREMENTS

- A. Agreement between Owner and Contractor: Lump Sum and Unit Prices.
- B. Conditions of the Contract: Progress Payments, Retainage, and Final Payment.
- C. Section 01370: Schedule of Values.
- D. Section 01700: Contract Closeout.

1.03 FORMAT AND DATA REQUIRED

- A. Submit applications using format specified by Engineer or Owner, with itemized data typed on 8-1/2" x 11" sheets.
- B. Provide itemized data on continuation sheet:
 - 1. Format, schedules, line items, and values: Those of the Schedule of Values accepted by Engineer.

1.04 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

- A. Application Form:
 - 1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
 - 2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
 - 3. Execute certification with signature of a responsible officer of Contract firm.
- B. Continuation Sheets:
 - 1. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.
 - 2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.
 - a. Round to nearest dollar, or as specified for Schedule of Values.

3. List each Change Order executed prior to date of submission, at the end of the continuation sheets.
 - a. List by Change Order Number, and description, as for an original component item of work.

1.05 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When the Owner or the Engineer requires substantiating data, Contractor shall submit suitable information, with a cover letter identifying:
 1. Project.
 2. Application number and date.
 3. Detailed list of enclosures.
 4. For stored products:
 - a. Item number and identification as shown on application.
 - b. Description of specific material.
- B. Submit one copy of data and cover letter for each copy of application.

1.06 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in Application form as specified for progress payments.
- B. Use continuation sheet for presenting the final statement of accounting as specified in Section 01700 - Contract Closeout.

1.07 SUBMITTAL PROCEDURE

- A. Submit Application for Payment to Engineer at the times stipulated in the Agreement.
- B. Number: As specified by Engineer or Owner.
- C. When Engineer finds Application properly completed and correct, he will transmit certificate for payment to Owner, with copy to Contractor.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01153

CHANGE ORDER PROCEDURES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Promptly implements Change Order procedures.
 - 1. Provide full written data required to evaluate changes.
 - 2. Maintain detailed records of work done on a time-and-material/force account basis.
 - 3. Provide full documentation to Engineer on request.
- B. Designate in writing the member of Contractor's organization:
 - 1. Who is authorized to accept changes in the Work.
 - 2. Who is responsible for informing others in the Contractor's employ of the authorization of changes in the Work.
- C. Owner will designate in writing the person who is authorized to execute Change Orders.

1.02 RELATED REQUIREMENTS

- A. Agreement: The amounts of established unit prices.
- B. Conditions of the Contract:
 - 1. Methods of determining cost or credit to Owner resulting from changes in Work made on a time and material basis.
 - 2. Contractor's claims for additional costs.
- C. Section 01152: Application for Payment.
- D. Section 01720: Project Record Documents.

1.03 DEFINITIONS

- A. Change Order: See General Conditions.
- B. Engineer's Supplemental Instructions: A written order, instructions, or interpretations, signed by Engineer making minor changes in the Work not involving a change in Contract Sum or Contract Time.

1.04 PRELIMINARY PROCEDURES

- A. Owner or Engineer may initiate changes by submitting a Proposal Request to

Contractor. Request will include:

1. Detailed description of the Change, Products, and location of the change in the Project.
2. Supplementary or revised Drawings and Specifications.
3. The projected time span for making the change, and a specific statement as to whether overtime work is, or is not, authorized.
4. A specific period of time during which the requested price will be considered valid.
5. Such request is for information only, and is not an instruction to execute the changes, or to stop Work in progress.

B. Contractor may initiate changes by submitting a written notice to Engineer containing:

1. Description of the proposed changes.
2. Statement of the reason for making the changes.
3. Statement of the effect on the Contract Sum and the Contract Time.
4. Statement of the effect of the work of separate contractors.
5. Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

1.05 DOCUMENTATION OF PROPOSALS AND CLAIMS

A. Support each quotation for a lump sum proposal, and for each unit price which has not previously been established, with sufficient substantiating data to allow Engineer to evaluate the quotation.

B. On request, provide additional data to support time and cost computations:

1. Labor required.
2. Equipment required.
3. Products required.
 - a. Recommended source of purchase and unit cost.
 - b. Quantities required.
4. Taxes, insurance, and bonds.
5. Credit for work deleted from Contract, similarly documented.
6. Overhead and profit.
7. Justification for any change in Contract Time.

C. Support each claim for additional costs, and for work done on a time-and-material/force account basis, with documentation as required for a lump sum proposal, plus additional information.

1. Name of the Owner's authorized agent who ordered the work, and date of the order.
2. Dates and times work was performed, and by whom.
3. Time record, summary of hours worked, and hourly rates paid.
4. Receipts and invoices for:
 - a. Equipment used, listing dates and times of use.
 - b. Products used, listing of quantities.
 - c. Subcontracts.

1.06 PREPARATION OF CHANGE ORDERS

- A. Engineer will prepare each Change Order.
- B. Form: Change Order: As specified by Engineer or Owner.
- C. Change Order will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
- D. Change Order will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.

1.07 LUMP SUM/FIXED PRICE CHANGE ORDER

- A. Content of Change Orders will be based on either:
 - 1. Engineer's Proposal Request and Contractor's responsive Proposal as mutually agreed between Owner and Contractor.
 - 2. Contractor's Proposal for a change, as recommended by Engineer.
- B. Owner and Engineer shall sign and date the Change Order as authorization for the Contractor to proceed with the changes.
- C. Contractor shall sign and date the Change Order to indicate agreement with the terms therein.

1.08 UNIT PRICE CHANGE ORDER

- A. Content of Change Orders will be based on either:
 - 1. Engineer's definition of the scope of the required changes.
 - 2. Contractor's Proposal for a change, as recommended by Engineer.
 - 3. Survey of completed work.
- B. The amounts of the unit prices to be:
 - 1. Those stated in the Agreement.
 - 2. Those mutually agreed upon between Owner and Contractor.
- C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
 - 1. Owner and Engineer will sign and date the Change Order as authorization for Contractor to proceed with the changes.
 - 2. Contractor shall sign and date the Change Order to indicate agreement with the terms therein.
- D. When quantities of the items cannot be determined prior to start of the work:
 - 1. Engineer or Owner will issue a construction change authorization directing Contractor to proceed with the change on the basis of unit prices, and will

-
2. cite the applicable unit prices.
At completion of the change, Engineer will determine the cost of such work based on the unit prices and quantities used.
 - a. Contractor shall submit documentation to establish the number of units of each item and any claims for a change in Contract Time.
3. Engineer will sign and date the Change Order to indicate their agreement with the terms therein.
4. Owner and Contractor will sign and date the Change Order to indicate their agreement with the terms therein.

1.09 CORRELATION WITH CONTRACTOR'S SUBMITTALS

- A. Periodically revise Request for Payment forms to record each change as a separate item of Work, and to record the adjusted Contract Sum.
- B. Periodically revise the Construction Schedule to reflect each change in Contract Time.
- C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01310

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. If so directed, promptly after award of the Contract prepare and submit to Engineer estimated construction progress schedules for the Work, with sub-schedules of related activities which are essential to its progress.
- B. Submit revised progress schedules periodically.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01010: Summary of Work.
- C. Section 01340: Shop Drawings, Product Data, and Samples.

1.03 FORM OF SCHEDULES

- A. Prepare schedules in the form of a horizontal bar chart.
 - 1. Provide separate horizontal bar for each trade or operation.
 - 2. Horizontal time scale: Identify the first workday of each week.
 - 3. Scale and spacing: To allow space for notations and future revisions.
 - 4. Minimum sheet size: 8-1/2" x 11".
- B. Format of listings: The chronological order of the start of each item of work.
- C. Identification of listings: By major specification section numbers.

1.04 CONTENT OF SCHEDULES

- A. Construction Progress Schedule:
 - 1. Show the complete sequence of construction by activity.

2. Show the dates for the beginning and completion of each major element of construction. Where applicable, specifically list:
 - a. Site clearing.
 - b. Site utilities.
 - c. Foundation work.
 - d. Structural framing.
 - e. Subcontractor work.
 - f. Equipment installations.
 - g. Finishings.
3. Show projected percentage of completion for each item, as of the first day of each month.

B. Submittals Schedule for Shop Drawings, Product Data, and Samples. Show:

1. The dates for Contractor's submittals.
2. The dates approved submittals will be required from the Engineer.

C. Prepare and submit sub-schedules for each separate stage of work specified in Section 01010.

D. Provide sub-schedules to define critical portions of prime schedules.

1.05 PROGRESS REVISIONS

A. Indicate progress of each activity to date of submission.

B. Show changes occurring since previous submission of schedule:

1. Major changes in scope.
2. Activities modified since previous submission.
3. Revised projections of progress and completion.
4. Other identifiable changes.

- C. Provide a narrative report as needed to define:
 - 1. Problem areas, anticipated delays, and the impact on the schedule.
 - 2. Corrective action recommended, and its effect.
 - 3. The effect of changes on schedules of other prime contractors.

1.06 SUBMISSIONS

- A. Submit initial schedules within 15 days after award of Contract.
 - 1. Engineer will review schedules and return review copy within 10 days after receipt.
 - 2. If required, resubmit within 7 days after return of review copy.
- B. Submit revised progress schedules with each application for payment.
- C. Submit the number of opaque reproductions which the Contractor requires, plus two copies which will be retained by the Engineer.

1.07 DISTRIBUTION

- A. Distribute copies of the reviewed schedules to:
 - 1. Job site files.
 - 2. Subcontractors.
 - 3. Other concerned parties.
- B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit Shop Drawings, Product Data, and Samples required by Contract Documents.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract: Definitions, and Additional Responsibilities of Parties.
- B. Section 01310: Construction Schedules.
- C. Section 01720: Record Documents.
- D. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that reviewed Shop Drawings, Product Data, and Samples will be needed.

1.03 SHOP DRAWINGS

- A. Drawings shall be presented in a clear and thorough manner.
 - 1. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Drawings.
- B. Minimum sheet size: 8-1/2" x 11".

1.04 PRODUCT DATA

- A. Preparation:
 - 1. Clearly, mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring or piping diagrams and controls.
- B. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information not applicable to Work.
 - 2. Supplement standard information to provide information specifically

applicable to the Work.

1.05 SAMPLES

- A. Office samples shall be of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture, and pattern.

1.06 CONTRACTOR RESPONSIBILITIES

- A. Review Shop Drawings, Product Data, and Samples prior to submission.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with specifications.
- C. Coordinate each submittal with requirements of the Work and of the Contract Documents.
- D. Notify the Engineer in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.
- E. Begin no fabrication or work which requires submittals until return of submittals with Engineer approval.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Number of submittals required:
 - 1. Shop Drawings: Submit the number of opaque reproductions which the Contractor requires, plus two copies which will be retained by the Engineer.
 - 2. Product Data: Submit the number of copies that the Contractor requires, plus two which will be retained by the Engineer.
 - 3. Samples: Submit the number stated in each specification section.
- C. Submittals shall contain:
 - 1. The date of submission and the dates of any previous submissions.
 - 2. The project title and number.
 - 3. Contract identification.
 - 4. The names of:
 - a. Contractor.

- b. Supplier.
- c. Manufacturer.
- 5. Identification of the project, with specification section number.
- 6. Field dimensions, clearly identified as such.
- 7. Relation to adjacent or critical features of the Work or materials.
- 8. Applicable standards, such as ASTM or Federal Specification numbers.
- 9. Identification of deviations from Contract Documents.
- 10. Identification of revisions on submittals.
- 11. An 8" x 3" blank space for Contractor and Engineer stamps.
- 12. Contractor's stamp, initialed / signed, and dated certifying to review of submittal, verification of products, field measurements, and field construction criteria, and coordination of the information within the submittal with requirements of the Work of Contract Documents. As necessary for clarification, Contractor shall indicate the referenced plan sheet or specification section.

1.08 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.
- B. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 - 2. Indicate any changes that have been made other than those requested by the Engineer.
- C. Samples: Submit new samples as required for initial submittal.

1.09 DISTRIBUTION

- A. Distribute reproductions of Shop Drawings and copies of Product Data which carry the Engineer stamp of approval to:
 - 1. Job site file.
 - 2. Record Documents file.
 - 3. Other affected contractors.
 - 4. Subcontractors.
 - 5. Supplier or fabricator.
- B. Distribute samples which carry the Engineer stamp of approval as directed by Engineer.

1.10 ENGINEER DUTIES

- A. Review submittals with reasonable promptness and in accord with schedule.
- B. Affix stamp and initials or signature, and indicate requirements for resubmittal or

approval of submittal.

- C. Return submittals to Contractor for distribution, or for resubmission.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01370

SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Submit to the Engineer a Schedule of Values allocated to the various portions of the Work within ten days after award of contract for lump sum contracts only.
- B. Upon request of Engineer, support the values with data which will substantiate their correctness.
- C. The Schedule of Values, unless objected to by the Engineer, shall be used only as the basis for the Contractor's Applications for Payment for lump sum contracts only.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01152: Application for Payment.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on 8-1/2" x 11" white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. Engineer and Project number.
 - 3. Name and address of Contractor.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Follow the table of contents of this Project Manual as the format for listing component items.
 - 1. Identify each line item with the number and title of the respective major section of the specifications.
- D. For each major line item, list sub-values of major products or operations under the item.

- E. For the various portions of the Work:
 - 1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with taxes paid.
 - b. The total installed value.
 - 3. Submit a sub-schedule for each separate stage of work specified in Section 01010.
- F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a sub-schedule of unit cost and quantities for:
 - 1. Products on which progress payments will be requested for stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
- C. The unit quantity of bulk materials shall include an allowance for normal waste.
- D. The unit values for the material shall be broken down into:
 - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2. Installation costs, including Contractor's overhead and profit.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

Recordings

SECTION 01375

PRECONSTRUCTION VIDEO RECORDINGS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

Employ a competent video recorder to take pre-construction video recordings.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01720: Project Record Documents.

1.03 VIDEO RECORDINGS

- A. Provide video recording of the entire project site/ route prior to any construction activity.
The recording shall be made using a hand held video camera while the camera operator walks the job/ route.
 - 1. The video shall record the job site/ route and all adjacent areas.
 - 2. The tape shall include audio recording, allowing the operator to provide relative comments.
- B. Format and quantities required:
 - 1. The video recording shall be of VHS format unless otherwise specified.
 - 2. Contractor shall provide at least three (3) copies of the recordings, while maintaining one (1) copy for his records and distributing the one (1) each to the Engineer and Owner

1.04 COSTS - VIDEO RECORDINGS & PHOTOGRAPHS

Pay costs for specified recording and copies. Parties requiring additional recordings or copies will pay the video recorder directly.

PART 2 - PRODUCTS

2.01 VIDEOS

- A. Color: Color VHS. Minimum C-120.
- B. Identify each tape on label, listing:
 - 1. Name of Project.
 - 2. Corresponding location of filming.
 - 3. Date and time of recording.

Recordings

4. Name and address of video recorder.

PART 3 - EXECUTION

3.01 TECHNIQUE

- A. Factual Presentation.
- B. Correct exposure and focus.
 1. High resolution and sharpness.
 2. Maximum depth-of-field.
 3. Minimum distortion.

3.02 VIEWS REQUIRED

- A. Record from locations to adequately illustrate condition of site(s) prior to construction.

3.03 DELIVERY OF RECORDINGS & PRINTS

- A. Deliver preconstruction video recording prior to commencement of work with one copy each to:
 1. Owner.
 2. Engineer.
 3. Project Record File.

Photographs

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Employ competent photographer to take construction record photographs periodically during course of the Work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01720: Project Record Documents.

1.03 PHOTOGRAPHY REQUIRED

- A. Provide photographs taken at each major stage of construction.
- B. Views and Quantities Required:
 - 1. At each specified time, photograph Project from three different views, as approved by Engineer.
 - 2. Provide three prints of each view.
- C. Negatives:
 - 1. Remain property of photographer.
 - 2. Require that photographer maintain negatives for a period of two years from Date of Substantial Completion of entire Project.
 - 3. Photographer shall agree to furnish additional prints to Owner and Engineer at commercial rates applicable at time of purchase.

1.04 COSTS OF PHOTOGRAPHY

- A. Pay costs for specified photography and prints. Parties requiring additional photography or prints will pay photographer directly.

PART 2 - PRODUCTS

2.01 PRINTS

- A. Color:

Photographs

1. Finish: Smooth surface, glossy.
 2. Size 3" x 5".
- B. Identify each print on back, listing:
1. Name of Project.
 2. Orientation of view.
 3. Date and time of exposure.
 4. Name and address of photographer.
 5. Photographer's numbered identification of exposure.

PART 3 - EXECUTION

3.01 TECHNIQUE

- A. Factual Presentation.
- B. Correct exposure and focus.
1. High resolution and sharpness.
 2. Maximum depth-of-field.
 3. Minimum distortion.

3.02 VIEWS REQUIRED

- A. Photograph from locations to adequately illustrate condition of construction and state of progress.
1. At successive periods of photography, take at least one photograph from the same overall view as previously.
 2. Consult with Engineer at each period of photography for instructions concerning views required.

3.03 DELIVERY OF PRINTS

- A. Deliver prints to Engineer to accompany each Application for Payment.
- B. Deliver prints as soon as processed, one set each to:
1. Owner.
 2. Engineer.
 3. Project Record File.

SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain temporary utilities required for construction; remove on completion of Work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01590: Field Offices and Sheds.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with Federal, State, and local codes and regulations and with utility company requirements.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

- A. Arrange with utility company, provide service required for power and lighting, and pay all costs for service and for power used.
- B. Install circuit and branch wiring, with area distribution boxes located, so that power and lighting is available throughout the construction by use of construction-type power cords.
- C. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work and for areas accessible to the public.

2.03 TEMPORARY HEAT AND VENTILATION

- A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work. Meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.
- B. Provide adequate forced ventilation of enclosed areas for curing of installed materials to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
- C. Portable heaters shall be standard approved units complete with controls.
- D. Pay all costs of installation, maintenance, operation, removal, and consumed fuel.

2.04 TEMPORARY TELEPHONE SERVICE

- A. Arrange with local telephone service company to provide direct line telephone service at the construction site for the use of personnel and employees. Service required:
 - 1. One direct line instrument in field office.
 - 2. Other instruments at the option of the Contractor, or as required by regulations.
- B. Pay all costs for installation, maintenance, removal, and service charges for local calls. Toll charges shall be paid by the party who places the call.

2.05 TEMPORARY WATER

- A. Arrange with utility service company to provide water for construction purposes; pay all costs for installation, maintenance, removal, and service charges for water used.
- B. Install branch piping with taps located so that water is available throughout the construction by the use of hoses. Protect piping and fittings against freezing.

2.06 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary facilities in compliance with laws and regulations.
- B. Service, clean, and maintain facilities and enclosures.
- C. Existing facilities may be used during the construction period.

PART 3 - EXECUTION

3.01 GENERAL

- A. Maintain and operate systems to assure continuous service.
- B. Modify and extend systems as work progress requires.

3.02 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore existing facilities, if any, used for temporary services as specified, or to original, conditions.
- D. Restore permanent facilities, if any, used for temporary services to specified condition.
 - 1. Prior to final inspection, remove temporary lamps and install new lamps.

SECTION 01520

CONSTRUCTION AIDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain required construction aids; remove on completion of Work.

1.02 RELATED DOCUMENTS

- A. Section 01010: Summary of Work.

PART 2 - PRODUCTS

2.01 MATERIAL, GENERAL

- A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required by personnel and to facilitate execution of the Work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoist, cranes, chutes, and other such facilities and equipment.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Consult with Engineer, review site conditions and factors which affect construction procedures and construction aids, including adjacent properties and public facilities which may be affected by execution of the Work.

3.02 GENERAL

- A. Comply with applicable requirements specified in sections of Division 2 through 16.
- B. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements of Owner and other contractors employed at the site.

3.03 REMOVAL

- A. Completely remove temporary materials, equipment, and services:
 - 1. When construction needs can be met by use of permanent construction.
 - 2. At completion of Project.
- B. Clean and repair damage caused by installation or by use of temporary facilities.
 - 1. Remove foundations and underground installations for construction aids.
 - 2. Grade areas of site affected by temporary installations to required elevations and slopes, and clean the area.
- C. Restore existing facilities used for temporary purposes to specified or original condition.
- D. Restore permanent facilities, if any, used for temporary purposes to specified condition.

SECTION 01530

BARRIERS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain suitable barriers as required to prevent public entry, and to protect the Work, existing facilities, trees, and plants from construction operations; remove when no longer needed, or at completion of work.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01520: Construction Aids.
- C. Section 01580: Project Identification and Signs.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.02 FENCING

- A. Unless otherwise specified materials to Contractor's option, minimum fence height 6 feet.

2.03 BARRIERS

- A. Unless otherwise specified materials to Contractor's option, as appropriate to serve required purpose.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install facilities of a neat and reasonable uniform appearance, structurally adequate for required purposes.

- B. Maintain barriers during entire construction period.
- C. Relocate barriers as required by progress of construction.

3.02 FENCES

- A. Prior to start of work at the Project site, install enclosure fence with suitably locked entrance gates.
 - 1. Locate as shown on drawings.

3.03 TREE AND PLANT PROTECTION

- A. Preserve and protect existing trees and plants at site which are designated to remain, and those adjacent to site.
- B. Consult with Engineer and remove agreed-on roots and branches which interfere with construction.
 - 1. Employ qualified tree surgeon to remove, and to treat cuts.
- C. Provide temporary barriers to a height of six feet, around each, or around each group, of trees and plants.
- D. Protect root zones of trees and plants:
 - 1. Do not allow vehicular traffic or parking.
 - 2. Do not store materials or products.
 - 3. Prevent dumping of refuse or chemically injurious materials or liquids.
 - 4. Prevent puddling or continuous running water.
- E. Carefully supervise excavating, grading and filling, and subsequent construction operations, to prevent damage.
- F. Replace, or suitably repair, trees and plants designated to remain which are damaged or destroyed due to construction operations.

3.04 REMOVAL

- A. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed and when approved by the Engineer.
- B. Clean and repair damage caused by installation, fill and grade areas of the site to required elevations and slopes, and clean the area.

SECTION 01540

SECURITY

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide a project security program, to:
 - 1. Protect Work, stored products, and construction equipment from theft and vandalism.
 - 2. Post and or protect premises from entry by unauthorized persons.
- B. Comply with applicable requirements.

1.02 RELATED REQUIREMENTS

- A. Section 01510: Temporary Utilities.
- B. Section 01530: Barriers.

1.03 MAINTENANCE OF SECURITY

- A. Initiate security program, prior to job mobilization.
- B. Maintain security program throughout construction period, until Owner occupancy or Owner acceptance precludes the need for Contractor security.

1.04 PATROL/GUARD SERVICE

- A. Employ a recognized patrol/guard service, as necessary, to provide a watchman service, which shall be in effect:
 - 1. At all times day or night when general construction work is not in progress.

PART 2 - PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

SECTION 01560

TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide and maintain methods, equipment, and temporary construction, as necessary, to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of work.

1.02 RELATED REQUIREMENTS

- A. Section 01510: Temporary Utilities.
- B. Section 01570: Traffic Regulation.
- C. Section 01710: Cleaning.

1.03 DUST CONTROL

- A. Provide positive methods and apply dust control materials to minimize raising dust from construction operation, and provide positive means to prevent airborne dust from dispersing into the atmosphere.

1.04 WATER CONTROL

- A. Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.
 - 1. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper run-off.
- B. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface water.
- C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

1.05 DEBRIS CONTROL

- A. Maintain all areas under Contractor's control free of extraneous debris.
- B. Initiate and maintain a specific program to prevent accumulation of debris at construction site, storage and parking areas, or along access roads and haul routes.
 - 1. Provide containers for deposit of debris as specified in Section 01710--Cleaning.
 - 2. Prohibit overloading of trucks to prevent spillage on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.
- C. Schedule periodic collection and disposal of debris as specified in section 01710--Cleaning.
 - 1. Provide additional collections and disposal of debris whenever the periodic schedule is inadequate to prevent accumulation.

1.06 POLLUTION CONTROL

- A. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of noxious substances from construction operations.
- B. Provide equipment and personnel, perform emergency measures required to contain any spillage, and to remove contaminated soils or liquids.
 - 1. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Take special measures to prevent harmful substances from entering public waters.
 - 1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutant into the atmosphere.
 - 3. There shall be no open burning of debris without specific approval of the Owner and the local authorities.

1.07 SLOPE PROTECTION AND EROSION CONTROL

- A. This section shall consist of temporary control measures as shown in the Plans or directed by the Engineer, during the life of the Contract to control erosion and pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.
- B. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features to assure economical, effective, and continuous erosion features and to assure economical, effective, and continuous erosion control

throughout the construction and post-construction period.

PART 2 - PRODUCTS

2.01 TEMPORARY BERMS

- A. A temporary berm is constructed of compacted soil, with or without a shallow ditch at the top of fill slopes or transverse to centerline of fills.
- B. These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

2.02 TEMPORARY SLOPE DRAINS

- A. A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete, or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod or other material acceptable to the Engineer that may be used to carry water down slopes to reduce erosion.

2.03 SEDIMENT STRUCTURES

- A. Sediment basins, ponds and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the constructed areas from excessive siltation. During construction phases, future detention ponds may be converted for use as sediment basins.

2.04 CHECK DAMS

- A. Check dams are barriers composed of logs and poles, large stones or other materials placed across a natural or constructed drain way.
- B. Stone check dams shall not be utilized where the drainage area exceeds fifty (50) acres. Log and pole structures shall not be used where the drainage area exceeds five (5) acres.

2.05 TEMPORARY SEEDING AND MULCHING

- A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing and mating utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion.

2.06 BRUSH BARRIERS

- A. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operations.

- B. Brush barriers are placed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located to restrain sedimentation particles.

2.07 BALED HAY OR STRAW CHECKS

- A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing five (5) cubic feet or more of material.
- B. Baled hay or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of the slopes, in ditches or other areas where siltation erosion or water run-off is a problem.

208. TEMPORARY SILT FENCES

- A. Silt fences are temporary measures utilizing woven wire or other approved material attached to post with filter cloth composed of burlap, plastic filter fabric, etc., attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

PART 3 - EXECUTION

3.01 PROJECT REVIEW

- A. Prior to the pre-construction conference, the Contractor shall meet with the Engineer and go over in detail the expected problem areas in regard to the erosion control work. Different solutions should be discussed so that the best method might be determined. It is the responsibility of the Contractor to develop an erosion control plan acceptable to the Engineer.

3.02 PRE-CONSTRUCTION CONFERENCE

- A. At the pre-construction conference, the Contractor shall submit for acceptance his schedule for accomplishment of temporary and permanent erosion control work, as is applicable for clearing and grubbing, grading, bridges and other structures at watercourses, construction and paving. He shall also submit for acceptance his proposed method for erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer.

3.03 CONSTRUCTION REQUIREMENTS

- A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface of erodible earth material exposed by

excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains and use of temporary mulches, mats, seeding or other control devices or methods to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds to the extent directed by the Engineer.

- B. The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in his accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise erosion control measures may be required between successive construction stages. Under no conditions shall the surface area of erodible earth material exposed at one time by clearing and grubbing exceed 750,000 square feet without approval of the Engineer.
- D. The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- E. Under no conditions shall the amount of surface area or erodible earth material exposed at one time by excavation or fill within the project area exceed 750,000 square feet without prior approval by the Engineer.
- F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow, and fill operations as determined by his analysis of project conditions.
- G. In case of conflict between these requirements and pollution control laws, rules or regulations, or other Federal, State, or Local agencies, the more restrictive laws, rules and regulations shall apply.

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Provide, operate, and maintain equipment, services, and personnel with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at site entrances, on-site access roads, and parking areas.
- B. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.02 RELATED REQUIREMENTS

- A. Section 01530: Barriers.

Section 01560: Temporary Controls.
- C. Manual of Uniform Traffic Control Devices, latest edition.

1.03 TRAFFIC SIGNALS AND SIGNS

- A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.
- B. Provide traffic control and directional signs, mounted on barricades or standard posts:
 - 1. At each change of direction of a roadway and at each crossroads.
 - 2. At detours.
 - 3. At parking areas.

1.04 FLAGGERS

- A. Provide qualified and suitably equipped flaggers when construction operations encroach on traffic lanes, as required for regulation of traffic.

1.05 FLARES AND LIGHTS

- A. Provide flares and lights during periods of low visibility.

1. To clearly delineate traffic lanes and to guide traffic.
2. For use by flaggers in directing traffic.

B. Provide illumination of critical traffic and parking areas.

1.06 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to preclude interference with public traffic or parking access by emergency vehicles, Owner's operations, or construction operations.

B. Monitor parking of construction personnel private vehicles:

1. Maintain free vehicular access to and through parking areas.
2. Prohibit parking on or adjacent to access roads, or in non-designated areas.

1.07 HAUL ROUTES

A. Consult with governing authorities, to establish public thoroughfares, which will be used as haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to expedite traffic flow and, to minimize interference with normal public traffic.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain project identification sign.
- B. Provide temporary on-site informational signs to identify key elements of construction facilities.
- C. Remove signs on completion of construction.
- D. Allow no other signs to be displayed.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01510: Temporary Utilities.
- C. Section 01570: Traffic Regulation.

1.03 PROJECT IDENTIFICATION SIGN

- A. One painted sign, of not less than 32 square feet area, with painted graphic content to include:
 - 1. Title of Project.
 - 2. Name of Owner.
 - 3. Names and titles of Owner's officials.
 - 4. Names and titles of:
 - a. Engineer.
 - b. Professional Consultants.
 - 5. Prime Contractor.
 - 6. Major Subcontractors.
 - 7. Funding Agency, if other than Owner.
- B. Graphic design, style of lettering, and colors: as designated by Engineer.
- C. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by Engineer.

1.04 INFORMATIONAL SIGNS

- A. Painted signs with painted lettering or standard products.
 - 1. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.
 - 2. Colors: as required by regulatory agencies, otherwise of uniform colors throughout Project.
- B. Erect at appropriate locations to provide required information.

1.05 QUALITY ASSURANCE

- A. Sign Painter: Professional Experience in type of work required.
- B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: May be new or used, wood or metal, in sound condition and structurally adequate to work and suitable for specified finish.
- B. Sign Surface: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.
- C. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.
- D. Rough Hardware: Galvanized.
- E. Paint: Exterior quality.
 - 1. Use Bulletin colors for graphics.
 - 2. Colors for structure, framing, sign surfaces, and graphics: As selected by Engineer.

PART 3 - EXECUTION

3.01 PROJECT IDENTIFICATION SIGN

- A. Paint exposed surfaces of supports, framing, and surface material; one coat of primer and one coat of exterior paint.
- B. Paint graphics in styles, sizes, and colors selected.

3.02 INFORMATIONAL SIGNS

- A. Paint exposed surfaces: one coat of primer and one coat of exterior paint.
- B. Paint graphics in styles, sizes, and colors selected.
- C. Install at a height for optimum visibility, on ground-mounted poles or attached to temporary structural surfaces.

3.03 MAINTENANCE

- A. Maintain signs and supports in a neat, clean condition; repair damage to structure, framing, or sign.
- B. Relocate information signs as required by progress of the work.

3.04 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of project.

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain temporary field offices during entire construction period.
- B. Furnish, install, and maintain storage and work sheds needed for construction.
- C. At completion of work, remove field offices, sheds, and contents.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01510: Temporary Utilities.

1.03 OTHER REQUIREMENTS

- A. Prior to installation of offices and sheds, consult with Engineer on location, access and related facilities.

1.04 REQUIREMENTS FOR FACILITIES

- A. Construction:
 - 1. Structurally sound, watertight, with floors raised above ground.
 - 2. Temperature transmission resistance: Compatible with occupancy and storage requirements.
 - 3. At Contractor's option, portable or mobile buildings may be used.
 - a. Mobile homes, when used, shall be modified for office use.
 - b. Do not use mobile homes for living quarters.
- B. Office for Engineer and Owner's Representative:
 - 1. A separate space for sole use of designated occupants, with secure entrance doors and one key per occupant.
 - 2. Area: 150 square feet minimum, with minimum dimension of 8 feet.
 - 3. Windows:
 - a. Minimum: Total area of 10% of floor area.
 - b. Operable sash and insect screens.
 - c. Locate to provide view of construction areas.

4. Furnishings:
 - a. Standard size desks with three lockable drawers, one per occupant.
 - b. One drafting table: 39" x 72" x 36" high, with one equipment drawer. Locate table at a window with a view of the site.
 - c. One plan rack to hold a minimum of six racks of project drawings.
 - d. One chair per occupant.
 - e. One drafting table stool.
 - f. One wastebasket per desk and table.
 - g. One tackboard, 36" x 30" (0.92m x 0.76m).
5. Services:
 - a. Lighting: 50 foot-candles at desk top height.
 - b. Exterior lighting at entrance door.
 - c. Automatic heating and mechanical cooling equipment to maintain comfort conditions.
 - d. Minimum of four 110 volt duplex electric convenience outlets, at least one on each wall.
 - e. Electric distribution panel: Two circuits minimum, 110 volt, 60 hertz service.
 - f. Convenient access to drinking water and toilet facilities.
 - g. Telephone: One direct line instrument.

C. Contractor's Office and Facilities:

1. Size: As required for general use, and to provide space for project meetings.
2. Lighting and temperature control: As specified for Engineer's office.
3. Telephone: One direct line instrument.
4. Furnishing in Meeting Area:
 - a. Table and chairs for at least eight persons.
 - b. Racks and files for Project Record Document in, or adjacent to, the meeting area.
5. Other furnishings: Contractor's option.
6. One 10 inch (250 mm) outdoor-type thermometer.

D. Storage Sheds:

1. To requirements of various trades.
2. Dimensions: Adequate for storage and handling of products.
3. Ventilation: Comply with specified and code requirements for products stored.
4. Heating: Adequate to maintain temperature specified in respective sections for the products stored.

1.05 USE OF EXISTING FACILITIES

- A. Existing spaces designated by the owner may be used for field offices.

- B. Provide specified furnishings, equipment, and services.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. May be new or used, but must be serviceable, adequate for required purpose, and must not violate applicable codes for regulations.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Fill and grade site for temporary structures to provide surface drainage.

3.02 INSTALLATION

- A. Construct temporary field offices and storage sheds on proper foundations, provide connections for utility service.
 - 1. Secure portable or mobile buildings when used.
 - 2. Provide steps and landings at entrance doors.
- B. Mount thermometer at convenient outside location, not in direct sunlight.

3.03 MAINTENANCE AND CLEANING

- A. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

3.04 REMOVAL

- A. Remove temporary field offices, contents, and services at a time when no longer needed.
- B. Remove storage sheds when no longer needed.
- C. Remove foundations and debris; grade site to required elevations and clean the areas.

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Material and equipment incorporated into the Work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type, and quality specified, or as specifically approved in writing by the Engineer.
 - 3. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
 - c. Two or more items of the same kind shall be identical, by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
 - 4. Do not use material or equipment for any purpose other than that for which it is designated or is specified.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01010: Summary of Work.
- C. Section 01340: Shop Drawings, Product Data, and Samples.
- D. Section 01710: Cleaning.

1.03 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, materials and equipment removed from the existing structure, if any, shall not be used in the completed Work.
- B. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation, to

assure proper function in the completed Work.

2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation. Pay all costs for such work.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Engineer.
 1. Maintain one set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition, and adjust products in strict accord with such instructions and in conformity with specified requirements.
 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
 2. Do not proceed with work without clear instructions.
- C. Perform work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.05 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of Products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.
 1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
 2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.
- B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.06 STORAGE AND PROTECTION

- A. Store Products in accord with manufacturer's instructions with seals and labels intact and legible.
 1. Store products subject to damage by the elements in weather -tight enclosures.
 2. Maintain temperature and humidity within the ranges required by

manufacturer's instructions.

- B. Exterior Storage:
 - 1. Store fabricated products above the ground or on blocking or skids to prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage and deterioration.
- D. Protection after installation:
 - 1. Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.07 SUBSTITUTIONS AND PRODUCT OPTIONS

- A. Products List:
 - 1. Within 30 days after Contract Date, submit to Engineer a complete list of major Products proposed to be used, with the name of the manufacturer and the installing Subcontractor.
- B. Contractor's Options:
 - 1. For Products specified only by reference standard, select any Product meeting that standard.
 - 2. For Products specified by naming several Products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.
 - 3. For Products specified by naming one or more Products or manufacturers or "or equal," Contractor must submit a request as for substitutions for any Product or manufacturer not specifically named.
 - 4. For Products specified by naming only one Product and manufacturer, there is no option.
- C. Substitutions:
 - 1. For a period of 30 days after Contract Date, Engineer will consider written requests from Contractor for substitution of Products.
 - 2. Submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:
 - a. Comparison of qualities of the proposed substitution with that specified.

- b. Changes required in other elements of the work because of the substitution.
 - c. Effect on the construction schedule.
 - d. Cost data comparing the proposed substitution with the Product specified.
 - e. Any required license fees or royalties.
 - f. Availability of maintenance service, and source of replacement materials.
 - 3. Engineer shall be the judge of the acceptability of the proposed substitution.
- D. Contractor's Representation:
 - 1. The request for a substitution constitutes a representation that Contractor:
 - a. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified.
 - b. Will provide the same warranties or bonds for the substitution as for the Product specified.
 - c. Will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work.
 - d. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
- E. Engineer will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract. Fiscal provisions, legal submittals, and additional administrative requirements.
- B. Section 01710: Cleaning.
- C. Section 01720: Projects Record Documents.
- D. The respective sections of specifications: Closeout Submittals Required of Trades.

1.03 SUBSTANTIAL COMPLETION

- A. When Contractor considers the Work substantially complete, he shall submit to Engineer:
 - 1. A written notice that the Work, or designated portion therefore, is substantially complete.
 - 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, Engineer will make an inspection to determine the status of completion.
- C. Should Engineer determine that the Work is not substantially complete:
 - 1. Engineer will promptly notify the Contractor in writing, giving the reasons therefore.
 - 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Engineer.
 - 3. Engineer will re-inspect the Work.
- D. When the Engineer finds that the Work is substantially complete, he will:
 - 1. Submit written, tentative notice to the Owner of Substantial Completion with a list of items to be completed before final payment should be issued.
 - 2. After consideration of any objections made by the Owner as provided in

Conditions of the Contract, and when Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a written certification of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.04 FINAL INSPECTION

- A. When Contractor considers the work complete, he shall submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Work has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 - 5. Work is completed and ready for final inspection.
- B. Engineer will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Engineer consider that the Work is incomplete or defective:
 - 1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 - 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
- 3. Engineer will re-inspect the Work.
- D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.

1.05 REINSPECTION FEES

- A. Should Engineer perform re-inspection due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 - 1. Owner will compensate Engineer for such additional service.
 - 2. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.06 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- A. Evidence of compliance with requirements of governing authorities.
- B. Project Record Documents: to requirement of Section 01720.
- C. Evidence of Payment and Release of Liens: To requirements of General and Supplementary Conditions.

- D. Certificate of Insurance for Products and Completed Operations, as applicable.

1.07 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to Engineer.
- B. Statement shall reflect all adjustments to the Contract Sum:
 - 1. The original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Previous Change Orders.
 - b. Allowances.
 - c. Unit Prices.
 - d. Deduction for uncorrected work.
 - e. Penalties and Bonuses.
 - f. Deductions for liquidated damages.
 - g. Deductions for reinspection payments.
 - h. Other adjustments.
 - 3. Total Contract Sum, as adjusted.
 - 4. Previous Payments.
 - 5. Sum remaining due.
- C. Engineer will prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.08 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 01710

CLEANING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01560: Temporary Controls.
- C. Each Specification Section: Cleaning for specific Products or work.

1.03 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface materials to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the Work, the site and adjacent properties and roads free from accumulations of waste materials, rubbish, and wind-blown debris, resulting from construction operations.

- B. Provide on-site containers for the collection of waste materials, debris, and rubbish.
- C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

- A. Clean surfaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.

3.03 FINAL CLEANING

- A. Employ skilled workman for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Broom clean exterior paved surfaces; rake and clean other surfaces of the grounds.
- D. Prior to final completion, or Owner occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire Work is clean.

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Maintain at the site for the Owner one record copy of:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Engineer Field Orders or written instructions.
 - 6. Approved Shop Drawings, Product Data, and Samples.
 - 7. Field Test records.
 - 8. Construction photographs.
 - 9. Pre-Construction Video

1.02 RELATED REQUIREMENTS

- A. Section 01340: Shop Drawings, Product Data, and Samples.
- B. Section 01375: Preconstruction Video Recordings.
- C. Section 01380: Construction Photographs.

1.03 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with CSI/CSC format.
- C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for inspection by Engineer.

1.04 MARKING DEVICES

- A. Provide pens for recording information in the color code designated by Engineer.

1.05 RECORDING

- A. Label each document "PRODUCT RECORD" in neat, large printed letters.
- B. Record information concurrently with construction progress.
 - 1. Do not conceal any work until required information is recorded.

1.06 SUBMITTAL

- A. At Contract closeout, deliver Record Documents to Engineer for the Owner.
- B. Accompany submittal with transmittal letter in duplicate, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. Title and number of each Record Document.
 - 5. Signature of Contractor or his authorized representative.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Removal and disposal of designated foundations, pavements, concrete, bridges, culverts, and other structures.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare adjacent areas to prevent injury, movement or settlement of structures which are to remain.
- B. Make accommodations for pedestrian and vehicular traffic where areas are to be closed.

3.02 DEMOLITION

- A. Remove foundations of buildings and structures to a depth of not less than one foot below natural ground, except in the construction area where a depth of not less than two feet below subgrade elevations is required.
- B. Break up basement floors to prevent water retention.
- C. Remove concrete pavement, parking strip, base, curbs, gutters, sidewalks, driveways, etc. and dispose of as follows:
 - 1. Dispose of items below subgrade elevations by no more than two feet.
 - 2. Break items more than two feet below subgrade elevations into sizes not to exceed two feet in maximum dimension and leave in place, unless it interferes with succeeding items of construction.
 - 3. Stockpile ballast, gravel, bituminous pavement or other pavement materials

when required.

- D. Fill basements or cavities left by structure removal within the prism of construction and below subgrade elevation to the level of the surrounding ground and compact in accordance with Section 02210.

3.03 DEBRIS REMOVAL

- A. Promptly remove demolition debris from site.
- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.

3.04 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Clearing, grubbing, removal, and disposal of vegetation, rocks, roots, and debris within the limits of the Work except objects designated on the drawings to remain.
- B. Preserve from injury or defacement all vegetation and objects to remain.

1.02 RELATED WORK

- A. Section 02050: Demolition.
- B. Section 02210: Grading and Excavation.

1.03 LIMITS OF WORK

- A. Rights-of-way area established by Engineer.
- B. Construction area including those areas outside the construction lines established by Engineer.
- C. Approved borrow pit areas.
- D. Designated stockpiles of construction material other than borrow material.

1.04 PROTECTION

- A. Protect living trees not marked for removal and outside the construction area. Treat cut or scarred surfaces of trees or shrubs with a paint prepared especially for tree surgery.
- B. Protect bench marks and existing structures, roads, sidewalks, paving, and curbs against damage from vehicular or foot traffic.
- C. Maintain designated temporary roadways, walkways, and detours for vehicular and pedestrian traffic.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Maintain bench marks, monuments, and other reference points. Re-establish if disturbed or destroyed at no cost to Owner.

3.02 CLEARING AND GRUBBING

- A. Clear rights-of-way, borrow pit and other stockpile areas of objectionable material to the ground surface except for trees and stumps.
- B. Cut trees and remove all stumps where embankments are to be constructed.
- C. Cut trees and remove all stumps outside the construction area marked for removal by the Engineer.
- D. Remove low-hanging, unsound or unsightly branches on trees or shrubs designated to remain.
- E. Trim branches of trees extending over the roadbed to a clear height of twenty feet above the roadbed surface.
- F. Grub construction area of all protruding obstructions.
- G. Grub borrow pit and stockpile areas of all objectionable material. Strip overburden over the material to be obtained in stockpile areas.
- H. Perform clearing and grubbing well in advance of construction or material removal activities.

3.03 BACKFILLING AND SURFACE PREPARATION

- A. Backfill and compact all depressions resulting from clearing and grubbing with suitable materials in accordance with Section 02210.
 - 1. Backfill embankment areas to natural ground elevation.
 - 2. Backfill excavation areas below finished subgrade to finished subgrade.
- B. Perform backfilling a satisfactory distance ahead of construction operations.
- C. Prepare areas designated on the drawings to receive erosion control matting to smooth surfaces that have been shaped, fertilized, and seeded.

3.04 DEBRIS REMOVAL AND DISPOSAL

- A. Promptly remove cleared debris from site.

- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.
- C. There shall be no open burning without specific approval of the Owner and local authorities. If burning is approved, a pit burner or similar device must be used.

3.05 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02210

GRADING AND EXCAVATING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Excavating and grading of:
 - 1. Roadways (including the removal of slides).
 - 2. Borrow pits.
 - 3. Waterways and ditches (including structure inlet and outlet ditches, channels, waterways, etc., although they extend beyond the highway limits).
 - 4. Intersections.
 - 5. Approaches.
 - 6. Benches under side-hill embankments.
- B. Excavating of unsuitable material from roadbed and beneath embankment areas.
- C. Excavating selected material found in the roadway which is required for specific use in the construction.
- D. Construction and removal of detours.

1.02 RELATED WORK

- A. Section 02050: Demolition.
- B. Section 02110: Clearing and Grubbing.

1.03 CLASSIFICATION OF EXCAVATION MATERIALS

- A. Road and Drainage Excavation (unclassified): all excavation regardless of the nature of the excavated material except borrow, channel, undercutting, and solid rock excavation provided for in the Bid Form.
- B. Borrow excavation: material required for construction and obtained from approved sources outside the rights-of-way limits or other designated areas. Flattening of approved cut slopes graded under previous contracts is permitted for use as borrow provided the material is satisfactory. Borrow material other than solid rock shall be AASHTO A-6 or no worse than the predominant soil type in the roadway excavation, based on AASHTO classification if A-6 is not reasonably available. Removal and placement of borrow is classified as:
 - 1. Borrow Excavation (solid rock): non-degradable rock which cannot be economically excavated by the proper use of a power shovel or explosives.
 - 2. Borrow Excavation (unclassified): all approved material including Borrow Excavation (solid rock).

- 3. Borrow Excavation (select material): designated material.
- C. Channel Excavation (unclassified): removal and disposal of all material excavated from existing or new channels with a bottom width of more than fourteen feet as shown on the drawings.
- D. Road and Drainage Excavation (unclassified): Channel excavation with a bottom width fourteen feet or less, as shown on the drawings.
- E. Solid Rock Excavation: An excavation classification only when it is provided for in the Bid Form and defined as follows:
 - 1. Excavation of rock which cannot be economically excavated without the use of explosives.
 - 2. Any rock, boulder, fragment of rock, or concrete having a volume of at least one-half (1/2) cubic yard or a fragment excavated from a formation having a volume greater than one-half (1/2) cubic yard.

1.04 REFERENCE STANDARDS

- A. Determine maximum density and optimum moisture in accordance with the "Standard Method of Test for Moisture Density Relationship of Soils Using a 5.5 Pound Rammer and a 12-inch Drop," AASHTO Designation T-99, Method A.
- B. Compact all designated materials to 95% of maximum density unless otherwise specified.
- C. Rock borings or soundings, if provided, are:
 - 1. For information purposes only.
 - 2. No guarantee of existing conditions.
 - 3. No substitute for investigations deemed necessary by Contractor.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to beginning excavation, grading, and embankment operations in any area, perform all necessary clearing, grubbing, and demolition in accordance with Section 02110 and 02050.

3.02 EMBANKMENT

- A. Construct embankments by placing and compacting approved embankment materials:
 - 1. In reasonably close conformity with the lines, grades, and typical cross-

- sections shown on the drawings or established by the Engineer.
- 2. Use Road and Drainage, Channel, and Borrow Excavation materials only.
- 3. Compact the embankment to 6" of the roadbed in both cut and fill sections, unless otherwise specified.
- 4. Place roadway embankment materials consisting predominantly of soil in horizontal layers not to exceed ten inches in depth and compact each layer.

B. Provide adequate surface drainage for embankments at all times.

3.03 EXCAVATION UNDER GRADE (UNDERCUTTING)

- A. Remove and dispose of unsatisfactory materials:
 - 1. Below grade in cut sections.
 - 2. Areas where embankments are to be placed.
 - 3. Below the foundation elevation of pipe and box culverts.
- B. Stripping, stockpiling and placing of topsoil, and step-benching for hillside embankments is not classified as undercutting.

3.04 CLEAN-UP AND DISPOSAL OF DEBRIS

- A. Dress for final inspection all excavated and graded areas to within reasonably close conformity to the lines, grades, and cross-sections shown on the drawings:
 - 1. Producing a uniform, satisfactory finish.
 - 2. Scale rock cuts of all loose fragments and leave in a neat, safe, and workmanlike condition.
 - 3. Clean the entire rights-of-way of all vegetation unless otherwise specified on the drawings.
 - 4. Clear and clean all structures of all objectionable materials and obstructions.
 - 5. Perform final dressing prior to sodding and seeding operations when these items are in the Contract.
- B. Dress spoil banks, waste areas, etc., in a manner approved by the Engineer.
- C. Dispose of excess material created by trimming slopes, re-sloping, and shaping outside the rights-of-way.
- D. Promptly remove cleared debris from site.
- E. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.

3.05 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.

- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02215

BASE AND SUBGRADE TREATMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Preparing and stabilizing subgrade to receive a base or pavement.
- B. Placing and compacting base material.
- C. Placing and compacting stabilized base.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavating.
- C. Section 02515: Portland Cement Concrete Paving.

1.03 REFERENCE STANDARDS

- A. Compact all subgrade materials to 100% of maximum density unless otherwise specified.
 - 1. Determine maximum density and optimum moisture in accordance with the "Standard Method of Test for Moisture Density Relationship of Soils Using a 5.5 Pound Rammer and a 12-inch Drop," AASHTO Designation T-99, Method A.
- B. Compact Type A Base materials to an average dry density of at least 100% of theoretical density based upon 83% of a solid volume, unless otherwise specified.
 - 1. No individual test shall be less than 97% of theoretical density.
 - 2. The theoretical density of limestone aggregates shall be based on bulk specific gravity AASHTO T-85.
 - 3. The theoretical density of all other aggregates shall be based on bulk specific gravity AASHTO T-84 and T-85.
- C. Compact Type B base materials to at least 95% of maximum density, unless otherwise specified.
 - 1. No individual test shall be less than 92% of maximum density.
 - 2. Determine maximum density and optimum moisture in accordance with the "Standard Method of Test for Moisture Density Relationship of Soils Using a 5.5 Pound Rammer and a 12-inch Drop," AASHTO Designation T-99, Method D.

PART 2 - PRODUCTS

2.01 MINERAL AGGREGATE MATERIALS--GENERAL

- A. Mineral aggregate: sound, tough, and durable fragments of crushed stone, crushed slag, crushed or uncrushed gravel or chert.
- B. Fine aggregate: natural sand, silt-clay, or other inert materials with similar characteristics conforming to AASHTO M-6, M-29, and M-45 requirements except as specified herein.
- C. Coarse aggregate: AASHTO M-43, except as specified herein, consisting of crushed stone, crushed slag, crushed or uncrushed gravel, crushed or uncrushed chert, or a combination thereof, or other inert materials with similar characteristics, having hard, strong, durable pieces free from adherent coatings.
- D. Coarse aggregates: graded to standard sizes between the limits specified and to the gradation requirements set forth in the following table:

SIZES OF COARSE AGGREGATE
AASHTO M-43

Size No.	Nominal Size Square Openings (1)	Amounts Finer Than Each Laboratory Sieve (Square Openings), Percentage by Weight														
		4	3½	3	2½	2	1½	1	¾	½	⅜	No. 4	No. 8	No. 16	No. 50	No. 100
1	3½ to 1½	100	90-100		25-60		0-15		0-5							
2	2½ to 1½			100	90-100	35-70	0-15		0-5							
24	2½ to ¾			100	90-100		25-60		0-10	0-5						
3	2 to 1				100	90-100	35-70	0-15		0-5						
357	2 to No. 4				100	95-100		35-70		10-30		0-5				
4	1½ to ¾					100	90-100	20-55	0-15		0-5					
467	1½ to No. 4					100	95-100		35-70		10-30	0-5				
5	1 to 1½						100	90-100	20-55	0-10	0-5					
56	1 to ⅜						100	90-100	40-75	15-35	0-15	0-5				
57	1 to No. 4						100	95-100		25-60		0-10	0-5			
6	¾ to ⅜							100	90-100	20-55	0-15	0-5				
67	¾ to No. 4							100	90-100		20-55	0-10	0-5			
68	¾ to No. 8							100	90-100		30-65	5-25	0-10	0-5		
7	½ to No. 4								100	90-100	40-70	0-15	0-5			
78	½ to No. 8								100	90-100	40-75	5-25	0-10	0-5		
8	⅜ to No. 8									100	85-100	10-30	0-10	0-5		
89	⅜ to No. 16									100	90-100	20-55	5-30	0-10	0-5	
9	No. 4 to No. 16										100	85-100	10-40	0-10	0-5	10-30
10	No. 4 to 0 (2)										100	85-100				

(1) In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.

(2) Where Size No. 10 (Screenings) is specified in asphalt pavement design the percent passing the No. 4 sieve shall be 90-100 and the percent passing the No. 200 sieve shall be from 5-16.

2.02 SUBGRADE STABILIZATION MATERIAL

- A. Thoroughly pulverize and mix all subgrade and aggregate material until not more than five percent of the material exclusive of gravel or stone is retained on a 2-inch sieve.
- B. Add sufficient water during the mixing and compacting operation to provide optimum moisture content, as determined by AASHTO t-99, plus or minus three percentage points.

2.03 MINERAL AGGREGATE BASE MATERIALS

- A. Base aggregates shall conform to the requirements of article 2.01 and shall be either Type A or Type B as shown on the plans.

- B. Base aggregate gradations:

Grading D

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2"	100
1"	85-100
3/4"	60-95
3/8"	50-80
No. 4	40-65
No. 16	20-40
No. 100	9-18

- C. Type A aggregate: crushed stone, crushed slag, crushed gravel, or crushed chert, and other fine grained mineral matter.

1. Crushed stone: free from adherent coatings, clay, or other soils with wear not exceeding 50% and sodium sulfate soundness loss not exceeding 15%.
2. Crushed slag: quality as for crushed stone having a uniform density.
3. Crushed gravel and chert: screened and all oversize material crushed and fed back over the screen in a uniform manner.
4. Coarse aggregate wear for those retained on the No. 4 sieve shall not exceed 30%.
5. Material passing the No. 40 sieve: non-plastic, or with a liquid limit not exceeding 25 and a plasticity index not exceeding 6.
6. Only grading D aggregate shall be used.

- D. Type B aggregate: crushed stone, crushed slag, crushed or uncrushed gravel, crushed or uncrushed chert, or a combination of these materials, and other fine grained material. The quality of Type B aggregate shall be the same as for Type A aggregate except as follows:

1. Gravel or chert: screened and the oversize material wasted or crushed and blended in a uniform manner with the remainder of the material.
2. Gravel or chert: no more than 12% clay.
3. Coarse aggregate wear for those retained on the No. 4 sieve shall not exceed 40%.
4. Additional binder or mineral aggregate may be incorporated into the material to meet gradation, density, or bonding requirements.
5. Grading D shall be used.

- E. Furnish test reports on quality of all aggregates for approval by the Engineer prior to blending or mixing. If requested by the Engineer, furnish samples for testing by an independent laboratory. Test methods for aggregate base quality shall be by the

following AASHTO methods:

<u>Test</u>	<u>Method</u>
Sampling	T-2
Percentage of Wear	T-96
Soundness	T-104
Unit weight	T-19
Sieve analysis	T-27

2.04 CEMENT STABILIZED BASE MATERIALS

- A. The Engineer will determine the proportions of materials to be used that will produce a workable lean concrete.
 - 1. Maximum design slump of 1-1/2 inches, AASHTO T-119.
 - 2. Minimum compressive strength of 500 psi in seven (7) days.
 - 3. Cement content of 200 pounds per cubic yard of concrete.
 - 4. Maximum entrained air of 5 percent.
 - 5. Water reducer quantity as recommended by the manufacturer.
 - 6. Other applicable requirements as stipulated in Section 02515.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clear construction areas as stipulated in Section 02110.
- B. Maintain bench marks, monuments, and other reference points.

3.02 SUBGRADE PREPARATION

- A. Prepare subgrade in reasonably close conformity with the lines and grades as shown on the drawings or as designated by Engineer.
- B. Haul, spread, and compact suitable material in sufficient quantity when the roadbed is below grade.
- C. Prepare subgrade across the entire sub-base section when sub-bases are to be constructed on the subgrade.
- D. Construct subgrade 12" wider on each side of the base or pavement when forms are required for the base or pavement.
- E. Clear subgrades, as stipulated in Section 02110, required reworking to the limits described above.

- F. Grade subgrade in such a manner as to provide ready drainage of water from subgrade. Maintain ditches and drains during construction.

3.03 SUBGRADE COMPACTION

- A. Compact the finished subgrade to not less than 100 percent of the maximum density.
- B. When the density requirement is not met, loosen the subgrade by discing, harrowing, or other approved methods to a depth of not less than six inches, then reshape and re-compact.
- C. Moisten and aerate the subgrade material as necessary during mixing and compacting to provide optimum moisture content.
- D. Rework or remove, replace, and re-compact all soft, yielding material which will not compact readily.
- E. Protect subgrade from damage and limit hauling over the finished subgrade to, that which is essential for construction, purposes.
- F. Smooth and re-compact all ruts or rough places that develop in a completed subgrade.
- G. Check the lines, cross sections, and grades of the subgrade as completed for reasonably close conformity with those shown on the drawings for the bottom of the sub-base, or pavement, or with those established by Engineer.

3.04 SUBGRADE STABILIZATION

- A. Add and incorporate granular stabilizing material, with or without additives as required, into existing subgrade.
- B. Replace unsuitable subgrade material with stabilizing material in reasonably close conformity to the widths and depths shown on the drawings or as directed by the Engineer.
- C. Spread the quantity of aggregate for subgrade treatment, as designated on the drawings or as directed, by means of a mechanical spreader and thoroughly mix with the subgrade material by means of a mechanical mixer. Spreading and mixing may be performed by other approved methods on short sections to be established, when permitted by the Engineer.
- D. Spread material uniformly by motor grader to the required cross section and compact. Accompany compaction operations with sufficient blading by motor graders to assure a smooth, uniform surface.
- E. Maintain the complete subgrade until covered by the following stage of construction or

until the project has been completed and accepted.

3.05 PLACING AGGREGATE BASE

- A. Place one or more courses of aggregates, and additives if required, on a prepared subgrade in reasonably close conformity with the lines, grades, thickness', and typical cross sections shown on the drawings or established by the Engineer.
- B. Construct mineral aggregate base in one or more layers with a compacted thickness as shown on the drawings.
- C. The subgrade shall be checked and approved by the Engineer at least 500 feet in advance of spreading any mineral aggregate. This distance may be shortened by permission of the Engineer to as little as 200 feet between November first and April first or during periods of prolonged wet weather.
- D. Mineral aggregate bases shall not be spread on a subgrade that is frozen or contains frost.
- E. Hauling over material already placed will not be permitted until it has been spread, mixed, shaped, and compacted to the required density.

3.06 MIXING AND SPREADING AGGREGATE BASE

Unless otherwise specified, mix and spread base course materials, including additives if required on the drawings. Furnish sieve analyses of mix gradations for all materials for approval by Engineer prior to beginning work. Methods of sampling and testing shall be in accordance with current AASHTO requirements.

- A. Stationary Plant Method--For Type A or B base materials.
 - 1. Mix and add water in an approved stationary mixing plant capable of producing a well-graded mix.
 - 2. Add water and calcium or sodium chloride, if specified, during the mixing operation in the amount necessary to provide a moisture content satisfactory for compacting.
 - 3. If combining of materials is required to meet the grading requirements, blend prior to mixing by uniformly adding the material. Blending of materials in stockpiles will not be permitted.
 - 4. All material fed into the plant shall travel the full length of the pugmill.
 - 5. After mixing, transport the material for each layer of base to the job site while it contains the proper moisture content, and spread to the required thickness and cross section by means of an approved mechanical spreader.
 - 6. Test samples may be taken from the conveyor feeding the mixer or from the mixer output.
- B. Road Mix Method (Mechanical Mixer)--For Type B base materials.

1. Place the material for each layer of base course through an aggregate spreader or window-sizing device capable of being adjusted to spread the materials in the proper proportions.
 2. After placing, mix the material with an approved mechanical mixing machine of rotary or pugmill type capable of producing a uniform blend.
 3. During mixing, add water in the amount sufficient to provide a moisture content satisfactory for compacting.
 4. If two or more materials are to be blended on the road, spread each material separately in the necessary proportions prior to blending and mixing, unless moisture control additives are specified.
 5. If two or more materials are blended, test samples shall be taken after mixing and before compaction. If blending is not required, test samples may be taken from plant production or stockpiles.
- C. Road Mix Method (Motor Grader)--For Type B base materials.
1. After depositing and uniformly spreading the material for each layer of base course, sprinkle it with water in sufficient quantity to moisten all particles, but not in such quantity that segregation of sizes or softening of the subgrade will occur.
 2. Immediately following the application of water, thoroughly mix the material by windrowing and spreading with motor graders until the mixture is uniform throughout, unless moisture control additives are specified or if two or more materials are to be blended.
 3. Spread the base material while at optimum moisture content in layers of specific thickness and cross-section by means of approved motor graders.
 4. If the required compacted depth of the base course exceed 6", construct the base in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 6" except when vibrating or other approved types of special compacting equipment are used. The compacted depth of a single layer of the base course may be increased to 8" upon approval of Engineer.
 5. Immediately following spreading, shape the base material to the required degree of uniformity and smoothness.
 6. Compact to the required density prior to any appreciable evaporation of surface moisture. Continuously compact each layer until the minimum density requirement is achieved.
 7. Test samples may be taken from stockpiles or plant production.

3.07 COMPACTING AGGREGATE BASES

- A. For compaction testing purposes, each completed layer will be divided into lots of approximately 10,000 square yards. Smaller lots may be considered when approved by the Engineer.
- B. Five density tests will be performed on each lot and the results averaged.

3.08 PLACING CEMENT STABILIZED BASE

- A. Construct a base of lean concrete on a prepared subgrade or subbase in reasonably close conformity with the lines, grades, thickness, and typical cross-section shown on the drawings or as directed by the Engineer. Unless otherwise specified, construction shall be performed in accordance with the applicable requirements of Section 02515.
- B. Offset longitudinal joints 1' from the portland cement concrete pavement joint with the 1' offset located on the median half of the lean concrete base.
- C. Form a butt type joint, as directed by the Engineer, at the end of each days operation or when there is an interruption of paving operations.
- D. Consolidate by the use of vibratory equipment.
- E. Finish the surface to a uniformly closed texture. After strike-off and consolidation, no additional finishing will be required except that needed to maintain grade alignment and provide the close texture.
- F. Insure that the lean concrete base grade alignment is such that portland cement concrete pavement thickness is not deficient.
- G. Reconstruct or replace, at no expense to Owner, bases with back thickness' not within 1/2" of those shown on the drawings.
- H. Do not place Portland cement concrete pavement upon the base until the mixture has cured for seven (7) days.

3.09 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02221

TRENCHING, BACKFILLING, AND COMPACTION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Excavation for piped utility material.
- B. Provide necessary sheeting, shoring, and bracing.
- C. Prepare trench bottom with appropriate materials.
- D. Dewater excavation as required.
- E. Place and compact granular beds, as required, and backfill.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.
- C. Section 02513: Asphaltic Concrete Paving.
- D. Section 03001: Concrete Work.

1.03 PRECAUTIONS

- A. Notify utility companies (Tennessee 1-Call: 1-800-351-1111) when necessary to disturb existing facilities and abide by their requirements for repairing and replacing.
- B. Protect all vegetation and other features to remain.
- C. Protect all bench marks and survey points.

PART 2 - PRODUCTS

2.01 BEDDING AND BACKFILL MATERIALS--SANITARY SEWERS

- A. Class I Material: Angular, 1/4 to 1 inch graded stone including a number of fill materials that have regional significance such as crushed stone, cinders, slag, and crushed shells.

- B. Class II Material: Coarse sands and gravel with a maximum particle dimension of 1-1/2 inches, including variously graded sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
- C. Class III Material: Fine sand and clayey gravel, including fine sands, sand-clay mixtures, and gravel-clay mixtures.
- D. Class IV Material: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
- E. Class V Material: Organic soils, as well as soil containing frozen earth, debris, rocks larger than 1-1/2 inches, and other foreign material.

2.02 BEDDING AND BACKFILL MATERIALS--STORM SEWERS

- A. Class A Material: Continuous concrete cradle constructed in conformity with details shown on drawings, consisting of Class "B" concrete as specified in Section 03001.
- B. Class B Material: Sand or a natural sandy soil, all passing a 3/8" sieve with not more than 10% passing a No. 200 sieve; or stone, gravel, chert, or slag of Graduation C or D of TDOT specifications.
- C. Class C Material: Natural ground or compacted embankment at a depth of at least 10% of the outside vertical pipe diameter.
- D. In rock cuts or other areas where free drainage bedding or backfill materials are required, use crushed stone, slag, or washed gravel of size 6, 7, 8, 57, or 78 of TDOT specifications.
- E. For crushed stone pavement and shoulder replacement, use crushed stone meeting Type "A", Grading D, of TDOT specifications.

2.03 BACKFILL MATERIALS – STREET CROSSINGS

- A. Unless otherwise specified, flowable fill material shall be used in all excavations crossing public streets.
- B. Pipe bedding and initial backfill (+/- 1 ft. above bedding) shall be placed as specified herein to prevent flotation of the pipe by the flowable fill.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install barriers and other devices to protect areas adjacent to construction.

- B. Protect and maintain all benchmarks and other survey points.

3.02 EXCAVATION TRENCHES

- A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.
- B. Maximum width at the crown of the pipe--2 feet plus the nominal diameter of the pipe.
- C. Cut pavement along neat, straight lines with either a pavement breaker or pavement saw.
- D. Trench depth: for waterlines--sufficient to provide minimum cover of 30 inches over the top of the pipe; for sewer lines--as shown on the Plans or as specified.
- E. Align trench as shown on the Plans unless a change is necessary to miss an unforeseen obstruction.
- F. For water pipe, shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
- G. For sewer pipe, fill the bottom of the trench with granular material as specified herein.
- H. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with coarse aggregate AASHTO M-43, Size No. 2 or 3. This will be a pay item under crushed stone for undercutting material.
- I. Remove rock encountered in trench excavation to a depth of 6 inches below the bottom of the pipe barrel, backfill with an approved material, and compact to uniformly support the pipe. In no case shall solid rock exist within six (6) inches of the finished pipeline.
- J. When rock borings or soundings are provided, they are for information only and do not guarantee existing conditions. Make such investigations as deemed necessary to determine existing conditions.

3.03 SHEETING, SHORING, AND BRACING

- A. When necessary or when directed by the Engineer, furnish, put in place, and maintain such sheeting, bracing, etc., as may be required to support the sides of the excavation and to prevent movement.
- B. Take care to prevent voids outside the sheeting.
- C. If voids are formed, immediately fill and ram to the satisfaction of the Engineer.
- D. Devise plans for performing this work subject to the approval of the Engineer.

- E. Unless adjacent facilities will be injured, remove all sheeting, shoring, and bracing after backfill has been placed to a depth of 18 inches over the pipeline.
- F. Cut shoring off at the top of the pipe and leave the lower section in the trench.

3.04 USE OF EXPLOSIVES

- A. Conduct all blasting operations in accordance with prevailing municipal, state or other agency regulations, codes, ordinances, or laws.
- B. Exercise due caution when blasting adjacent to existing structures and pipelines.
- C. If structures or pipelines are damaged, promptly replace or repair them at no expense to Owner.
- D. Do not conduct blasting operations within 25 feet of water, sewer, gas or other utility lines, unless otherwise directed by the Engineer.
- E. Cover all shots with blasting mats to prevent flying material.

3.05 DISPOSAL OF EXCAVATED MATERIAL

- A. Satisfactorily dispose of all excess excavated material that cannot be used for or is not suitable for embankments.

3.06 UNAUTHORIZED EXCAVATION

- A. Unauthorized Excavation will be defined as an excavation outside or below the proposed lines and grades shown on the Plans or directed by the Engineer.
- B. Backfill areas of Unauthorized Excavation with the type material necessary (earth, rock, or concrete) to insure the stability of the structure of construction involved.
- C. Unauthorized Excavation or backfill to replace same shall not be a pay item.

3.07 REMOVAL OF WATER

- A. Keep excavated areas free of water while work is in progress.
- B. Well-pointing shall be performed if required.
- C. Take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water.

3.08 OBSTRUCTIONS

- A. Obstructions shown on the Plans are for information only and do not guarantee their exact locations nor that other obstructions are not present.
- B. When utilities or obstructions are not shown on the plans but are present off the roadway at the location of the proposed pipeline route, the Contractor may request to relocate the pipeline in the roadway if necessary to avoid disturbing the utility or obstructions.
 - 1. If the relocation is approved, the Contractor shall receive compensation for additional granular backfill and pavement replacement as measured and paid for under Crushed Stone for Shoulder Repair and Pavement Maintenance.
 - 2. If the relocation is not approved, the Contractor and Engineer shall work together to resolve the conflict with the obstruction.
- C. Exercise due care in excavating adjacent to existing obstructions and do not disturb same unless absolutely necessary.
- D. In the event obstructions are disturbed, repair or replace as quickly as possible to the condition existing prior to their disturbance. This repair or replacement will not be a pay item.
- E. If desired by the utility company, pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.
- F. If replacement or repair of disturbed obstructions is not performed after a reasonable period of time, the Owner may have the necessary work done and deduct the cost of same from payments to the Contractor.

3.09 STORM SEWER BEDDING

- A. Use Class A, B, or C bedding, whichever is shown on the Plans. If not shown, use Class C bedding.
- B. Construct Class B bedding in a trench cut in natural ground or compacted embankment.
 - 1. Bed pipe on 6" of Class B material and sufficient additional Class B material accurately shaped by a template to fit the lower part of the pipe exterior.
 - 2. Ram and tamp in layers not over 6", in loose thickness, around the pipe to a minimum depth of that shown on the Plans.
 - 3. When bell and spigot pipe is to be placed, dig recesses in the bedding material of sufficient width and depth to accommodate the bell.
- C. Construct Class C bedding in a shallow trench.
 - 1. Shape the bedding to fit the lower pipe exterior for the specified bedding.
 - 2. When bell and spigot pipe is to be placed, dig recesses of sufficient width and depth to accommodate the bell.

3.10 SANITARY SEWER BEDDING

- A. Always maintain proper grade and alignment during the bedding and tamping process.
 - 1. Any pipe dislodged during this process shall be replaced by the Contractor at his expense.
 - 2. Dig bell holes to assure uniform support of the pipe.
- B. Bedding for PVC and RCP sewers.
 - 1. Completely encapsulate each sewer pipe section with 6" of granular material on the top, both sides, and the bottom of the pipe.
 - 2. For PVC sewer pipe, use Class I angular material.
 - 3. Bedding for RCP sewer pipe may be rounded material where crushed material is not readily available.
- C. Bedding for ductile iron pipe sewers.
 - 1. Lay each sewer pipe section on a 6" bed of granular material and backfill to the springline of the pipe with granular material.
 - 2. In unimproved areas, use Class I or II granular material.
 - 3. In improved areas, use Class I angular material.

3.11 BEDDING FOR WATERLINES

- A. Bed in a trench cut in natural ground. Excavations through solid rock will require 6" bed of granular material to the springline of the pipe.
- B. Dig bell holes to assure uniform support throughout the entire length of pipe.
- C. Excavate the trench in such a manner as to form a suitable bed on which to place the pipe.

3.12 INITIAL BACKFILLING

- A. Do not begin backfilling before the Engineer has inspected the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipe. If backfill material is placed over the pipe before an inspection is made, reopen the trench in order for an inspection to be made.
- B. Perform backfilling by hand, together with tamping, until fill has progressed to 18" above the top of the pipe.
 - 1. Deposit Class I granular material (where required) or loose soil free from lumps, clods, frozen material, or stones in layers approximately 6" thick.
 - 2. Compact by hand, or with manually operated machine tampers actuated by compressed air or other suitable means.
 - 3. Use tamps and machines of a suitable type which do not crush or otherwise damage the pipe.

3.13 FINAL BACKFILLING

- A. After the backfill has reached a point 18" or more above the top of the pipe, perform final backfilling depending upon the location of the work and danger from subsequent settlement.
- B. Backfilling in unimproved areas.
 - 1. Dispose of and replace all soft or yielding material which is unsuitable for trench backfilling with suitable material.
 - 2. Deposit backfill to the surface of the ground by dragline, bulldozer, or other suitable equipment in such a manner so as not to disturb the pipe.
 - 3. Neatly round sufficient surplus excavated material over the trench to compensate for after settlement.
 - 4. Dispose of all surplus excavated material.
 - 5. Prior to final acceptance, remove all mounds to the elevation of the surrounding terrain.
- C. Backfilling beneath driveways and streets where non-rigid and rigid type surfacing is to be replaced.
 - 1. Use Class I granular material of either crushed limestone or crushed gravel of high weight and density.
 - 2. Carefully deposit in uniform layers, not to exceed 6" thick.
 - 3. Compact each layer thoroughly by rolling, ramming, and tamping with tools suitable for that purpose in such a manner so as to not disturb the pipe.
 - 4. Unless otherwise specified, flowable fill material shall be used in all excavations crossing public streets.
- D. Backfilling of shoulders along streets and highways.
 - 1. Backfilling methods and materials for shoulders along streets and highways shall be in accordance with the requirements of governing local, county, or state departments maintaining the particular roadway or highway.
 - 2. Replace with similar materials, all shoulders which may be damaged or destroyed as a result of pipe trenching.
 - 3. Backfilling of shoulders shall not be directly measured for payment unless traffic dislodges the shoulder material rather than settling it, then any additional crushed stone placed shall be paid for as crushed stone for shoulder replacement.
 - 4. Where shoulders along state highways have seal coat surfaces, replace with double bituminous seal in accordance with Section 02573, part 2, paragraph 2.14.
 - 5. Where the State Highway Department or local authority requires trenches to be backfilled entirely with granular material in the shoulder of roads, granular material so placed shall not be a pay item, but included in the prices per linear foot of pipe.
- E. Crushed stone for pavement maintenance and shoulder replacement.

1. Where possible, salvage and reuse all base material that is removed during construction.
2. Wet and thoroughly compact crushed stone and blade to tie into the existing surface prior to final acceptance.
3. Base material placed as a portion of pavement replacing items will not be directly measured for payment unless traffic whips out the base material rather than settling it, then any additional base material placed shall be paid for as crushed stone for pavement maintenance.

3.14 MEASUREMENT AND PAYMENT - TRENCHING, BEDDING, BACKFILLING, UNDERCUT BEDDING, AND CRUSHED STONE FOR PAVEMENT MAINTENANCE AND SHOULDER REPLACEMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items
- C. Payment for work outside the limits of construction indicated in the plans or specified shall not be made unless approved in advance by the Engineer.

SECTION 02271 RIP-RAP

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Preparation of foundation.
- B. Placing of rubble stone or sacked sand-cement rip-rap.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavating.
- C. Section 03001: Concrete Work.

PART 2 - PRODUCTS

2.01 GROUT

- A. Mix one part Portland cement, four parts sand, and sufficient water to make grout flow into and fill voids.
- B. Fine Aggregate Sand.
 - 1. AASHTO M-45: hard, strong, durable uncoated mineral or rock particles free of injurious amounts of organic or other deleterious substances.
 - 2. Sand for grout: uniformly graded from coarse to fine within the following limits:

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
8	100
50	15-40
100	0-10
200	0-5

- 3. Test aggregate, when required, by methods of AASHTO:

Sampling	T-2
Clay lumps	T-112
Coal and lignite	T-113
Material passing 200 sieve	T-11

Organic impurities	T-21
Mortar-making properties	T-71
Sieve analysis	T-27
Soundness (sulfates)	T-104
Soundness (freezing and thawing)	T-103
Light weight particles	T-149

C. Portland cement.

1. AASHTO M-85 or ASTM C-150.
2. Sample and test Portland cement, when required, by the methods of AASHTO:

Soundness	T-107
Sampling	T-127
Chemical analysis	T-105
Fineness:	
Turbidimeter	T-98
Air permeability	T-153
Time of setting:	
Gillmore needles	T-154
Vicat needles	T-131
Air content of mortar	T-137
Normal consistency	T-129
Tensile strength	T-132
Compressive strength	T-106
False set	T-186
Light weight particles	T-149

2.02 RUBBLE STONE RIP-RAP

- A. Masonry stone that is sound, dense, and free from structural defects.
- B. Approximately rectangular in shape ranging in sizes of 6 to 8 inches in width, 10 to 12 inches in length, and 10 to 12 inches in depth.

2.03 MACHINED RIP-RAP

- A. Limestone rip-rap processed and machined in accordance with the TDOT Standard Specifications for Road and Bridge Construction, latest edition.

2.04 SACKED SAND-CEMENT

- A. One bag (94 pounds) of Portland cement and five cubic feet of sand.
- B. Sacks shall be made of either cotton or jute, standard grade, and of approximately one cubic foot capacity.

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Immediately prior to the construction of rip-rap, trim the slopes or ground surfaces within reasonably close conformity to the lines and grades indicated on the Plans or as directed by the Engineer, and thoroughly compact by the use of hand or mechanical tamps in accordance with Section 02210.
- B. On slopes, place the bottom of the rip-rap at least 2 feet below the natural ground surface, unless otherwise directed.

3.02 RUBBLE STONE AND MACHINED RIP-RAP

- A. Hand place rubble stone rip-rap (plain) upon the prepared foundation so that the stones shall be as close together as is practicable to reduce voids.
- B. For grouted rip-rap, place the stone in such a manner as to stagger all joints as far as it is possible, then fill voids with grout.

3.03 CONCRETE BLOCK RIP-RAP

- A. Place each block against the adjoining blocks with sides and ends in contact.
- B. Place the blocks in a manner that the joints will be staggered.

3.04 SACKED SAND-CEMENT RIP-RAP

- A. Fill sacks, approximately 3/4 full with a mixture of sand and cement.
- B. Place sacks as close together as possible to reduce voids.

3.05 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items
- C. Payment for work outside the limits of construction indicated in the plans or specified shall not be made unless approved in advance by the Engineer.

SECTION 02305

BORING AND JACKING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Placing casing and carrier pipe by boring and jacking under highways and railroads or where otherwise specified.

1.02 RELATED WORK

- A. Appropriate specifications of subject utility.

1.03 REGULATIONS AND PERMITS

- A. Permits for crossing highways or railroads will be obtained by the Owner.
- B. For highway crossings, satisfy the highway department to the extent of the Owner's posted surety bonds.
- C. For railroad crossings, furnish certificates of insurance in amounts established by the railroad company, naming the railroad as the insured.

PART 2 - PRODUCTS

2.01 STEEL CASING PIPE

- A. Minimum yield strength of 35,000 psi.
- B. Minimum thickness:

<u>Nominal Diameter (inches)</u>	<u>Minimum Thickness (inches)</u>
Under 14	0.188
14-16	0.219
18	0.250
20	0.281
22	0.312
24	0.344
26	0.375
28-30	0.406
32	0.438
34-36	0.469
38-42	0.500

Where casing pipes are to be installed under railroads, provide with a protective bituminous coating, cathodic protection; or an increased wall thickness one standard size greater than that shown above.

- D. Steel casing pipe shall be of continuous weld construction, installed with welded joints.

2.02 CARRIER PIPE

- A. Carrier pipe installed in the casing pipe shall be as required by the specifications of the subject utility.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform all crossings according to the requirements of the governing highway department or Railroad Company.
- B. Notify the appropriate authorities involved and request their supervisory services during construction.
- C. Provide necessary safeguards to protect the crossing.
- D. Where bored highway installations are not shown on the plans, open cut the crossing and provide a casing pipe only if required by the governing highway department.

3.02 INSTALLATION

- A. Perform all crossings in the manner shown on the drawings, except as otherwise directed by the highway department or railroad company.
- B. Dry bore an opening under the crossing.
- C. Jack the casing pipe, of the type and size specified, into the bored opening.
- D. Install the appropriate carrier pipe into the casing pipe according to the appropriate specifications.

3.03 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise

specified shall not be made unless approved in advance by the Engineer.

SECTION 02444

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Fence fabric and parts.
- B. Excavation for post bases.
- C. Concrete anchorage.
- D. Gates and hardware.

1.02 RELATED WORK

- A. Section 02210: Grading and Excavation.
- B. Section 03001: Concrete Work.

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCING

- A. AASHTO M-181, unless otherwise specified or directed by the Engineer.

2.02 POSTS

- A. Line Posts: 2" galvanized steel pipe meeting ASTM A-120 and weighing 3.65 pounds per foot or 2" aluminum alloy pipe meeting ASTM B-241, Alloy 6063, T.
- B. Top Rail: 1 1/4" galvanized steel pipe weighing 2.27 pounds per foot meeting ASTM A-120 or 1 1/4" aluminum alloy pipe (ASA Schedule 40) meeting ASTM B-241, Alloy 6063, Temper T6.
- C. End and Corner Posts: 2 1/2" galvanized steel pipe meeting ASTM A-120 and weighing 5.79 pounds per foot or 2 1/2" aluminum alloy pipe (ASA Schedule 40) meeting ASTM B-241, Alloy 6063, Temper T6.
- D. Braces: meet the requirements for top rails as shown above.

2.03 GATES

- A. Fabric for Gates: same as for adjacent fence and meeting the requirements of article 2.01.
- B. Posts: galvanized steel pipe meeting ASTM A-120 or aluminum alloy pipe meeting ASTM B-240 (ASA Schedule 40), Alloy GSA 10A, T6. Size and length to be as specified or shown on the plans.
- C. Framing for Gates: meeting the requirements for gate posts. Size and dimensions to be as shown on the plans or specified.

2.04 HARDWARE AND FITTINGS

- A. Galvanized steel or aluminum alloy meeting ASSHTO M-181.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install line posts, corner posts, top rails, fabric and gates to provide a rigid structure for fence of height as shown on the drawings.
- B. Use manufacturer's standard fittings, fasteners, and hardware.
- C. Maximum Post Spacing: CLFMI standard.
- D. Install line, corner, and terminal posts plumb and set in Class "B" concrete as specified in Section 03001.
- E. Base of post set approximately 6" from concrete footing bottom.
- F. Position fabric bottom 2" above finished grade with tension wire stretched taut between posts, unless otherwise specified.
- G. Pass top rail through line post to form continuous bracing.
- H. Install center and bottom brace rail on corner and gate leaves.
- I. Fasten fabric to top rail, line posts, braces, and bottom tension wire with wire ties on 15" centers, maximum.
- J. Attach fabric to end, corner, and gate posts with tension bars and clips.
- K. Stretch fabric between terminal posts or at 100 foot intervals, whichever is least.
- L. Install gates using fabric to match fence with 3 hinges per leaf, latch, and catches.

3.02 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02451

GUARDRAILS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Constructing guardrail assembly including anchor blocks, approach ends, and appurtenant work to make connections to existing structures as required.

PART 2 - PRODUCTS

2.01 MEET ALL REQUIREMENTS OF AASHTO M-180

2.02 METAL BEAM RAILS

- A. Corrugated sheet steel made of open hearth or electric furnace steel shaped into a "W" shaped beam with a projected width of not less than 12" and a depth of not less than 3".
- B. Class "A" guardrail: not less than 10 gauge; Class "B" guardrail not less than 12 gauge.
- C. Blanked to proper shape, fabricated, and ready for assembly when delivered. No punching, drilling, cutting, or welding will be permitted in the field.
- D. Straight, uniform sections rolled or rounded to eliminate sharp edges. Reject warped or deformed plates.
- E. Holes in the beam at posts shall be slotted to facilitate erection and permit expansion and contraction.
- F. All steel guardrail members shall be marked by the manufacturer or fabricator indicating brand name, gauge, weight, coating wt. per square ft., and manufacturer's heat number.
- G. Requirements for Beam Strength:

		Traffic Face Up		Traffic Face Down	
		Maximum		Maximum	
<u>Class</u>	<u>Gauge of Sheet</u>	<u>Load (lb.)</u>	<u>Deflection (Inches)</u>	<u>Load (lb.)</u>	<u>Deflection (Inches)</u>
A	10	2000	2.0	1600	2.0
A	10	3000	3.0	2400	3.0
B	12	1500	2.0	1200	2.0

B 12 2000 3.0 1600 3.0

2.03 TERMINAL OR END SECTIONS

- A. Formed from open hearth or electric furnace steel with a thickness not less than 12 gauge material.

2.04 POSTS

- A. Copper bearing steel "H" sections conforming to ASTM A-36 and galvanized in accordance with ASTM A-123.

2.05 GUARDRAIL HARDWARE

- A. Splice bolts, anchor bolts, and nuts shall conform to the requirements of ASTM A-307 and shall be galvanized in accordance with ASTM A-153.
- B. End caps, splice joints, anchor assemblies and all other items to complete the railing shall meet the requirements of ASTM A-36 and shall be galvanized in accordance with AASHTO M-111 or ASTM A-153.

2.06 GUARDRAIL DIMENSIONS

- A. In accordance with Tennessee Department of Transportation standard drawings.

PART 3 - EXECUTION

3.01 POSTS

- A. Set all posts reasonably true to the lines and grades shown on the plans or established by the Engineer.
- B. Dig or drill holes to the depth indicated on the plans; or drive posts by approved methods and equipment, provided the posts are in the proper position and free of distortion and burring or any other damage.
 - 1. Size all post holes that are dug or drilled to permit proper setting of the posts, and allow sufficient room for backfilling and tamping.
 - 2. Backfill and tamp holes with selected earth or other suitable materials in layers not to exceed 4 inches in thickness. When backfilling and tamping is completed, the posts or anchors shall be held securely in place.
 - 3. Backfill post holes that are drilled in rock and holes for anchor posts or devices shall be backfilled with concrete.

3.02 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02452

HIGHWAY SIGNS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Construction of foundations and supports.
- B. Fabricating, assembling, and erecting ground-mounted highway signs.

PART 2 - PRODUCTS

2.01 ALUMINUM SIGNS

- A. Flat sheets and plates.
 - 1. Alloy 6061-T6 or 5052-H38 meeting the requirements of ASTM B-209.
 - 2. Size and sheet thickness to be as shown on the drawings.
- B. Mounting hardware and fittings: Applicable ASTM standards.

2.02 STEEL SIGNS

- A. Flat sheet and plates: ASTM A-36 and ASTM A-123.
- B. Mounting hardware: ASTM A-307 and ASTM A-153.

2.03 REFLECTIVE SHEETING

- A. AASHTO M-268. Color and reflective material shall conform to the current manual of "Uniform Traffic Control Devices."

2.04 FABRICATION

- A. AASHTO M-268 Type I (Engineering Grade) or Type III (Hi-intensity Encapsulated Glass Bead) as shown on drawings or bid schedule.
- B. All signs shall conform to the current edition of the "Manual on Uniform Traffic Control Devices" (MUTCD) and all other documents as cited by the MUTCD.

2.05 SIGN SUPPORTS

- A. Required lengths and weights of posts are shown on the drawings.
- B. Supports shall be one of the following:
 - 1. U-shaped steel posts: ASTM A-499 and ASTM A-123.
 - 2. Steel square tube perforated posts: ASTM A-446 and ASTM A-123.
 - 3. U-shaped aluminum-alloy posts: ASTM B-221, alloy 6061, T6.

PART 3 - EXECUTION

3.01 ERECTION

- A. Construct highway signs and devices in accordance with the "Manual on Uniform Traffic Control Devices," FHWA latest edition.
- B. Construct signs at the locations and within reasonably close conformity to the lines and grades indicated on the Plans or as otherwise directed by the Engineer.

3.02 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02485

LAWN AND GRASS LANDSCAPING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Preparation of landscape area including loosening, pulverizing, and fertilizing.
- B. Placement of seed, sprigging, sod, and topsoil including mulch, where required.
- C. Watering of landscaping.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.

PART 2 - PRODUCTS

2.01 SEED MATERIALS

- A. Inspect and test seed for germination and purity prior to mixing.
- B. Uniformly mix by Group:

SEED NAME	QUANTITY % BY WEIGHT
<u>GROUP "A"</u>	
Lespedeza (common or Korean)	20%
Sericea Lespedeza	15%
Kentucky 31 Fescue	40%
English Rye	25%
<u>GROUP "B"</u>	
Kentucky 31 Fescue	55%
Redtop	15%
English Rye	30%
<u>GROUP "C"</u>	
Sericea Lespediza	50%
Kentucky 31 Fescue	30%
English Rye	20%

- C. Use Group "A" seed from February 1 to August 1.
- D. Use Group "B" seed from August 1 to December 1, with the exception that either Group "A" or "B" may be used during the month of August.
- E. Use Group "C" seed from February 1 to December 1 only when specified on the plans or otherwise approved.
- F. All seed shall meet the requirements of the Tennessee Department of Agriculture.
- G. Furnish the Engineer a certified laboratory report showing the analysis of the seed to be furnished. The report shall bear the signature of a senior seed technologist.
- H. Inoculate for legumes:
 - 1. Nitrogen fixing bacteria cultures adapted to the particular seed to be treated.
 - 2. Furnish in containers of a size sufficient to treat the specified quantity of seed to be planted.

2.02 MULCH MATERIAL

- A. Hay composed of approved stalks from grasses, sedges, or legumes; or straw composed of stalks from rye, oats, wheat, or other approved grains.
- B. Air dried and reasonably free from noxious weeds, weed seeds, and other detrimental plant growth.
- C. Suitable for spreading with mulch blower machinery.
- D. Wood fiber mulch, when used, shall meet the following specifications.
 - 1. Moisture Content 10.0% $\pm 2.0\%$
 - 2. Organic Matter 99.4% $\pm 0.2\%$
 - 3. Ash Content 0.6% $\pm 0.2\%$
 - 4. Water Hold Capacity 1050 grams minimum
(per 150 grams of oven dry fiber)
- E. Mulch binders.
 - 1. Cut back asphalt, Grade RC-70 or RC-250 conforming to AASHTO M-81, M-82, or M-141, for the type and grade specified.
 - 2. Emulsified asphalt, Type SS-1 conforming to AASHTO M-140. In addition to Type SS-1, a special mixing material AE-3 or a special priming material AE-P may be specified.

2.03 JUTE MESH

- A. Open plain weave of single jute yarn and non-toxic to vegetation.
- B. Tag jute rolls for identification with 58 warp ends per yard, 41 weft ends per yard and weighing approximately 0.9 pounds per square yard with an acceptable tolerance of 5 percent.

2.04 STAPLES

- A. New and unused, machine made of No. 11 gauge steel wire formed into a "U" shape.

2.05 SOD MATERIALS

- A. Live dense, well-rooted growth of permanent grasses, free from Johnson grass, nutgrass, and other undesirable grasses or weeds and well-suited for the proposed application to particular soils.
- B. Cleanly cut in strips having a reasonably uniform thickness of not less than 2 1/2 inches, a uniform width of approximately 8 inches, and a minimum length of 12 inches.

2.06 COMMERCIAL FERTILIZERS

- A. Unless otherwise specified, inorganic 10-20-10 nitrogen, phosphoric acid, and potash for seeding and 15-15-15 or 1-1-1 for sodding.
- B. Furnish in standard containers with the brand name, weight and guaranteed analysis of the contents clearly marked.
- C. Comply with Federal, State, and local laws.
- D. Ammonium nitrate shall be a standard commercial product, having a minimum of 33.5 percent nitrogen.
- E. Agricultural limestone shall contain a minimum of 85% of calcium carbonate and magnesium carbonate combined, and be of particular size that 85% will pass a No. 10 mess sieve.

2.07 WATER

- A. Free from harmful organisms or other objectionable materials.

2.08 TOPSOIL

- A. Natural, friable, fertile, fine, sandy loam possessing characteristics of representative topsoil in the vicinity which produces heavy growths of vegetation.
- B. Free from subsoil, noxious weeds, stones larger than one inch in diameter, lime, cement, ashes, slag, or other deleterious matter.
- C. Well-drained in its original position and free from toxic quantities of acid or alkaline elements.

2.09 GEOSYNTHETIC MATERIALS

- A. Geosynthetic materials may be submitted for consideration by the Engineer. Such material shall be installed and maintained in accordance with the manufacturer's recommendations.

PART 3 – EXECUTION

3.01 SEEDING

- A. Scarify, disc, harrow, rake, or otherwise work each area to be seeded until it has been loosened and pulverized to a depth as directed by the Engineer.
- B. Uniformly incorporate fertilizer into soil for a depth of approximately 1/2" at the rate of:
 - 1. Not less than 20 lbs. per sq. ft. for grade 10-10-10 or equivalent
 - 2. Not less than 100 pounds per 1000 square feet for agricultural limestone.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment.
- D. Sow seed of the specified group as soon the seedbed has been prepared.
- E. Sow uniformly by means of a rotary seeder, hydraulic equipment, or other satisfactory means at the rate of 1 1/2 pounds per 1,000 square feet, unless otherwise specified.
- F. Inoculate Group "C" seed and seeds of legumes, when sown alone, before sowing in accordance with the recommendations of the manufacturer of the inoculant.
- G. Do not perform seeding during windy weather, or when the ground surface is frozen, wet, or otherwise non-tillable. No seeding shall be performed during December through February unless otherwise permitted.
- H. When specified, provide seeding with mulch:
 - 1. Spread hay or straw mulch evenly over the seeded area at an approximate rate of 75 pounds per 1,000 square feet immediately following the seeding operations. This rate may be varied by the Engineer, depending on the texture and condition of the mulch material and the characteristics of the area seeded.
 - 2. Hold hay or straw mulch in place by the use of a mulch binder applied at the approximate rate of 4 gallons per 1,000 square feet as required.
 - 3. Cover bridges, guardrails, signs, and appurtenances, if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
 - 4. When wood fiber mulch is used, uniformly apply at the rate of 28 to 35 pounds per 1,000 square feet with hydraulic mulching equipment.

3.02 SPRIGGING

- A. Lightly incorporate fertilizer into the soil for a depth 1/2" at the rate of:
 - 1. 12 pounds per 1,000 square feet for grade 0-20-20 or equivalent.
 - 2. 100 pounds per 1,000 square feet for agricultural limestone.
- B. Perform sprigging during September-November or April-May and only when the soil is in tillable or workable condition.

- C. Do not set crowns during windy weather or when the ground surface is frozen.
- D. Set crowns as soon as preparation of the sprig bed has been completed.
- E. Set crowns at the rate of three sprigs per sq. yd. by means of a tree-planting bar or equal.
- F. When specified, perform mulching before sprigging.
 - 1. Spread mulch material evenly over the area to be planted at the rate of 100 pounds per 1,000 square feet. This rate may be varied by the Engineer depending upon the texture and condition of the mulch material and the ground surface.
 - 2. Cover with a uniform layer of mulch so that 20% to 25% of the ground is visible. The mulch shall be loose enough to allow sunlight to penetrate and air to circulate slowly, but thick enough to partially shade the ground and to reduce erosion.
 - 3. Hold the mulch in place with mulch binders applied at the rate directed by the Engineer, not to exceed 0.1 gallon per square yard, as required to hold the mulch in place.

3.03 SODDING

- A. Place sod at all locations shown on the Plans or where directed.
- B. Loosen the surface of the ground to be sodded to a depth of not less than one inch with a rake or other device.
- C. If necessary, sprinkle with water until saturated for a minimum depth of one inch and keep moist until the sod is placed.
- D. Immediately before placing sod, fertilize the prepared surface uniformly at the rate of:
 - 1. 12 pounds per 1,000 square feet for grade 10-10-10 or equivalent.
 - 2. 100 pounds per 1,000 square feet for agricultural limestone.
- E. Place sod as soon as practical after removal from the point of origin, and keep in a moist condition during the interim.
- F. Carefully place, by hand, on the prepared ground surface with the edges in close contact and, as far as possible, in a position to break joints.
- G. Each strip of sod laid shall be fitted and pounded into place using 10 inch by 10 inch wood tramps, or other satisfactory implements.
- H. Immediately after placing, thoroughly wet and roll with an approved roller or hand-tamp as approved by the Engineer.
- I. On slopes of 2:1 or steeper, pinning or pegging may be required to hold the sod in place.

3.04 TOPSOIL

- A. Prepare landscape area to receive topsoil in close conformity to the lines and grades

shown on the drawings.

- B. Place topsoil at depths and locations shown on the drawings.

3.05 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02513

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Mixing, spreading, compacting, and finishing of bituminous pavements for base, leveling, and surface courses on roads, parking lots, and other areas.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.
- C. Section 02215: Base and Subgrade Treatment.
- D. Section 02577: Pavement Marking.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR ALL MIXES

- A. Mineral Aggregate shall meet the general requirements of Section 02215 and additional requirements specified for each type paving mixture.
- B. Furnish test reports for aggregate and bituminous materials to be approved for quality by the Engineer prior to incorporation into the mix.
- C. The Engineer may require samples of aggregate, bituminous materials, or the plant mixed material for testing in an independent laboratory.
- D. All methods of sampling and testing will be in accordance with current AASHTO methods for use on highway materials.
- E. Submit a job-mix formula for approval by the Engineer, for each mix to be used on the project to establish:
 - 1. Percentage of each size aggregate to be used in the mix.
 - 2. Percentage of bituminous material.
 - 3. Discharge temperature of the mix.

- F. The job-mix formula shall be within the range established for each type mix with allowable tolerances as follows:

Aggregate passing 3/8 inch sieve and larger	± 7%
Aggregate passing No. 4 sieve and larger	± 5%
Aggregate passing No. 8 to No. 5 sieves	± 4%
Aggregate passing No. 100 to No. 200 sieves	± 2%
Bitumen	± 0.4%
Temperature of mix	± 20 degrees F.

- G. Submit a new job-mix formula if a change in materials is made or if an unsatisfactory mixture results.

- H. Bituminous mixing plants, either batch or continuous, sufficiently equipped and coordinated to provide paving mixes in an amount necessary for orderly prosecution of the work and to:

1. Produce a uniform mixture having complete and uniform coating of all aggregate and a uniform distribution of the bituminous material in the mix.
2. A canvas cover, or cover of suitable material, to protect the mix during transit.
3. Insulation, if required, so that the mix can be delivered to the paving machine at the specified temperature or not more than 25 degrees F. less than the discharge temperature at the plant.

- I. Do not produce bituminous mixed material when the surface on which the material to be placed is wet or otherwise unsuitable; the air temperature is below 40 degrees F.; or when other conditions would prevent the proper placing and compacting of the mix.

2.02 GENERAL REQUIREMENTS - HOT MIX PAVEMENTS

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.03 HOT MIX BASE

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.04 HOT MIX BINDER

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.05 HOT MIX LEVELING COURSE

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.06 HOT MIX ASPHALTIC CONCRETE (CRUSHED LIMESTONE)

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.07 HOT MIX ASPHALTIC CONCRETE (CRUSHED GRAVEL, SLAG, OR GRANITE)

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.08 HOT MIX LEVELING COURSE FOR WEARING SURFACE

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.09 GENERAL REQUIREMENTS - COLD MIX PAVEMENTS

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.

- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.10 COLD MIX BASE

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.11 COLD MIX SURFACE COURSE

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.12 PRIME COAT

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.13 TACK COAT

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

2.14 DOUBLE BITUMINOUS SURFACE TREATMENT

- A. Conform to Tennessee Department of Transportation Standards and Specifications for Road and Bridge Construction, latest edition.
- B. Alternative mix designs may be submitted to the City Engineer for review and consideration.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Construct bases and subgrades in conformance with Section 02210.
- B. Obtain approval of Engineer for the mix and surface to be treated prior to placing any materials.
- C. Protect all adjacent trees, surfaces, and structures from the bituminous material during construction.
- D. Prepare all receiving surfaces in reasonably close conformity with the lines, grades, and cross sections shown on the drawings.

3.02 LIMITATIONS FOR HOT MIX PAVEMENT

- A. Place bituminous plant mix only on an accepted subgrade.
- B. The subgrade and the surface upon which the bituminous plant mix is placed shall be free of excessive moisture.
- C. Place in accordance with the temperature limitations of the following table and only when weather conditions otherwise permit the pavement to be properly placed, compacted, and finished.

Temperature Limitations

<u>Compacted Thickness</u>	<u>Minimum Placement Temperature – Air or Surface – Whichever is Less</u>
Less than 1-1/2"	50 degrees F.
1-1/2" or More	40 degrees F.

3.03 MIXING HOT MIX PAVEMENTS

- A. Measure and combine dried aggregates and the bituminous material within the mixer in the amount specified by the job-mix formula.
- B. After the required materials have been introduced into the mixer, mix until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured.
- C. Wet-mixing time shall be determined by the Engineer for each plant and type of aggregate used, but in no case less than 25 seconds for batch plants and 40 seconds for continuous mix plants.

- D. The temperature of the completed mixture (determined at the time it is dumped from the mixer) made with aggregates containing absorbed moisture which causes foaming or boiling shall be not less than 225 degrees F.
- E. The temperature for grading A-S mixtures shall be between 225 and 275 degrees F.

3.04 SPREADING AND FINISHING HOT AND COLD MIX PAVEMENT

- A. Deliver and spread bituminous mixtures in ample time to secure thorough compaction during daylight hours.
- B. Deposit the mixture in the paver hopper within 25 degrees F. of the temperature at which it was discharged from the mixer.
- C. Place the mixture upon an approved surface, spread, and strike-off to the established line, grade, and elevation by means of approved asphalt paving machines.
- D. Echelon paving will not be permitted on 2-lane projects where traffic is being maintained.
- E. Control alignment of the outside edge of the pavement using preset control string lines or other approved methods.
- F. For multi-course pavement, the longitudinal joint in one layer shall offset that in the layer immediately before by approximately one foot; for 2 lanes of width, the joint in the top layer shall be at the centerline or at lane lines if the roadway is more than two lanes in width.
- G. Coordinate plant production and paving operations so that a uniform continuity of operation is maintained.
- H. Use automatic screen controls of such as the string line or ski type grade reference system on all work regardless of the paver width.
 - 1. The string line reference system may be required on new construction.
 - 2. If the base has been finished with equipment having automatic grade control or the contractor demonstrates that an alternate method of spreading and finishing will result in a satisfactory riding surface, the Engineer may conditionally waive the string line requirement and authorize use of the ski type reference system.
 - 3. The Engineer may at any time require the use of a string line reference system, even if previously waived, if the string line system will result in a superior riding surface.
 - 4. When the string line system is required on a multi-course pavement, use at least two courses exclusive of the surface course.
 - 5. For the ski type system, use the maximum practical length not less than 40 ft.

6. Pavement lanes previously placed with automatic controls or to form grade may serve as longitudinal control reference for placing adjacent lanes by utilizing a ski or joint matching shoe.
- I. String line reference system: suitable wire or twine supported by approved devices compatible with the automatic paver control system.
 1. The string line and supports shall be capable of maintaining the line and grade designated by Plans at the point of support while withstanding the tensioning necessary to prevent sag in excess of 1/4" between supports spaced 50 ft. apart.
 2. Install additional supports to provide a minimum spacing of 25 feet, or less as directed by the Engineer, to remove the apparent deviation of the string line from theoretical grade.
 3. Establish the reference system from the control points shown on the plans.
 4. Maintain the reference system until its use is no longer required.
 5. The string line reference system shall be complete in place at least 300 feet in advance of the point where the pavement is being placed.
- J. Automatic screen controls will not be required on sections where service connections or other conditions interfere with their efficient operation.
- K. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, take the mixture from the hopper of the spreading machine and distribute immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.

3.05 COMPACTION OF HOT AND COLD MIX PAVEMENTS

- A. After the bituminous mixture has been spread, stuck off, and surface irregularities adjusted, it shall be thoroughly compacted.
- B. The method employed must be approved by the Engineer and be capable of compacting the mixture to the specified density while it is in a workable condition.
- C. When no density requirements are specified, employ a system of compaction for roadway pavement which has previously produced required densities. A control strip and random density samples may be employed to aid the Engineer in evaluating the system.
- D. Minimum roller requirements:
 1. For each paver 16 feet wide or less use two rollers.
 2. For each paver 16-26 feet wide, use three rollers.
 3. For each paver 26 feet wide or more, use four rollers.
 4. Increase the number of rollers if the required results are not being obtained.
 5. Alternative roller arrangements may be submitted to the Engineer for

consideration.

- E. The minimum number of rollers listed above may, with the approval of the Engineer, be reduced to one roller of either the steel-wheel or vibratory type on the following types of construction:
 - 1. On shoulder construction.
 - 2. On incidental construction such as bridge approaches, driveways, etc.
 - 3. On projects containing less than 10,000 square yards of bituminous pavement.
- F. Begin rolling at the low side and proceed longitudinally parallel to the road centerline.
 - 1. When paving in echelon or abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling procedure.
 - 2. When paving in echelon, do not compact within six inches of an edge where an adjacent lane is to be placed.
 - 3. Roll at a slow, uniform speed with the drive wheels nearer the paver and keep as nearly as possible in continuous operation.
 - 4. Continue rolling until all roller marks are eliminated.
- G. To prevent adhesion of the mixture to the rollers, properly moisten with water or water mixed with very small quantities of detergent or other approved material. An excess of liquid shall not be used.
- H. Do not park or refuel rollers on the bituminous pavements.

3.06 REQUIRED DENSITY OF HOT MIX PAVEMENTS

- A. Bituminous plant mix base, Grading A and B (Black Base and Binder). An average of 90% of maximum theoretical density with no individual test less than 87%. Density requirements for these mixes will be waived if placed in lifts of two inches or less.
- B. Bituminous plant mix base, Grading C (Leveling). Same as for Grading A and B, except density requirements of this mix will be waived if placed in lifts of 1 1/4" or less.
- C. Bituminous plant mix base, Grading C-W (Leveling-Wearing). An average density not less than 88% of maximum theoretical density with no individual test less than 85%. Density requirements on this mix will be waived if placed in lifts 1 1/4" or less.
- D. Bituminous sand-gravel binder or surface course. An average of 85% of maximum theoretical density with no individual density test less than 82%.
- E. Asphaltic concrete surface course, Grading D or E. An average of 93% of laboratory density as determined by the Marshall Method, 75 blow with no individual test less than 90%. When these mixes are used for shoulder construction, the average density shall not be less than 88% of maximum theoretical density with no individual test below 85%. Density requirements for these mixes will be waived if placed in lifts of one inch

or less.

- F. Asphaltic surface course, Grading F and sand-asphalt surface course. An average of 92% of laboratory density as determined by the two-inch Hubbard-Field Method with no individual density test less than 89%. Density requirements on this mix will be waived if placed in lifts of 3/4 inch or less.
- G. For density testing purposes, divide the pavement into lots of approximately 10,000 square yards, except for Grading "A" and "B" with lots of approximately 5,000 square yards. Perform five density tests in each lot and compare the average results with the requirements listed above.

3.07 JOINTS FOR HOT MIX PAVEMENTS

- A. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer.
- B. Form transverse joints by cutting back on the previous run to expose the full depth of the course.
- C. When directed by the Engineer, use a brush coat of bituminous material on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

3.08 SEPARATING COLD MIX AGGREGATES

- A. Produce the aggregate for the bituminous mixtures in two fractions:
 - 1. Separate Mix No. 1 on the 1 1/4", 1 1/2", or 1 3/4" screen.
 - 2. Separate Mix No. 2 on the 1" or 1 1/4" screen.

3.09 MIXING COLD MIX PAVEMENTS

- A. Measure and combine the aggregate and the bituminous material within the mixer in the amount specified by the job-mix formula.
- B. The temperature of the bituminous material shall not exceed 180 degrees F. when combined with the mineral aggregate.
- C. Mix the materials until a complete and uniform coating of the aggregate particles and a thorough distribution of the bituminous material throughout the aggregate is secured.
- D. The mixing time will be determined by the Engineer for each plant and type of aggregate used.
- E. The temperature of the completed mixture, determined at the time it is dumped from the mixer, shall not be less than 110 degrees F. nor more than 200 degrees F.

3.10 PLACING PRIME COAT

- A. Seasonal and temperature limitations for applying bituminous prime coat shall conform to the same requirements as those specified for the succeeding stage of construction except the prime may be applied to a surface that is slightly damp, but not wet.
- B. If prime coat is specified, apply bituminous material to the width of the section to be primed with a pressure distributor at a uniform, continuous spread.
- C. Correct any areas containing an excess or deficiency of priming material by adding blotter material or bituminous material.
- D. If, after the bituminous material has been applied, it fails to penetrate before the time that the roadway must be used by traffic, spread dry cover material between 8 and 12 pounds per square yard to prevent damage to the primed surface. Avoid an excess of cover material.

3.11 PLACING TACK COAT

- A. Immediately after cleaning the surface, apply bituminous material with a pressure distributor at a rate not exceeding 0.05 gallon of residual bitumen per square yard for all materials except asphalt cement.
- B. For asphalt cement AC-20, apply at the rate of 0.05 to 0.10 gallons per square yard.
- C. Allow the tacked surface to dry until it is in a proper condition to receive the next course.
- D. Apply only so far in advance of the paving operations as is necessary to obtain the proper condition of tackiness.
- E. Protect the tack coat from damage until the next course is placed.

3.12 DOUBLE BITUMINOUS SURFACE TREATMENT

- A. Make the first application of bituminous material by pressure distributors at a uniform rate of between 0.38 and 0.42 gallons per square yard.
- B. Each width of spread shall not be less than one-half the surface to be treated.
- C. Before beginning each spread, lay building paper across roadway surfaces with the forward edge exactly coinciding with the end of the preceding covered spread.
- D. Start distributors on the paper, the width of which shall be such that the full-force of all nozzles shall be in effect before the forward edge of the paper is reached.

- E. Correct all defects in any application, at once.
- F. Treat areas inaccessible to the distributor either with hand sprays or pouring pots.
- G. If less than the full width of roadway is being treated, do not spread aggregate on the inside 6" of either the first or second application until the adjacent lane has been treated.
- H. Immediately after each application, cover uniformly with Size No. 6 mineral aggregate reasonably free of surface moisture.
- I. Spread the aggregate by self-propelled mechanical spreaders between 30 and 40 pounds per square yard. Back the truck on the aggregate being spread and not on or over uncovered bituminous material.
- J. The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover material can immediately cover.
- K. Apply the second application of bituminous material in the same manner as the first application, at a uniform rate between 0.30 and 0.35 gallon per square yard as established by the Engineer.
- L. Spread mineral aggregate, Size No. 7, in the same manner as the first spread at a rate of 20 to 25 pounds per square yard.
- M. Hand-broom each spread of cover aggregate for uniform coverage. Place additional aggregate by hand on thin or bare areas.
- N. Roll the entire surface, beginning at the edges and progressing to the center, within 30 minutes after spreading. Initial rolling shall normally be done with a pneumatic tire roller, followed by steel-wheel rolling.
- O. Allow the first application to cure for such length of time as deemed necessary before the second application is begun. Immediately before the second application of bituminous material, roll the surface with a steel-wheel roller.
- P. Repeat the same rolling and curing procedures required in making the first application for the second application.
- Q. Allow slow-moving traffic to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

3.13 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit in the Bid Schedule.

- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02515

PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Formwork complete with required shoring, bracing, and anchorage.
- B. Concrete reinforcing, complete with required supports, spacers, and related accessories.
- C. Cast-in-place concrete.
- D. Construction, expansion, and contraction joints.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.
- C. Section 02215: Base and Subgrade Treatment.
- D. Section 03001: Concrete Work.

PART 2 - PRODUCTS

- A. Use Class "P" Concrete as specified in Section 03001.

PART 3 - EXECUTION

3.01 PREPARATION OF BASE

- A. Construct or correct the base to such grade tolerances as will insure the concrete pavement thickness required in accordance with Section 02215.
- B. Complete base work not less than 500 linear feet in advance of paving.
- C. The base grading machine and slip-form paver shall be equipped with automatic line guidance and grade controls.

3.02 FORMWORK

- A. Base Support:
 - 1. Set form firmly in contact for its whole length and at the specified grade.
 - 2. Fill and compact areas below grade with suitable material in lifts of 1/2 inch or less for a distance of 18 inches on each side of the base of the form.
 - 3. Tamp or cut any grade at the form line found above the grade.
 - 4. Do not use pedestals of earth or other material upon which to rest the forms to bring them to grade.

- B. FORM SETTING
 - 1. Set forms a minimum of 500 feet in advance of the point where concrete is being placed, except as approved by the Engineer.
 - 2. After the forms have been set to correct grade, tamp the material supporting the forms at both the inside and outside edges of the base of the forms.
 - 3. Stake forms into place with not less than three pins for each 10 foot section and with a pin at each side of every joint.
 - 4. Lock form section to be free from ply or movement in any direction.
 - 5. Do not allow forms to deviate from true line by more than 1/4" at any point.
 - 6. Reset or remove forms that settle or spring under the spreading and finishing equipment.
 - 7. Clean and oil the top and face of forms prior to the placing of concrete.

- C. GRADE AND ALIGNMENT
 - 1. Check and correct the alignment and grade elevation of the forms immediately before placing the concrete.
 - 2. When any form has been disturbed or any grade has become unstable, reset and recheck the form.

3.03 RETEMPERING

- A. The ret tempering of concrete which has partially hardened by the addition of any ingredient will not be permitted except in special emergencies. In such emergencies, water and Portland cement may be added at the rate of five (5) gallons of water, per sack of cement.

3.04 CONCRETE PLACING

- A. Unload the concrete into an approved spreading device, or deposit on the base. Mechanically spread in such a manner to prevent segregation of the materials.
 - 1. When central or transit mixed concrete is used, place the mixture where it will require as little re-handling as possible.
 - 2. The mechanical spreader will not be required on areas too small to accommodate the paving equipment, projects that contain 10,000 square yards or less nor on variable width sections and ramps.
 - 3. Continuously place between transverse joints without the use of intermediate bulkheads.

4. Perform necessary hand spreading with shovels, or other approved tools.
 5. Do not allow workmen to walk in the freshly mixed concrete with boots or shoes coated with foreign substances.
- B. Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall meet the requirements for opening to traffic. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after seven days.
- C. Consolidate concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete.
1. Do not permit vibrators to come in contact with a joint assembly, the grade, or a side form.
 2. Do not operate vibrator longer than 5 seconds in any one location.
 3. Use hand operated vibrators only on projects that contain 10,000 square yards or less of concrete paving and on variable width sections and ramps.
 4. Operate vibrators mounted on a machine only while in motion.
- D. Deposit concrete as near to expansion and contraction joints as possible without disturbing them, but do not dump from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.
- E. Should any concrete materials fall on or be worked into the surface of a complete slab, remove immediately by approved methods.
- F. When the slip-form method of concrete paving (without the use of fixed forms) is used, place the concrete with an approved slip-form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense and homogenous pavement.
1. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed.
 2. Rigidly hold the sliding forms together to prevent spreading of the forms.
 3. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur and that necessary finishing can be accomplished while the concrete is still within the forms.
 4. Correct any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch before the concrete has hardened.
 5. Operate the slip-form paver with as nearly a continuous forward movement as possible to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, stop the vibratory and tamping elements immediately.
 6. Do not apply any tractive force to the machine, except that which is controlled from the machine.

3.05 CURING

- A. Cure concrete in accordance with applicable articles of Section 03001.

3.06 JOINTS

- A. Construct joints of the type and dimensions shown on the drawings.
- B. Longitudinal joints shall be perpendicular to the pavement surface and parallel to the centerline of the pavement, unless otherwise specified.
- C. Transverse joints shall be straight, vertical to the pavement surface and at the angles to the centerline of the pavement shown on the Plans.
- D. Unless otherwise specified, all contraction and construction joints shall be of the plain and sawed groove or insert and sawed groove type, except that when limestone coarse aggregate is used, the joints shall be the plain sawed groove type.
- E. Longitudinal Joints:
 - 1. Place deformed steel tie bars of specified length, size, spacing, and materials across and perpendicular to the longitudinal joints by approved supports to prevent displacement.
 - 2. When adjacent lanes of pavement are constructed separately, form a keyway along the construction joint of the first lane constructed by the use of one of the alternate metal center strip types detailed on the Plans.
 - a. Tie bars may be bent at right angles against the form and straightened into final position before the concrete of the adjacent lane is placed, or they may be placed in holes drilled through the forms.
 - b. Tool construction joints to a 1/4 inch radius during finishing operations before sawing.
 - 3. Cut longitudinal sawed joints by means of approved concrete saws to the depth, width, and line shown on the Plans, not later than 10 days after placing concrete and before any equipment or vehicles are allowed on the pavement.
 - 4. Inserts that are to be sawed shall be an approved rigid material of the thickness and width shown on the Plans with a length equal to one-half the pavement width for transverse joints and not less than 10 feet for longitudinal joints. Do not use insert material that cracks, shatters, warps during installation, or that leaves a residue from sawing that will prevent seal material from adhering to the concrete.
 - 5. After the concrete has sufficiently set, saw the insert to the width and depth shown on the Plans, leaving the remainder of the insert in place.
 - 6. Immediately after sawing, clean all longitudinal contraction and construction

- joints of all residue by flushing with water under pressure.
7. As an alternate to sawing, form the longitudinal contraction joint by placing a continuous strip of polyethylene sheeting having a minimum thickness of 10 mils, a width of 1/3 the total thickness of the concrete being placed and no adverse reactions with the chemical constituents of the concrete.
 8. The joint insert material when placed vertically in the concrete, shall not bond with the concrete but shall form an effective weakened plane joint of the specified depth.
 - a. Insert the joint material with an approved mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving.
 - b. Splices in the joint material will be permitted provided they maintain the continuity of the joint material.
 - c. Place the joint material so that top of the strip is not more than 1/4 inch below the finished surface of the concrete.
 - d. Do not deform the joint material from a vertical position, either in the installation or in subsequent finishing operations.
 - e. The mechanical installation device shall vibrate the concrete sufficiently to cause the concrete to flow evenly about the joint material producing homogeneous concrete free of segregation and rock pockets or voids.
 9. The alignment of the finished joint shall meet the approval of the Engineer.
- F. Transverse Expansion Joints:
1. Hold dowels across transverse joints, parallel to the surface and centerline of the slab, by an approved metal device that is left in the slab.
 - a. Paint dowels that are not corrosion resistant with one coat of approved primer.
 - b. When the paint has dried and immediately before placing the dowel in position, coat the dowel with a thick film of heavy grease.
 - c. Bond breaker for corrosion resistant dowels shall be as recommended by the coating manufacturer.
 - d. Cover one end of each dowel with a close fitting, closed end metal sleeve, not less than 4 inches long, with a flange or other approved device to separate the end of the sleeve and the end of the dowel during the placing of the concrete so that a space 1/4" greater than the thickness of the joint will be provided.
 - e. Dowels shall have ends free from burrs and distortions.
 2. When pre-moulded joint filler is used, install by the use of one of the alternate expansion joint and dowel assembly devices shown on the Plans, or other approved expansion joint assemblies.
 - a. The installing device shall have a length 1/2 inch less than the width of the slab.
 - b. Assemblies shall be a rigid metal device capable of holding

dowels and filler firmly in position during the entire construction operation and shall remain in place.

3. Set the top of the filler below the surface of the proposed slab to accommodate the type sealant specified, as detailed on the Plans.
 - a. When in position, the filler shall be perpendicular to the surface of the slab.
 - b. Protect the top edge of the filler by an approved metal channel cap. The assembly device may be designed with this cap self-contained.

G. Transverse Contraction Joints:

1. Place contraction joints at the intervals specified.
2. Do not use formed contraction joints unless specified or required by the Engineer to control random cracking.
3. When called for on the Plans, contraction joints shall include load transfer assemblies.
4. In lieu of using dowel assemblies, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Engineer.
5. Saw contraction joints as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling and before uncontrolled shrinkage cracking takes place.
 - a. If necessary, perform sawing operations both day and night, regardless of weather conditions.
 - b. Omit sawing any joint if a crack occurs at or near the joint.
 - c. Saw all joints in sequence.
 - d. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, form a contraction joint groove at intervals of every third or fourth joint or as often as required prior to initial set of concrete.
 - e. Immediately after sawing, clean the joints of all residue by flushing with water under pressure.
6. Transverse contraction joints made by the insert and sawed groove method shall comply with the applicable requirements for the longitudinal contraction joint.
7. Form contraction joints during the placing of the concrete.
 - a. Form these joints by placing inserts in the plastic concrete, at the angle to the centerline of the pavement indicated on the Plans and perpendicular to the surface.
 - b. When the concrete has attained its initial set and after the joint has been carefully finished, remove the insert.
 - c. The formed groove shall maintain its full width and depth as shown on the Plans, and the pavement at the joint shall meet surface requirements.

H. Transverse Construction Joints:

1. Construct transverse construction joints as detailed on the Plans.
 2. Form grooves by one of the methods specified for longitudinal or transverse expansion joints.
 3. Construction joints when there is an interruption of more than 30 minutes in the concreting operations.
 4. Do not construct transverse joints within 10 feet of an expansion joint, contraction joint, or plane of weakness.
 5. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, remove and dispose of the excess concrete back to the last preceding joint.
- I. Expansion Joints at Structures: Form expansion joints about all structures and features projecting through, into, or against the slab by use of premoulded joint filler 1/2 inch in width.

3.07 CONCRETE FINISHING

Sequence operations to strike-off and consolidate, float, and remove laitance, straight-edge, then finish final surface.

- A. Finishing at Joints:
1. Compact or firmly place the concrete adjacent to joints without voids or segregation against the joint material, under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement.
 2. After the concrete has been placed and vibrated adjacent to the joints, bring the finishing machine forward, operating in a manner to avoid damage or misalignment of joints.
 3. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, stop the finishing machine when the front screed is approximately 8 inches from the joint.
 4. Remove segregated concrete from in front of and off the joint; lift the front screed and set directly on top of the joint then resume the forward motion of the finishing machine.
 5. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, lift and carry it over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, providing there is no segregation in the concrete.
- B. Machine Finishing:
1. Spread the concrete as soon as placed then strike-off and screed by an approved finishing machine.
 2. When the pan-float finisher combination machine is used, longitudinal floats will not be required.

3. The machine shall go over each area of pavement as many times as necessary to give the proper consolidation and to leave a surface of uniform texture.
4. Avoid excessive operation over a given area.
5. Keep the tops of the forms clean by an effective device attached to the machine, and maintain travel on the forms true without lift, wobbling, or other variation tending to affect the precision finish.
6. During the first pass of the finishing machine, maintain a uniform roll of concrete ahead of the front screed for its entire length. Do not move rolls of concrete in excess of 6 inches.
7. If uniform and satisfactory consolidation of the concrete is not obtained by the vibratory method throughout the pavement, furnish equipment and methods which will produce satisfactory work.

C. Hand Finishing:

1. Unless otherwise specified, do not use hand finishing methods except under the following conditions:
 - a. In the event of mechanical equipment breakdown when concrete has already been deposited on grade.
 - b. On ramps and variable width sections, where the use of finishing machines is impractical.
2. When hand finishing is permitted, strike-off and screed the concrete as soon as placed.
 - a. The screed shall be at least 2 feet longer than the maximum width of the slab to be struck-off. It shall be of approved design, and sufficiently rigid to retain its shape.
 - b. When reinforcement is used in the pavement, provide a strike-off template for striking-off the bottom layer of concrete.
3. Attain consolidation by the use of a suitable vibrator or other approved equipment.
4. Repeat screening until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

D. Floating:

1. After the concrete has been struck-off and consolidated, further smooth, true and consolidate, using one of the following methods as specified or permitted.
2. Hand Method: Use equipment and methods approved by the Engineer.
3. Mechanical Method: Use mechanical floats unless otherwise specified.
 - a. Adjust the tracks from which the float operates to the required cross section.
 - b. Adjust the float and coordinate with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times.
 - c. Adjust the forward speed so that the float will lap the distance

- specified by the Engineer on each transverse trip.
- d. Pass the float over each area of pavement at least two times, but not excessively.
- e. Waste any excess water or soupy material over the side forms on each pass.
- f. After floating, remove any excess water and laitance by a straightedge 10 feet or more in length.
- g. Lap successive drags one-half the length of the blade.

E. Straight-edging:

1. After the floating has been completed and the excess water removed, but while the concrete is still plastic, test the surface of the concrete for trueness.
2. Furnish and use an accurate metal straightedge, not less than 10 feet in length swung from handles at least 3 feet longer than one-half the width of the slab.
3. Hold the straightedge in contact with the surface in successive portions parallel to the road centerline and go over the whole area from one side of the slab to the other as necessary.
4. Advance along the road in successive stages of not more than one-half the length of the straightedge.
5. Any depressions found shall be immediately filled with freshly mixed concrete, struck-off, consolidated, and refinished.
6. High areas shall be cut down and refinished.
7. Give special attention to assure that the surface across joints meets the requirements for smoothness.
8. Continue straightedge testing and surface corrections until the entire surface is found free from observable departures from the straightedge and the slab conforms to the required grade and cross section.
9. When, in the opinion of the Engineer, superficial water is required to assist in finishing, apply by lightly fogging.
10. Follow straight-edging by belting with an approved belt or hose. Do not rest belts on the pavement.

F. Final Finish:

1. The surface texture shall be a burlap drag finish.
 - a. The drag shall consist of a seamless strip of damp burlap which, when dragged longitudinally along the full width of pavement, will produce a uniform surface of gritty texture.
 - b. For pavement 24 feet or more in width, mount the drag on a bridge.
 - c. The dimensions of the drag shall be such that a strip of burlap at least three feet wide is in contact with the full width of pavement surface while the drag is used.
 - d. The drag shall consist of not less than two layers of burlap with the bottom layer approximately six inches wider than the upper layer.

- e. Maintain the drag in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth.
- f. Maintain drags clean and free from encrusted mortar.
- g. Discard uncleanable drags.
- 2. After the pavement has been finished by the burlap drag, texture the surface by the formation of transverse grooves.
 - a. Form the transverse grooves by mechanical equipment using a comb made of steel tines, vibrating beam roller, or other approved device.
 - b. Manual tools such as rakes with spring steel tines may be used on areas inaccessible to mechanical equipment.
 - c. Form the grooves at an appropriate time during the setting of the concrete mixture, so that the grooves will be between 0.09 inch and 0.13 inch in width, between 0.12 inch and 0.19 inch in depth, and spaced at random intervals between 0.3 and 1.0 inch.
- 3. Regardless of the method used to form the grooves, the grooves shall be relatively smooth and uniform, and formed without excessive tearing of the surface and without bringing pieces of the coarse aggregate to the top of the surface.
- 4. In the event of mechanical failure, manual tools may be used for grooving, provided all mixing and placing operations cease until proper repairs are made.
- 5. Any individual areas of 50 yards or larger not conforming to these requirements shall be corrected at the Contractor's expense, by the cutting of acceptable grooves in the hardened surface with an approved cutting machine, or by other approved methods.

3.08 TESTING

- A. As soon as the concrete has hardened sufficiently, test the pavement surface with a 12 foot straightedge or other specified device.
- B. When the straightedge is placed parallel to the centerline of the pavement, the surface shall not vary more than 1/8 inch from the lower edge of the straightedge.
- C. Areas showing high spots of more than 1/8 inch, but not exceeding 1/2 inch in twelve feet, shall be marked and immediately ground down with an approved grinding tool. The ground area shall then be sealed with an epoxy resin system approved by the Engineer.

3.09 DEFECTIVE INSTALLATION

- A. Where surface deviations exceed 1/2 inch, remove and replace the pavement except for any section less than ten feet in length or less than the full width of the lane involved.

- B. When it is necessary to remove pavement, remove and replace any remaining portion of the slab adjacent to the joints that is less than 10 feet in length.

3.10 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02528

CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Formwork complete with shoring, bracing, and anchorage.
- B. Concrete reinforcement complete with required supports, spacers, and related accessories.
- C. Cast-in-place concrete for curbs, gutters, and sidewalks.
- D. Joint work.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.
- C. Section 02215: Base and Subgrade Treatment.
- D. Section 03001: Concrete Work.

PART 2 - PRODUCTS

2.01 Use Class "A" concrete as specified in Section 03001.

2.02 FORM MATERIALS

- A. Either wood or metal, free from warp with sufficient strength to resist the pressure of the concrete without springing, extending for the full depth of concrete.
- B. Use curbed forms of proper radius on all radial sections and of acceptable design to Engineer.
- C. Use 1/8" thick metal templates between 10 foot section with:
 - 1. Width - same as curb, gutter, or sidewalk.
 - 2. Depth - at least 1/4" more than curb, gutter, or sidewalk depth.
 - 3. Lugs or other devices to hold templates in position and permit removal without causing damage to concrete.
- D. Use a metal strike-off template to shape the top surface of gutters or sidewalks.

2.03 JOINT MATERIALS

- A. 1/2" thick preformed filler, unless otherwise specified.
- B. Cut to full cross section of curb, gutter, and/or sidewalk.

- C. True, even, and of satisfactory appearance.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clear construction area in accordance with Section 02110.
- B. Compact subgrade by tamping or rolling as specified in Section 02215.
- C. Thoroughly wet base or subgrade prior to placing concrete.

3.02 FORMWORK

- A. Place forms so finished concrete will be true to line, grade, and cross section as shown on the drawings.
- B. Uniform section lengths - Maximum of 10 feet and minimum of 6 feet.
- C. Place joints at locations shown on drawings or in line with joints of adjoining construction, unless otherwise shown on drawings.
- D. Brace and stake forms to maintain vertical and horizontal alignment until their removal.
- E. Carefully set templates and leave in place until the concrete has set sufficiently to hold its shape. Remove templates while forms are still in place.
- F. Provide construction joints between new construction and all adjoining construction and around all utility appurtenances extending into the sidewalks, unless otherwise specified.
- G. Clean and coat forms with light oil immediately before placing concrete.

3.03 CONCRETE PLACING

- A. Deposit the concrete on the base:
 - 1. When central or transit mixed concrete is used, place the mixture where it will require as little rehandling as possible.
 - 2. Continuously place between transverse joints without the use of intermediate bulkheads.
 - 3. Perform necessary hand spreading with shovels, or other approved tools.
 - 4. Do not allow workmen to walk in the freshly mixed concrete with boots or shoes coated with foreign substances.
- B. Consolidate concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete.
 - 1. Do not permit vibrators to come in contact with a joint assembly, the grade, or a side form.
 - 2. Do not operate the vibrator longer than 5 seconds in any one location.
 - 3. Operate vibrators mounted on a machine only while in motion.

- C. Deposit concrete as near to expansion and contraction joints as possible without disturbing them, but do not dump from the discharge bucket or hopper onto a joint assembly unless the hopper is well-centered on the joint assembly.
- D. Should any concrete materials fall on or be worked into the surface of a complete slab, remove immediately by approved methods.

3.04 FINISHING CONCRETE - GENERAL

- A. When necessary, strike-off concrete using transverse templates resting upon the side forms.
- B. Remove templates, then the forms when the concrete has set sufficiently to hold its shape.
- C. Finish surface with floats and straightedges, when required, to a smooth even finish.
- D. Round edges at templates and expansion joints with an edging tool of 1/4" radius.
- E. Remove all tool marks with a wetted brush or wooden float.
- F. Clean the top and ends of expansion joint materials and trim to slightly below the concrete surface.
- G. Remove forms, without exerting pressure on the concrete, at any time when such removal will not damage the concrete.
- H. Protect concrete work until finally accepted.
- I. Remedy damaged work, that has not been accepted, by removing and reconstructing each section that is damaged.

3.05 FINISHED CURBS AND GUTTERS

- A. No plastering will be permitted.
- B. Unless otherwise specified, the edges of the curb and gutter shall be rounded to a radius of 3/4".
- C. Finish the back of curbs not less than 3" below the top of backfill against the curb.
- D. Any exposed surface or surfaces against which some rigid type of construction is to be made shall be left smooth and uniform so as to permit free movement of the curb, gutter, or combined curb and gutter.
- E. When the use of curb machines is permitted, finish as specified above except that contraction joints may be sawed a minimum depth of 1/4 the thickness of the section at intervals not less than 6 feet nor more than 10 feet in lieu of construction the curbs in sections.
- F. Place weep holes or drainage openings through curbs as indicated on the Plans or as directed by the Engineer, with at least one-half cubic foot of coarse aggregate behind each opening.

3.06 FINISHING SIDEWALKS

- A. When the surface of the concrete is free from water and just before the concrete obtains its initial set, finish and sweep lightly with a broom in order to produce a sandy texture.
- B. The longitudinal surface variations shall be not more than 1/4" under a 12 foot straightedge, nor more than 1/8" on a 5 foot transverse section.
- C. The surface of the concrete shall be so finished as to drain completely at all times.
- D. Round the edges with an edging tool having a radius of 1/2".
- E. Divide the surface of sidewalks into blocks by use of a grooving tool.
 - 1. Space the grooves approximately 5 feet apart with the blocks rectangular unless otherwise ordered by the Engineer.
 - 2. Cut the grooves to a depth of not less than 1".
 - 3. Edge the grooves with an edging tool having a radius of 1/4".
 - 4. Place grooves in median pavement in line with corresponding joints in adjoining construction or as directed by the Engineer.
- F. Unless otherwise indicated on the Plans, place marks or grooves at right angles to the centerline of driveways and approximately 8 inches apart.
 - 1. These markings shall be between 1/8" and 1/4" in depth and shall be made with a suitable marking tool.
 - 2. A grooving tool, 6 to 8 inches in width, with multiple grooves for grooving alternate strips 8" apart, may be used.
 - 3. All marking edges shall be rounded satisfactorily.
- G. Do not place grooves in the surface of sidewalks reinforced for beam action where the full thickness of concrete is required for strength.
- H. Do not allow pedestrians, vehicles, or loads upon concrete sidewalks until 12 hours after finishing concrete, or until the Engineer has determined that the concrete has attained sufficient strength for such loads.

3.07 EXTRUDING / SLIP-FORMING OF CURBS, GUTTERS, AND SIDEWALKS

Construction of curbs, gutters, and sidewalks using extrusion and/or slip-forming techniques may be approved by the City Engineer. Equipment and methodology proposed for use shall be submitted for review. Additional finishing in accordance with Sections 3.04, 3.05, and 3.06 may be required.

3.08 MEASUREMENT AND PAYMENT – CURBS, GUTTERS, AND SIDEWALKS

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02577

PAVEMENT MARKING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Marking of pavement including surface preparation and painting on bituminous or concrete surfaces.

1.02 ACCEPTANCE PROCEDURE

- A. Typical Sample analysis.
- B. Certification that paint meets requirements.

PART 2 - PRODUCTS

2.01 PAINT

- A. White or Yellow as shown on drawings.
- B. Paint shall be quick dry traffic marking meeting the requirements of the TDOT Standard Specifications for Road and Bridge Construction, latest edition.
- C. Drying time - 3 to 5 minutes when heated to application temperature.
- D. Application temperature – in accordance with manufacturer's recommendations.
- E. Each paint container shall be labeled showing details of paint, application procedure, and date of manufacture.

2.02 DROP ON GLASS BEADS

Glass beads shall meet the requirements of AASHTO M-247, Type I moisture resistant beads, with the following gradation:

<u>Sieve Designation</u>	<u>Mass Percent Passing</u>
20 Mesh	100
30 Mesh	75-95
40 Mesh	-----
50 Mesh	15-35
80 Mesh	-----
100 Mesh	0-5

2.03 THERMOPLASTIC PAVEMENT MARKINGS

- A. White or Yellow as shown on drawings.
- B. Thermoplastic markings shall meet the requirements of the TDOT Standard Specifications for Road and Bridge Construction, latest edition.
- C. Application temperature – in accordance with manufacturer's recommendations.
- D. Each container shall be labeled showing details of material, application procedure, and date of manufacture.

PART 3 - EXECUTION

3.01 Perform pavement marking in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways, published by FHWA.

3.02 Apply marking in strict accordance with the manufacturer's recommendations, but with a minimum wet film thickness of 15 ± 1 mils with 6 pounds of glass beads per gallon.

3.03 Mark pavement in close conformity to the lines, dimensions, patterns, locations, and details shown on the drawings or established by the Engineer.

3.04 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 02721

STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Installation of storm drainage systems.

1.02 RELATED WORK

- A. Section 02221: Trenching, Backfilling, and Compaction.
- B. Section 02305: Boring and Jacking.
- C. Section 02605: Separation of Piped Utilities.
- D. Section 03001: Concrete Work.

PART 2 - PRODUCTS

2.01 CONCRETE PIPE (CP)

- A. Culverts: AASHTO M-170 or ASTM C-76.
- B. Elliptical Culverts: AASHTO M-207 or ASTM C-507.
- C. Reinforced Low-Head: ASTM C-361.

2.02 VITRIFIED CLAY PIPE (VCP)

- A. Culverts: ASTM C-700, extra strength.

2.03 CORRUGATED POLYETHYLENE PIPE

- A. AASHTO M294 - Storm Sewers and Culverts.
- B. AASHTO M-252 - Underdrains.
- C. Circular or slotted perforations.
- D. Flexible extruded pipe with circular or slotted perforations.

2.04 CORRUGATED METAL PIPE (GALVANIZED) CULVERTS (CMP)

- A. Corrugated Metal Pipe: AASHTO M-36, Type I.
- B. Corrugated Metal Pipe Arches: AASHTO M-36, Type II.
- C. Corrugated Metal Pipe Underdrains: AASHTO M-36, Type III. Unless otherwise specified, any of the classes covered may be furnished, and shall be Type I pipe with circular or slotted perforations.
- D. Structural Plate for Pipes, Pipe Arches, and Arches: AASHTO M-167 for galvanized corrugated structural plates and fasteners.

2.05 CORRUGATED ALUMINUM ALLOY CULVERTS AND UNDERDRAINS

- A. Corrugated Aluminum Pipe: AASHTO M-196, Type I pipe.
- B. Corrugated Aluminum Pipe Arches: AASHTO M-196, Type II.
- C. Corrugated Aluminum Underdrains: AASHTO M-196, Type III. Unless otherwise specified, any of the classes covered may be furnished. All pipe shall be perforated.
- D. Aluminum Alloy Structural Plate: AASHTO M-219.

2.06 CONCRETE MATERIALS

- A. Class "A" in accordance with Section 03001.

2.07 BRICK

- A. AASHTO M-91 or ASTM C-32 for the grade specified.
- B. Clay or shale, Grade MS or MM.
- C. Test brick by AASHTO T-32.

2.08 MASONRY CEMENT

- A. AASHTO M-150, ASTM C-91.

- B. Methods of sampling and testing of masonry cement, when required, shall be by the methods of AASHTO:

Sampling	T-127
Fineness	T-192
Normal Consistency	T-129
Soundness	T-107
Time of Setting	T-154
Specific Gravity	T-133
Staining Test	T-105
Compressive Strength	T-106
Plastic Consistency	T-162
Air Content	T-137
Mixing of Mortar	T-162

- C. Fine Aggregate: AASHTO M-45 consisting of hard, strong, durable uncoated mineral or rock particles free from injurious amounts of organic or other deleterious substances.

1. Sand for mortar shall be uniformly graded from coarse to fine within the following limits:

<u>Sieve Size</u>	<u>Total Percent Passing By Weight</u>
8	100
50	15-40
100	0-10
200	0-5

2. Methods of test for fine aggregate, when required, shall be by the following methods of AASHTO:

Sampling	T-2
Organic Impurities	T-21
Mortar Making Properties	T-71
Sieve Analysis	T-27
Material Passing 200 Sieve	T-11

- D. Mix mortar in the following proportions:

1. 1 part masonry cement.
2. 2 parts fine aggregate.
3. Hydrated lime not exceeding 10% of the cement used.
4. Water free of injurious substances, added to form a stiff workable paste.

2.09 CASTINGS FOR FRAMES, GRATES, AND COVERS

- A. Gray Iron, Class 30, AASHTO M-108.
- B. Bituminous paint finish not affected by hot or cold weather.

2.10 PRE-CAST POLYETHYLENE MANHOLES

- A. ASTM D-1248
- B. See Section 02722 for complete specifications.

2.11 PRE-CAST CONCRETE MANHOLES

- A. AASHTO M-199 SR or ASTM C-478.
- B. See City of Alcoa Wastewater Collection – Construction Specifications, latest edition.

PART 3 EXECUTION

3.01 PREPARATION

- A. Prior to laying pipe, prepare a suitable bedding according to Section 02221.
- B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.
- C. Swab the interior of the pipe to remove all undesirable material.
- D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.02 INSTALLING STORM SEWER PIPE

- A. Lay pipe in a straight line on a uniform grade from structure to structure with the bell or groove end up grade.
- B. Firmly support each section throughout its length and form a close concentric joint with the adjoining pipe.
- C. Make junctions and turns with standard or special fittings.
- D. Do not open up more trench at any time than pumping facilities are able to de-water.
- E. Whenever the work ceases, close the end of the pipe with a tight fitting plug or cover.
- F. Close all openings provided for future use and abandoned pipe with a tight fitting plug sealed to avoid leakage.
- G. When the pipe connects with structures, the exposed ends shall be placed or cut off flush with the interior face of the structure and satisfactory connections made.
- H. Any pipe which is not in good alignment or which shows any undue settlement or damage shall be taken up and re-laid without additional compensation.
- I. Laying pipe and sealing joints shall be a continuous operation.

1. Seal all joints during the same day in which the pipe is laid.
 2. Construct the joints in such a manner that a watertight joint will result.
- J. Joints for rigid pipe:
1. Portland cement mortar.
 2. Rubber gaskets.
 3. Other types of joints recommended by the pipe manufacturer and approved.
- K. For mortar joints, the pipe ends shall be thoroughly cleaned and wetted with water before the joint is made. Place stiff mortar in the lower half of the bell or groove of the pipe already laid and on the upper half of the spigot or tongue of the section to be laid. Tightly join sections with their inner surfaces flush and even. Smoothly finish the inside of the joint and remove any surplus material. Protect the complete joints against rapid drying with suitable covering material.
- L. Install rubber ring gaskets to form a flexible watertight seal.
- M. When other type joints are permitted, install or construct in accordance with the recommendations of the manufacturer.
- N. Firmly join flexible pipe by approved coupling bands.
- O. Inspect the pipe before any backfill is placed.
- P. When strutting or vertical elongation is required, it shall be performed in accordance with the details shown on the Plans.
- Q. Leave ties and struts in place until the embankment is completed, unless otherwise specified.
- R. As the work progresses, clean the interior of all pipe in place.
- S. Make connections by constructing catch basins, other structures, or by installing wyes or tees as shown on the Plans. Wyes and tees for future connections shall be installed as indicated.

3.03 CAST-IN-PLACE CONCRETE CATCHBASINS

- A. Perform all concrete construction in accordance with Section 03001.
- B. Inverts: Class A concrete of the shapes indicated on the Plans and constructed to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes with a smooth and uniform finish.

3.04 BRICK CATCHBASINS

- A. Do not construct brick masonry in freezing weather nor when the bricks contain frost.
- B. Select brick for exposed surfaces, corners, etc., from brick approved for color and uniformity.

- C. All brick and the receiving bed shall be thoroughly cleaned and well moistened with water immediately before being laid.
- D. Lay all brick in freshly made mortar, in a substantial and workmanlike manner and true to the lines and grades indicated on the Plans.
- E. Arrange headers and stretchers to thoroughly bond the masonry and, unless otherwise indicated or directed, alternate headers and stretchers with consecutive courses breaking joints.
- F. Face joints shall be neatly struck, using the weather joint.
- G. Finish joints properly as the laying of brick progresses with each not less than 1/4" nor more than 1/2" in thickness.
- H. Do not use spalls or bats except in shaping around irregular openings or when unavoidable to finish out a course; in such case, place a full brick at the corner and the bat in the interior of the course.
- I. Filling materials for the interior of the walls shall be of the same quality as used in the face of the unit, unless otherwise indicated on the Plans.
- J. The surface of brick masonry against which embankment or backfill is to be placed shall be neatly plastered with mortar to a thickness of not less than 1/2", and the mortar shall be finished to a true and uniform surface. The mortar shall be protected and kept wet for 48 hours after completion.

3.05 CATCHBASIN - INLET AND OUTLET PIPES

- A. Extend inlet and outlet pipes through the walls of catch basins, for a sufficient distance beyond the outside surface to allow for connections, cut off flush with the wall on the inside surface, unless otherwise directed.
- B. The concrete or brick and mortar shall be so constructed around the pipes as to prevent leakage and form a neat connection.

3.06 CASTINGS AND FITTINGS

- A. Handle in a manner that will prevent damage. Reject all damaged castings and fittings.
- B. Place all casting and fittings in the positions indicated on the Plans and set true to line and grade.
- C. If castings are to be set in concrete or cement mortar, place all anchors or bolts and position before the concrete or mortar. The casting shall not be disturbed until the mortar or concrete has set.
- D. When castings are to be placed upon previously constructed masonry, the bearing surface of masonry shall be brought true to line and grade and present an even bearing surface in order that

the entire face or back of the casting will come in contact with the masonry. Castings shall be set in mortar beds or anchored to the masonry as indicated on the Plans.

- E. All castings shall be set firm and snug and shall not rattle.

3.07 MEASUREMENT AND PAYMENT – MANHOLES, CATCH BASINS, AND STORM SEWERS

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 03001

CONCRETE WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Formwork, complete with shoring, bracing, and anchorage.
- B. Concrete reinforcing, complete with supports, spacers, and accessories.
- C. Cast-in-place Concrete.

1.02 RELATED WORK

- A. Section 02110: Clearing and Grubbing.
- B. Section 02210: Grading and Excavation.
- C. Section 02215: Base and Subgrade Treatment.

PART 2 PRODUCTS

2.01 AGGREGATE MATERIALS

- A. Fine Aggregate: Natural sand, manufactured sand, or other inert materials with similar characteristics conforming to AASHTO M-6 and/or ASTM C 33 with the following exceptions:
 - 1. Freeze-thaw tests for soundness will not be required.
 - 2. Wash fine aggregates in the processing operations.
 - 3. Process limestone or dolomite from material scalped to remove quarry fines.
 - 4. The material from which the fine aggregate is processed shall have a maximum wear of 40% by the Los Angeles test.
 - 5. Deleterious substances shall not exceed 0.5% by weight for clay lumps, coal, and lignite and 3.0% for material passing the No. 200 sieve and other deleterious substances.
 - 6. Well-graded, coarse to fine and, when tested by means of laboratory sieves, conforming to:

<u>Sieve Size</u>	<u>Total % Passing By Weight</u>
3/8 inch	100
No. 4	95-100
No. 16	60-90
No. 50	10-30
No. 100	0-10

No. 200

0-3

- B. Coarse Aggregate: Crushed stone, crushed slab, gravel, chert, or a combination thereof, or other inert materials with similar characteristics, having hard strong durable pieces free from adherent coatings conforming to AASHTO M-43 and/or ASTM C 33 except as specified otherwise.
1. Furnish coarse aggregate for concrete base and pavement in two sizes: No. 4 and No. 57. The two sizes shall combined in the proper proportions at the batching plant.
 3. Coarse aggregate for structural concrete shall be Size No. 57 or No. 67, as specified or directed.
 4. Coarse aggregate for concrete curbing placed by machine-extrusion methods shall be Size No. 7 or No. 78.
 5. Conform to AASHTO M-80, except that the amount of deleterious substances shall not exceed the following limits:
 - a. Soft or non-durable fragments (fragments which are structurally weak, such as shale, soft sandstone, limonite concretions, gypsum, weathered schist or cemented gravel) 3.0
 - b. Coal or lignite 1.0
 - c. Clay lumps 0.25
 - d. Material passing the No. 200 sieve 0.75
 - e. Thin or elongated pieces (length greater than five (5) times average thickness) 10.00
 - f. Other local deleterious substances 1.0

(Items a, b, c, d, and f combined shall not exceed 5.0)

- B. Aggregate Test Methods: by the following AASHTO tests, when required:

Sampling	T-2
Material passing 200 sieve	T-11
Clay lumps	T-112
Coal and lignite	T-113
Sieve analysis	T-27
Soundness (sulfates)	T-104
Soundness (freezing & thawing)	T-103

1. For fine aggregate add:

Organic impurities	T-21
Mortar-making properties	T-71
Light weight particles	T-149
2. For coarse aggregate add:

Percentage of wear	T-96
Unit weight (slag)	T-19

2.02 CEMENT

- A. Use Portland cement unless otherwise specified.
- B. Portland cement: AASHTO M-85 or ASTM C-150.
1. Test by the following AASHTO methods, when required.
- | | |
|-----------------------|-------|
| Soundness | T-107 |
| Sampling | T-127 |
| Chemical Analysis | T-105 |
| Fineness: | |
| Turbidimeter | T-98 |
| Air permeability | T-153 |
| Time of Setting: | |
| Gillmore needles | T-154 |
| Vicat needles | T-131 |
| Air Content of Mortar | T-137 |
| Normal Consistency | T-129 |
| Tensile Strength | T-132 |
| Compressive Strength | T-106 |
| False Set | T-186 |
- C. Portland Blast Furnace Slag Cement: AASHTO M-151 or ASTM C-205.
1. Test by the following AASHTO methods, when required.
- | | |
|-------------------------|------------|
| Sampling | T-127 |
| Chemical Analysis | T-105 |
| Fineness by Wet Sieving | T-192 |
| Air permeability | T-153 |
| Time of Setting: | |
| Gillmore needles | T-154 |
| Vicat needles | T-131 |
| Air Content of Mortar | T-137 |
| Normal Consistency | T-129 |
| Tensile Strength | T-132 |
| Heat of Hydration | ASTM C-186 |

2.03 WATER

- A. Either potable or reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, sewage, or other injurious foreign matter. Test water not known to be potable in accordance with AASHTO T-26.

2.04 CHEMICAL ADDITIVES

- A. Conform to AASHTO M-194, ASTM C-494, ASTM C-260, and AASHTO M-154 covering the following 6 types.
- Type A - Water reducing admixtures.
- Type B - Retarding admixtures.

Type C - Accelerating admixtures.
Type D - Water reducing and retarding admixtures.
Type E - Water reducing and accelerating admixtures.

2.05 AIR ENTRAINING ADMIXTURES

- A. ASTM C-260, CSA A-23, or AASHTO M-154.

2.06 CONCRETE PROPORTIONING

- A. Base proportioning on a predetermined cement content.
- B. Adjust the quantity of water to meet slump requirements, not exceeding the maximum allowed.
- C. Unless otherwise specified, air entrainment shall be 5% with a tolerance of plus or minus 1-1/2%.
- D. Submit a mix design to Engineer for approval prior to commencing work; TDOT-approved mix designs may be submitted to the Engineer for review and approval.
- E. Use of fly-ash in accordance with TDOT standards will be allowed.
- F. Other admixtures may be used to achieve job-specific results.
- G. Collect compression test specimens using ASTM C-31 or AASHTO T-23.
- H. Test compression strength specimens using ASTM C-39 or AASHTO T-22.
- I. Test slump using ASTM C-143 or AASHTO T-119.
- J. In lieu of other references, the following proportioning table may be used as a basis for concrete mix design.

STRUCTURAL CONCRETE PROPORTIONING TABLE

Type of Coarse Aggregate	Type of Fine Aggregate	Dry Aggregate per Cement Sack		Nominal Yield Cu. Ft. per Sack	Maximum Water Gal. Per Sack	Minimum Sacks Cement per C. Y.
		C.A.	F.A.			
Air Entrained Concrete Based on 5% Air						
CLASS P						
Gravel	Natural	256	149	3.86	5.0	7.0
Limestone	Limestone	266	163	3.86	5.3	7.0
Limestone	Manufactured	266	157	3.86	5.2	7.0
CLASS A						
Gravel	Natural	275	161	4.09	5.3	6.6
Limestone	Limestone	286	175	4.09	5.6	6.6
Limestone	Manufactured	286	169	4.09	5.5	6.6
Non-Air Entrained						
CLASS P						
Gravel	Natural	250	165	3.86	5.8	7.0
Limestone	Limestone	250	180	3.86	5.8	7.0
Limestone	Manufactured	259	174	3.86	5.8	7.0
CLASS A						
Gravel	Natural	269	178	4.09	6.0	6.6
Limestone	Limestone	280	194	4.09	6.0	6.6
Limestone	Manufactured	280	187	4.09	6.0	6.6
Specific Gravity of Gravel Based on 2.52; Specific Gravity of Limestone Based on 2.70						
Specific Gravity of Natural Sand Based on 2.60; Specific Gravity of Limestone Sand Based on 2.70						
Gravel Mixes, 36% F.A. – Limestone Mixes, 38% F.A. for Air Entrained Concrete						
Gravel Mixes, 39% F.A. – Limestone Mixes, 41% F.A. for Non-Air Entrained Concrete						
Adjust cement as needed when fly ash or other admixtures are used.						
Fiber reinforcement may be used.						

2.07 CONCRETE CLASSIFICATIONS

- A. Class "A" Concrete (Structures): Unless otherwise specified and shown on the Plans, all concrete shall be Class A.
1. Fine Aggregate: proportioned by dry weight of fine to coarse aggregates between 30-45%.
 2. Coarse Aggregates: sizes as follows:
Size No. 57 - Structural Concrete.
Size No. 57 or No. 67 - Prestressed and pre-cast concrete.
Size No. 7 or No. 78 - Extruded concrete curbs.
 3. Minimum Compressive Strength: 28 day, 4000 psi, average any 3 cylinders.
 4. Slump: 1 to 3 inches for mass concrete and heavy reinforced section; 2 to 4 inches for slabs, columns, girders, walls, etc. Vary consistency to meet job requirements, provided there is no increase in the water-cement ratio specified in the mix design.
 5. Mixing Water: deduct the moisture content of the aggregate from the amount of mixing water required.
- B. Class "P" Concrete (Base and Pavement):
1. Fine Aggregate: do not use sand manufactured from limestone for traffic lane pavements.
 2. Coarse Aggregate: Size No. 57.
 3. Minimum Compressive Strength: 14 day, 3500 psi, average of any 3 cylinders.
 4. Slump: 1/2 to 1 1/2 inches, workable consistency.
 5. Mixing Water: Include surface moisture but not moisture absorbed by the aggregate.
- C. Class "B" Concrete: Use for anchors, kickers, encasement for pipelines, sub-foundations, mass footings, and fill, unless otherwise specified.
1. Fine Aggregate: proportion by dry weight of fine to coarse aggregates between 30-45%. Test for potential alkali reactivity per ASTM C-289-71. Use natural river sand or specially approved manufactured sand, only.
 2. Coarse Aggregate: Size No. 57 or 67 as specified.
 3. Minimum Cement Content: 5.0 bags (470 lbs) per cubic yard.
 4. Minimum Compressive Strength: 28 day, 2500 psi, ave. of any 3 cylinders.
 5. Slump: 5 to 8 inches for pipe encasements and 2 to 4 inches in sub-foundations and other specified areas.
 6. Mixing Water: Maximum amount of water per 94 lb. bag of portland cement shall be 6.5 gallons. Deduct the moisture content of the aggregate from the amount of water required.

2.08 CONCRETE MIXING

- A. Obtain approval of all equipment prior to commencement of concrete placing operations.
- B. Mix and handle concrete in accordance with the general requirements of the TDOT.

- C. Provide Engineer free access to mixing site for inspection of equipment and mixing operations.
- D. Check and compensate for, if applicable, moisture content of aggregates prior to mixing.
- E. Mix batches only in quantities required for immediate use.
- F. Remove from the project site all concrete reaching the site in a pre-set condition or which fails slump requirements.
- G. Project Site and General Plant Mixers:
 - 1. Furnish equipment sufficient to accurately measure, weigh, and control all materials entering the mixer.
 - 2. Discharge the entire batch from the mixer prior to recharging.
 - 3. Do not exceed the mixer capacity rating.
 - 4. Maintain drum rotation peripheral speed of 200 feet per minute.
 - 5. Start mixing time when all solid materials are in mixer drum.
 - 6. Mix water before 1/4 of the mixing time has elapsed.
 - 7. Mix a minimum of 1 1/2 minutes for the first cubic yard; add 15 seconds for each cubic or fraction of a cubic yard thereafter.
 - 8. For a Project Site Mixer: furnish equipment necessary for quality control at least equal to that obtained in an acceptable central plant.
 - 9. For Central Plant Mixer: furnish loading tickets showing class of concrete, project name and number, time of batching, and batch weights of each material to Engineer prior to placing concrete.
- H. Truck Mixers:
 - 1. Provide watertight, revolving drum truck mixers which maintain a uniform distribution of materials throughout the mix.
 - 2. First 30 seconds of mixing must be done at the proportioning plant.
 - 3. Measure, weigh, and control solid materials at the proportioning plant.
 - 4. Equip truck mixer with a mixing water tank capable of accurately measuring water.
 - 5. All water may be added at project site to prevent pre-set conditions.
 - 6. Mix a minimum of 50 revolutions after all ingredients are in the drum at a minimum speed of 4 rpm and a maximum peripheral drum speed of 225 feet per minute.
 - 7. Mix a maximum of 150 revolutions at speeds in excess of 6 rpm.

2.09 TRANSPORTING

- A. Transport only in approved truck mixers, truck agitators or non-agitating trucks.
- B. On-site mixing in the truck will be approved in hot weather or when the logistics of material handling requires it.
- C. If strength or slump tests are not found to be uniform, truck mixing will not be allowed.

2.10 CONCRETE CURING MATERIALS

- A. Cure all concrete surfaces not protected by forms by keeping the surface moist or by the application of a membrane-forming curing compound.
- B. Initially, wet cure for a period of at least (24) hours. During the initial curing period, keep the surface moist and protected by burlap mats or other approved materials.
- C. Water: Water used in curing Portland cement concrete shall not contain any substances which will damage the surface of the concrete.
- D. Sand and Earth: Free of stones or other materials which will damage the surface of the concrete.
- E. Liquid Membrane-Forming Compounds: AASHTO M-148.
- F. Polyethylene Sheeting: AASHTO M-171.
- G. Burlap: AASHTO M-182, Class 3 or 4.
- H. Straw: Reasonably clean and free of any material that will damage the surface of the concrete.

2.11 EXPANSION AND CONSTRUCTION JOINTS

- A. Preform Bituminous Fillers: AASHTO M-33.
- B. Hot-Poured Elastic Type: AASHTO M-173.
- C. Preformed Elastomeric Compression Joint Seals: AASHTO M-260.

2.12 REINFORCEMENT STEEL

Includes plain and deformed steel bars, cold drawn steel wire or fabricated forms of these materials.

- A. Bar Reinforcement for Concrete Structures:
 - 1. Steel bars for reinforcement of concrete structures shall be billet steel bars conforming to the requirements of ASTM A-615, grade 40 or 60.
 - 2. Reinforcing bars shall be deformed and shall have minimum section areas as shown in the following table:

SIZES AND AREAS OF REINFORCING BARS
(DIMENSIONS ARE FOR ROUND SECTIONS)

Bar Designation Number (a)	Nominal Diameter Inches	Cross Sectional Area Square Inches	Perimeter Inches	Weight Pounds Per Foot	Notes
#2	0.250	0.05	0.786	0.167	(b)
#3	0.375	0.11	1.178	0.376	
#4	0.500	0.20	1.571	0.668	
#5	0.625	0.31	1.963	1.043	
#6	0.750	0.44	2.356	1.503	
#7	0.875	0.60	2.749	2.044	
#8	1.000	0.79	3.142	2.670	
#9	1.128	1.00	3.544	3.400	
#10	1.270	1.27	3.990	4.303	
#11	1.410	1.56	4.430	5.313	
(a) Bar numbers denote nominal diameters of round bars in eighths-of-an-inch. The nominal diameter of a deformed bar is equivalent to the diameter of a plain bar having the same weight per linear foot as the deformed bar.					
(b) 1/4 inch diameter bar in plain round only.					

- B. Dowel Bars: plain steel bars.
- C. Tie Bars: deformed in accordance with ASTM A-305 except that No. 2 bars may be either deformed or plain. Tie bars which are to be bent during construction shall conform to ASTM A-615 grade 40.
- D. Welded Steel Wire Fabric: Welded steel wire fabric for concrete reinforcement shall meet the following minimum requirements:
 - 1. Conform to the requirements of ASTM A-185 for smooth wire or ASTM A-47 for deformed wire.
 - 2. Wire used in the manufacture of welded wire fabric shall conform to Cold Drawn Steel Wire ASTM A-82.
 - 3. When wire is ordered by size number, the following relationship between size number, diameter, and area shall apply:

Size No.	Nominal Diameter (In.)	Nominal Area (In. ²)	Size No.	Nominal Diameter (In.)	Nominal Area (In. ²)
W31	0.628	0.310	W6	0.276	0.060
W30	0.618	0.300	W5.5	0.265	0.055
W28	0.597	0.280	W5	0.252	0.050
W26	0.575	0.260	W4.5	0.239	0.045
W24	0.553	0.240	W4	0.226	0.040
W22	0.529	0.220	W3.5	0.211	0.035
W20	0.505	0.200	W3	0.195	0.030
W18	0.479	0.180	W2.5	0.178	0.025
W16	0.451	0.160	W2	0.160	0.020
W14	0.422	0.140	W1.5	0.138	0.015
W12	0.391	0.120	W1.2	0.124	0.012
W10	0.357	0.100	W1	0.113	0.010
W 8	0.319	0.080	W0.5	0.080	0.005
W 7	0.299	0.070			

- E. Fabricated Materials: steel bar, rod mates, or welded steel fabric shall conform to ASTM A-184 and A-185.
- F. Metal Supports: Support for tie bars and reinforcing bars shall conform to current CRST Standards.
- G. Expansion Dowel Caps: Use 32 gauge sheet metal indented to provide a limiting stop for a minimum 1" movement of the dowel bar.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clear construction area in accordance with Section 02110.
- B. Prepare base and/or subgrade in accordance with Section 02215.

3.02 FORMWORK

- A. Erect forms:
 - 1. True to line, grade, and cross section.
 - 2. Mortar tight and sufficiently rigid to prevent distortion due to the pressure of the concrete and construction operations.
 - 3. Held in place with studs or uprights and waling, sufficiently braced and tied to prevent the opening of formwork joints.
- B. Chamfer all exposed edges with 3/4" strips that are straight, of uniform width and dressed.
- C. Remove wood devices to separate forms before placing concrete within 4" of such devices.
- D. Form Lumber:
 - 1. Dressed at least on 1 side and 2 edges.
 - 2. Plywood or similar material for forms may be used if they are substantial, of uniform thickness, and are mortar tight when in position.
- E. Construct metal ties or anchors to permit removal to a depth of at least 1" from the face without injury to the concrete.
- F. Leave openings along the bottom of walls to permit cleaning prior to placing concrete. Close such openings prior to placing concrete.
- G. Treat forms with an approved coating to prevent the adherence of concrete. Do not use any material that will adhere to or discolor the concrete.
- H. Do not use metal forms which do not line up properly, are not true to shape, or which have rust, grease, or other foreign matter on them.

3.03 FALSEWORK

- A. Support falsework on sills resting on rigid, solid rock foundations, driven piles or earth-borne footings.
- B. Do not use earth-borne footings if, in the Engineer's opinion, the soil cannot support the superimposed loads.
- C. Construct falsework to support the forms without distortion or settlement.
- D. Provide "tell-tales" to observe falsework movement.

3.04 REINFORCEMENT

- A. Accurately bend, without heating, reinforcing steel to the forms and dimensions shown on the

drawings, if required.

- B. Bend in one plane, unless otherwise specified.
- C. Uncoated bars of 3/4" or less which have single bends may be bent in the field. Perform all other bending in the shop prior to shipment.
- D. Furnish reinforcement in full lengths without splices as shown on the drawings, unless otherwise indicated.
- E. Where splicing is approved:
 - 1. For bars, rigidly clamp splices with at least 2 metal clips placed 3" from the ends or securely wire in place.
 - 2. For fabric, overlap sheets not less than 12" and securely wire the overlapped sections.
- F. Clean all reinforcement of all foreign matter that will reduce the bond, prior to placing concrete.
- G. Accurately place reinforcement and firmly hold in place as shown on the drawings:
 - 1. Fasten with wire clips or wire at each intersection.
 - 2. Securely space reinforcement from forms and adjacent reinforcement with pre-cast concrete or mortar blocks, metal spacers, or approved devices.
 - 3. Do not use wood, brick, or gravel for spacers.
- H. Obtain approval of reinforcement from Engineer prior to placing concrete.

3.05 DRAINAGE AND WEEP HOLES

- A. Construction in the manner shown on the drawings.
- B. Backfill structures, when required, by placing a 1 foot by 1 foot wire basket filled with coarse aggregate of size 7, 8, 57, 67, 68, or 78 of TDOT specifications.

3.06 EXPANSION JOINTS

- A. Use expansion devices as shown on the drawings.
- B. Securely anchor in position, true to line and grade.
- C. Chamfer joint edges as shown on drawings.
- D. Construct open joints using forms permitting removal without injury to concrete.
- E. Construct filled joints with pre-molded filler, 1/2" thick.

- F. Thoroughly clean and seal joints when required.

3.07 PLACING CONCRETE

- A. Obtain approval of forms and reinforcement prior to placing concrete.
- B. Coat forms immediately before placing.
- C. Place concrete only during daylight hours.
- D. Thoroughly work concrete with approved tools to force aggregate from the surface and bring mortar against the forms to produce a smooth finish, free of water, air pockets, or honeycomb.
- E. Correct forms bulging or settlement before proceeding with placement.
- F. After the initial set and prior to final set, do not jar or strain projecting reinforcement.
- G. Place concrete to avoid segregation of materials and displacement of reinforcement.
- H. Compact the concrete using mechanical vibrators:
 - 1. Work concrete around reinforcement, fixtures, and into corners and angles of the forms.
 - 2. Do not prolong to the point where segregation occurs.
 - 3. Where necessary, supplement by hand spading.
- I. Feather-edge construction joints are not permitted, nor are transverse or longitudinal joints through spans, except where specified.
- J. Do not stop or temporarily discontinue concreting within 18" of any finished surface unless an 18" thick coping is provided.
- K. In resuming work, draw forms tightly against concrete faces.
- L. Clean and roughen concrete surfaces to be bonded and soak with clean water prior to proceeding with placement.

3.08 REMOVAL OF FORMS AND FALSEWORK

- A. Remove forms for vertical surfaces not carrying loads in from 12 to 48 hours.
- B. In cold, damp, or freezing weather, leave forms in place until the concrete has sufficiently set.
- C. Remove forms with care not to mar or strain the concrete.
- D. Remove or cut metal form ties in a neat workmanlike manner.

- E. Fill all holes with cement mortar mixed in the same proportions as the concrete used.
- F. Leave forms and supports under concrete structure until:
 - 1. A tested compressive strength of 3000 psi is attained.
 - 2. Minimum of 7 days not counting days with temperatures below 40 degrees F. or 21 days, whichever occurs first.
- G. Leave forms until all concrete in continuous slabs has been placed a sufficient time as stipulated above.

3.09 DEFECTIVE CONCRETE

- A. Remove and replace all concrete which:
 - 1. Is bulged, uneven, or shows honeycombing that cannot be repaired.
 - 2. Has a 28-day strength less than the minimum specified.

3.10 FINISHING CONCRETE

- A. Finish concrete surfaces immediately after form removal.
- B. Minimum Finish: Class I for all surfaces.
- C. Class II or Applied Texture Finish for:
 - 1. Curb tops and outside faces.
 - 2. Sidewalk slabs.
 - 3. Retaining, wing, and end walls.
 - 4. Those surfaces shown on the drawings.
- D. Class I, Ordinary Surface Finish:
 - 1. Remove all fins and irregularities where surfaces are to be exposed or waterproofed.
 - 2. Clean, saturate with water and point and true all holes, honeycombs, and other defects.
 - 3. Mortar for pointing shall be mixed in the proportions of the concrete class used and shall not be more than 30 minutes old.
 - 4. Tool and clean mortar and concrete from all joints.
 - 5. Leave joint filler exposed for its full length with clean and true edges.
 - 6. Rub all surfaces not repairable as specified for Class II finishes.
- E. Class II, Rubbed Finish:
 - 1. Start concrete rubbing as soon as conditions permit.
 - 2. Keep concrete saturated until starting rubbing.
 - 3. Allow pointing mortar to thoroughly set.
 - 4. Rub surfaces using a wetted wooden block or a medium coarse carborundum stone.
 - 5. Rub until all irregularities have been removed, all voids filled and a uniform surface has been obtained.

6. Leave the past produced by rubbing in place.
7. Do not brush finish or paint with grout.
8. Rub final finish with a fine carborundum stone and water until the entire surface is of uniform texture and color.
9. Rub with burlap to remove loose powder after the surface has dried.

F. Applied Texture Finish:

1. Initially prepare surface as for Class I.
2. Remove all foreign substances and surface moisture.
3. Shield and mask surfaces not receiving the coated finish.
4. Cracks over 1/8" wide are to be veed out and filled.
5. Apply the textured finish by spray only at the rate of 45 square feet per gallon with heavy-duty spray equipment.
6. The finish color shall be as near as practical to rubbed concrete finish color.

3.11 CURING

- A. In all cases, curing shall have prior right to all water.
- B. Do not expose the concrete for more than one-half hour between stages of curing or during the curing period.
- C. Immediately after finishing, when marring of the concrete will not occur, cover and cure the entire surface of the newly placed concrete in accordance with one of four methods.
- D. Completely cover all surfaces and edges with the curing substance.
- E. Maintain the curing substance in place for 72 hours after placement of concrete.
- F. Cotton or Burlap Mats:
 1. The mats used shall extend at least twice the thickness of the pavement beyond the edges of the slab.
 2. Prior to being placed, saturate the mats thoroughly with water.
 3. Place and weigh down the mats to cause them to remain in intimate contact with the surface.
 4. Keep the mats fully wetted during curing, unless otherwise specified.
- G. Waterproof Paper:
 1. Lap the units at least 18 inches.
 2. Place and weigh down to cause it to remain in intimate contact with the surface covered.
 3. The paper shall extend beyond the edges of the slab at least twice the thickness of the pavement.
 4. If laid longitudinally with paper not manufactured in sizes which provide this width, cement together in such a manner that the joints do not open up or separate during the curing period.

5. Wet the surface of the pavement prior to placing paper.

H. Impervious Membrane Method:

1. Spray the surface uniformly with white pigmented curing compound immediately after finishing the surface and before the set of the concrete has taken place.
2. If the pavement is cured initially with jute or cotton mats, apply upon removal of the mat.
3. Do not apply curing compound during rainfall.
4. Apply the curing compound under pressure by mechanical sprayers at the rate recommended by the manufacturer, but not less than one gallon to each 150 square feet.
5. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator.
6. At the time of use, thoroughly mix the pigment to uniformly disperse it throughout the vehicle.
7. Continuously stir the compound by effective mechanical means.
8. Hand spraying of odd widths, shapes, or concrete surfaces exposed by the removal of forms will be permitted.
9. Do not apply the curing compound to the inside faces of joints to be sealed.
10. Should the film become damaged during the curing period, repair the damaged portions immediately with additional compound.
11. Upon removal of side forms, protect exposed areas immediately by applying curing treatment equal to that provided for the surface.

I. White Polyethylene Sheeting:

1. Lap the units at least 18 inches.
2. Place and weigh down to cause it to remain in intimate contact with the surface covered.
3. The sheeting used shall extend beyond the edges of the slab at least twice the thickness of the pavement.
4. Wet the surface of the pavement prior to placing the sheeting.

J. Curing in Cold Weather:

1. When concrete is being placed and the air temperature may be expected to drop below 35 degrees F., sufficiently supply suitable blanketing material along the work.
2. Any time the temperature may be expected to reach the freezing point, spread the material over the pavement to a sufficient depth to prevent freezing of the concrete.
3. Take care not to mar the concrete surface.
4. Maintain such protection not less than 5 days.
5. This method is in addition to other curing methods specified above, rather than being a substitute therefore.
6. The Contractor shall be responsible for the quality and strength of concrete placed during cold weather, and any concrete injured by freezing action shall be removed and replaced at his expense.

3.12 MEASUREMENT AND PAYMENT

- A. Measurement and payment shall be in accordance with the unit the Bid Schedule.
- B. If no unit(s) for this work are included in the Bid Schedule, cost(s) for this shall be incorporated into other bid items.
- C. Payment for work outside the limits of construction indicated in the plans or otherwise specified shall not be made unless approved in advance by the Engineer.

SECTION 04001
DESIGN CRITERIA -
DRAINAGE SYSTEMS

PART 1 - SCOPE

- 1.01 The purpose of compiling this criteria for standard procedures in storm sewer design and subsurface drainage is to develop improved, routine methods of planning, designing, and checking storm sewer plans. Covered herein are the reference information needed, design procedures, and standard details. Some situations may dictate greater requirements. Alternative design methods may be presented to the City Engineer for consideration.

PART 2 -GENERAL

2.01 STORM WATER

- A. Storm waters shall generally be carried in storm sewer systems on the basis of criteria established in this section and subject to final determination and approval of the Engineer.

2.02 STORM SEWER SYSTEMS

- A. Systems shall be designed to protect against flooding of property of all classes and maintain the required level of service for public facilities. Storm sewer systems shall be designed as a coordinated unit and may include any or all of the following elements:
1. Enclosed storm sewers and appurtenance
 2. Open channels
 3. Swales on property lines and/or back lot lines
- B. Enclosed sewers shall be used to collect and convey drainage on, across, and through public street right-of-way. Outfall drains should extend along all side lot lines. The minimum allowable pipe diameter shall be 15-inch unless approved by the City Engineer.
- C. Open channels may be allowed only along rear lot lines, and/ or to carry storm water runoff from tributary areas exceeding 100 acres, from smaller tributary areas, or when approved as a Natural Channel as specified in Section 8.07. Otherwise, an enclosed storm sewer pipe shall be used. An adequate drainage structure(s) shall be provided where open channels cross public right-of-way.
- D. Roadside ditches are generally not acceptable and may be used to convey drainage along public rights-of-way only in rural areas when designated by the City Engineer. Culverts and appurtenant drainage facilities shall be designed to permit their incorporation into a future enclosed storm sewer system when possible. Ditches shall be designed to meet the requirements for open channels.
- E. Designers of storm sewer systems installed as part of a development shall investigate all receiving systems to the nearest blue-line stream. The developer will be required to improve / upgrade all down-gradient storm sewers as part of their site improvements.

1.03 VELOCITY

- A. Discharge velocity shall be controlled to prevent both erosion and siltation at and immediately downstream from the point(s) of discharge. Energy dissipating structures shall be used.

PART-3 DESIGN PROCEDURES

3.01 MAPS

- A. Prints showing the water shed area, recorded plats, survey maps, or other plans which are available showing the tributary area shall be obtained.

3.02 SURVEYS

- A. Check and confirm survey reference data with the official plat book and other recorded information.

3.03 UTILITIES

- A. The location of all utility lines existing and proposed from files and other information supplied by utility companies and City records shall be checked.

3.04 EXISTING INFORMATION

- A. Determine the ridge lines of the tributary area and establish the general routing of the proposed storm sewer. Check connecting storm sewer lines, appurtenances, street grades, and all other information pertaining to the location of the proposed sewer.

3.05 PRELIMINARY LAYOUT

- A. Prepare the preliminary layout and grades.
- B. The drainage pattern must be compatible with the existing pattern established in the area.

3.06 ULTIMATE DEVELOPMENT

- A. Compute the estimated ultimate density and impervious surfaces of the area. Information may be obtained from the City Engineer's office and/ or the Planning and Zoning Department.

3.07 FIELD CHECK

- A. Verify the preliminary design by field checking of the water shed area, critical connections, crossings, slopes, etc., before proceeding with the final draft of the plan.

3.08 RUNOFF

- A. Establish and indicate curb grades, outline of the runoff area, and indicate cubic feet per second by increment at each point of interception.

3.09 CURB CAPACITY

- A. Calculate curb capacities for each side of the street interdependently. Differences in curb elevations, off-center crowns, etc. must be taken into consideration.

3.10 INLETS

- A. When calculations indicate that curb capacities are exceeded at a point, no further allowance shall be made for flow beyond that point and basins shall be used to intercept flow at that point. However, catch basins should not be installed at intervals greater than 400 feet. All flow shall be picked up by an inlet. Paved gutters may be used to intercept flow and drained to an approved outfall on approval of the Engineer.

3.11 INLET AND PIPE CAPACITY

- A. Calculate capacities for inlets, pipe laterals, and storm sewers. No public storm sewer pipe shall be smaller than 15 inches in diameter unless approved by the City Engineer.

3.12 MAXIMUM DEPTH

- A. Drainage water must not exceed the depth of the curb at any point.

3.13 HYDRAULICS

- A. Calculate and show hydraulics of pipe inlets. Calculate velocity head and hydraulic profiles of flows exceeding a velocity of 15 feet per second.

PART-4 RUN-OFF CALCULATIONS AND CRITERIA

4.01 DRAINAGE CALCULATIONS

- A. The Rational Method of calculating storm water quantities may be used for water sheds less than 100 acres. For areas greater than 100 acres, the USDA Soil Conservation Service's Urban Hydrology for Small Watersheds, Technical Release No.55 shall be used. Alternative methodology may be submitted for consideration by the City Engineer.
- B. As a minimum, all components of the storm sewer system shall be designed to accommodate the peak runoff from a 25-year storm. However, depending on local conditions, storm sewers of larger capacity may be required by the City Engineer.

4.02 RATIONAL METHOD

- A. The Rational Method of calculating storm water quantities, $Q = AIR$, shall be used with the following definitions of terms, and arbitrary values.
 - 1. Q is the quantity of run-off in cubic feet per second and is used as a basis for design of the storm drainage system.
 - 2. A is the area in acres contributing to the drainage system. All upstream tributary areas are to be considered as fully developed as zoned at the time of design.
 - 3. I is the percentage of imperviousness of the area and shall have the following values where applicable:

For all watertight roof surfaces	.75 to .95
For asphalt runway pavements	.80 to .95
For concrete runway pavements	.70 to .90
For gravel or macadam pavements	.35 to .70
*For impervious soils (heavy)	.40 to .65
*For slightly pervious soils	.15 to .40
*For slightly pervious soils, with turf	.10 to .30
*For moderately pervious soils	.05 to .20
*For moderately pervious soils, with turf	.00 to .10

* = For slopes from 1% to 2%.

4. R is intensity of rainfall in inches per hour and shall be determined for the yearly frequency specified below and as specified from the intensity duration curves attached to this criteria:
 - a. 10 year (return period) - Rural and fringe areas with low volume streets.
 - b. 25 Year (return period) - Residential areas.
 - c. 50 years (return period) - Major drainage channels in residential, commercial, arterial street culverts, and open channel slopes.
 - d. 100 years (return period) - Critical area, flood plains in commercial areas and natural flood plains in residential areas.

4.03 TIME OF CONCENTRATION

Time of concentration equals the inlet time plus the time for water to flow down the pipe or channel to the point at which the peak flow is to be determined. The inlet time shall be figured taking into account the topography, size, and surface characteristics of the contributing area but shall not exceed 15 minutes unless detailed calculations justifying longer periods are submitted.

PART-5 PIPE SIZING

5.01 MANNING FORMULA

- A. Pipe size in integrated underground systems will normally be determined in accordance with the Manning Formula:

$$V = (1.48/n) r^{2/3} s^{1/2}$$

- B. Culverts shall be sized based on Hydraulic Design Series 3, 4, 5 and Hydraulic Engineering Circular 12 as published by the Federal Highway Administration. The value of N in the Manning Formula shall be as designated below. The exception will be in cases where slopes are above the critical. Pipe sizing shall then be determined by entrance control. Head shall be considered up to a point where inundation will not cause damage to properties.
- C. The coefficients of friction allowed for the various kinds of pipe are as follows:

Portland Cement Concrete	N = 0.013
Corrugated Metal	N = 0.023
Corrugated Metal with Paved Invert	N = 0.021
Smooth Flow Corrugated Metal	N = 0.013
Vitrified Clay Pipe	N = 0.013

Asbestos Cement	N = 0.012
Corrugated Polyethylene - Smooth Interior	N = 0.012

5.02 MINIMUM PIPE SIZE

- A. The minimum size storm sewer shall be 15 inches in diameter unless approved by the City Engineer. Reinforced concrete pipe will be required beneath all public streets.

5.03 VELOCITY

- A. All storm drainage systems shall be designed so as to maintain a minimum velocity of flow of 3 feet per second and a maximum velocity of 15 feet per second when flowing full.

5.04 VELOCITY HEAD

- A. Large quantities or masses of water flowing at a high rate of speed contain a large amount of kinetic energy, which in hydraulics is defined as velocity head ($V^2/2g$).
- B. Any change in cross section, restrictions in pipes or inlets shall be considered energy losses and shall be taken into consideration in the design of the system.

5.05 SLOPE

- A. All sewers shall be designed and constructed to give mean velocities when flowing full of not less than 3 feet per second. The following pipe sizes and minimum slopes are listed for information purposes. Slopes shall be shown on plans in percent.

Sewer Size	----- Minimum Slope - Percent -----		
	n=0.013	n=0.019	n=0.021
15"	0.33%	0.70%	0.85%
18"	0.26%	0.55%	0.65%
21"	0.20%	0.45%	0.55%
24"	0.17%	0.36%	0.45%

(Note: Percent is specified for purposes of compatibility with nomenclature used on current laser equipment.)

PART- 6 LOCATION AND DEPTH OF COVER

6.01 LOCATION

Storm drainage lines shall generally be located in a right-of-way or easement and shall be placed as shown on the approved submitted plans.

6.02 DEPTH OF COVER

- A. All storm drainage lines shall have a minimum cover of 18 inches where practical. Cover may be decreased to avoid conflicts or on short laterals. Special bedding or protection shall be required where cover is decreased below 18 inches.

PART- 7 DRAINAGE INLETS

7.01 LOCATION

- A. Provide inlets to maintain a reasonable level of vehicular and pedestrian traffic service.

7.02 GENERAL

- A. Contain all flow within street curbs during the design storm.

7.03 ARTERIAL & COLLECTION STREETS

- A. Limit gutter flow width to prevent encroachment on the center 24 feet of street during run-off occurring 50 percent of peak design rates of the design storm.
- B. Flow across intersections shall be limited. Where economic and other factors control, the following shall apply. Limit gutter flow across intersections with arterial or collector class streets to provide a maximum flow not greater than:

Longitudinal Gutter Slope	Flow C.F.S.
0.5%	0.30
1.0%	0.45
2.0%	0.60
3.0%	0.70
4.0%	0.70
5.0% and over	1.00

7.04 RESIDENTIAL STREETS

- A. Limit flow width to prevent encroachment on the center 14 feet of street during peak design rates of the design storm.
- B. Limit gutter flow across intersections with arterial or collector class streets as provided for arterial street intersections.

7.05 PEDESTRIAN CROSSWALK

- A. Gutter flow across major pedestrian crosswalks including marked crosswalks on streets bordering school grounds, pedestrian signal controlled crosswalks, and crosswalks in retail business areas shall be limited as provided for arterial street intersections.

PART- 8 OPEN CHANNELS

8.01 GENERAL

- A. Open channels shall be sized to carry design rates of flow without significant damage or erosion to the channel. Channels shall be fenced, sloped, or otherwise protected to prevent injury to the public. Open channels shall be stabilized with (1) seed & geotextile material, (2) sod, (3) rip-rap, (4) concrete, and/or (5) other means to prevent erosion. Such materials

shall be specified based on the design velocity of the stormwater, side slopes of the ditch, and other pertinent factors.

8.02 CONNECTIONS

- A. Pipe culverts, box culverts, and other structures entering channels shall not project into the normal waterway area.

8.03 VELOCITY

- A. Channel design shall include lining or treatment of the sides as required to minimize erosion. Minimum treatment shall include seeding and geotextile fabric. Channel inverts and sides shall be lined in accordance with the following minimum recommendations:

<u>Mean Flow Velocity</u>	<u>Type of Lining</u>
3 F.P.S. & Less	Seed & Geotextile Fabric
3 - 8 F.P.S.	Sod
8 - 15 F.P.S.	Rip-rap or Concrete
Over 15 F.P.S.	Concrete Paved

Lining materials having equivalent erosion control properties to those shown in the foregoing table may be used with prior approval by the City Engineer.

8.04 CAPACITY

- A. Open channels shall be sized to carry the design flow rates plus freeboard of one (1) foot or 10% of the design depth, whichever is greater.

8.05 SECTIONS

- A. Channel sections shall be compatible with the type of lining and maintenance practice to be used. Side slopes shall not be steeper than 2 horizontal to 1 vertical. Side slopes for channels lined with sod, grass, or other vegetative ground shall not be steeper than 3 horizontal to 1 vertical. Friction factors used in design shall be considered in selecting type of lining.

8.06 CHECK DAMS

- A. Check dams may be required to control flow velocity in open channels. Check dams shall be designed to prevent flow by-pass by undercutting or erosion around the ends. Adequate paving or rip-rap shall be provided at the downstream toe of check dams to prevent erosion or loss of foundation supported by undercutting. Wood may be used for temporary check dam construction only.

8.07 NATURAL CHANNELS

- A. Natural channels of adequate capacity and having stable banks and invert may be used without modification. The riparian zones of all such channels shall be maintained in their natural states. The easement document and/or plat for the channel shall include restrictions pertaining to clearing and/or modification of the riparian zone.

PART- 9 DESIGN DETAILS

9.01 PLAN

- A. The plan view of all storm sewer details shall indicate the proper location of the storm sewer, appurtenances, size of line, capacity, and other details of the drainage system.
- B. The plan shall show sufficient detail to include exact locations, proper ties into existing permanent reference points, proper angles, and distances from other utilities to be placed or presently in the street right-of-way.

9.02 PROFILE

- A. The profile of all storm sewers shall show the slope, existing and proposed street grades, locations of angles and appurtenances, and proper elevations for existing outfall ditches.
- B. The profile shall indicate the size of line and the capacity of each line as determined by the design engineer.
- C. The total area draining to each basin and the Q that will be required to be dissipated at that point shall also be indicated, on either plan or profile.

PART- 10 EASEMENTS

10.02 EASEMENTS

- A. Permanent drainage easements shall be obtained for all storm sewers and open drains that are not within a public right-of-way.
- B. Permanent easements shall be obtained for all detention/retention pond sites and flowage rights for temporary detention and conveyance of storm drainage.
- C. Easements shall be shown for all storm sewer components constructed on private property. The easements for storm sewers shall be a minimum width of 15 feet for enclosed structures and 20 feet for open paved channels. Easements shall:
 - 1. Be of adequate area/width to contain entire structure;
 - 2. Include adequate area/width for maintenance and repair of the same;
 - 3. Include means of ingress/egress necessary for inspection, maintenance, and/or repair of the storm sewer system.
- D. Deeds and easements shall be properly recorded.

PART- 11 SUGGESTED STORM SEWER DESIGN CHECK LIST

11.01 SUGGESTED STORM SEWER DESIGN CHECK LIST

- () 1. Control--Scale: Horizontal 1" = 50', Vertical 1" = 10'
- () Large scale for details
- () Drawing number and date
- () North Arrow
- () Tabulation of revisions

- () Name, address, and telephone number of developer/owner and engineer.
- () Signature Blocks
- () 2. Boundary Lines: Counties, Cities, Drainage Area, etc.
- () 3. Subdivision: Name and location by section
- () 4. Streets: Names and widths
- () 5. Easements: R.O.W.
- 6. Survey Data Complete:
 - () Curve Data - Where curved sewers are placed
 - () Line, grade & depth-dimensioned & specified
- 7. Pipe Size and Class:
 - () Existing lines
 - () Proposed lines - size, length, and cover
 - () Connections
 - () Elevations and grades shown
- () 8. Manholes: Designation, spacing, and invert elevations shown
- () 9. Location and depth of existing utilities, cable, and structures as available from records
- () 10. Test hole data if required
- () 11. Structural details adequate
- () 12. Removals and replacements - trees, poles, paving, etc.
- () 13. Sealed by Professional Engineer

PART- 12 TEMPORARY DETENTION

12.01 GENERAL

- A. Provisions of areas for the temporary, controlled detention of storm drainage and its regulated discharge to the downstream storm sewer system at peak rates less than would occur without such facilities, shall be included in storm sewer systems development unless specifically waived by the City Engineer.

12.02 PERFORMANCE CRITERIA

- A. As a minimum, the design storm shall be a storm of 24-hour duration and having a return period of a 25- years as set forth in "Run-off Calculations and Criteria" for enclosed structures. However, depending on local conditions, detention facilities of a larger capacity may be required by the City Engineer.
- B. Detention storage areas shall have adequate capacity to contain maximum required volume of tributary storm drainage run-off plus freeboard of one (1) foot or 10% of the design depth, whichever is greater.

- C. Adequate provisions and allowances shall be made for the accumulation and removal of silt.
- D. Outlet works shall be designed to limit peak outflow rates from detention storage areas to or below peak flow rates that would have occurred prior to the proposed or zoned development of the tributary area.
 - 1. Outlet works shall not include any mechanical components or devices and shall function without requiring attendance or control during operation.
 - 2. Size and hydraulic characteristics should be such that all water in detention storage is released to the downstream storm sewer system within 24 hours of the end of the design rainfall. Plans for “wet” detention / retention ponds may be submitted for consideration.
 - 3. The primary outlet(s) shall be restricted using a V-notch weir or other means of graduated or “stepped” release to limit peak flow to pre-development conditions for all storms of a 5- year interval or greater. The outlet restrictor may be designed with “steps” for storm intervals of 5-yr., 10-yr., 15-yr., etc.
- E. Detention storage systems shall be designed to accept storm drainage run-off from the entire area tributary thereto, regardless of ownership of lands included within the tributary area.
- F. Emergency spillways shall be provided to permit safe passage of water from storms producing run-off in excess of the design storm. The emergency spillway capacity shall be adequate to convey the peak run-off from a 100- year storm.
- G. Emergency spillways shall be either concrete or rip-rap lined and include an energy dissipating outlet.
- H. “Dry” detention ponds shall be designed and constructed to maximize the infiltration of water into the ground.
- I. The detention pond shall include a swale for the conveyance of flow to the outlet structure. The swale shall be designed and constructed to accommodate the flow from a 5-year design storm. The swale shall be designed and constructed in accordance with Part 8 of these specifications.
- J. All surfaces of the pond, dam, and surrounding area shall be seeded, fertilized, and mulched unless otherwise stabilized.

12.03 DESIGN DATA SUBMITTAL

In addition to complete plans and unless otherwise designated, the following design data shall be submitted for the City Engineer's approval for all projects including temporary detention facilities:

- A. Run-off hydrograph plotted in units of inches per hour, run-off rate of the tributary area as ordinates, and time from the start of run-off as abscissas. The run-off hydrograph shall be developed to include all storms of lesser duration within the 24-hour storm.
- B. Area: Capacity curve for proposed detention facility plotted in units of datum elevation as ordinates, and cumulative volume of storage as abscissas.
- C. Discharge characteristics curve of outlet works plotted in units of detention facility water surface elevation as ordinates, and discharge rate in C.F.S. as abscissas.

- D. Combined Storage: Outflow curves showing both inflow and discharge in units of accumulated volume as ordinates, and time from the start of run-off as abscissas.
 - 1. Curves shall be arranged so that the vertical distance between the accumulated storage and accumulated discharge will indicate the net volume in storage at any point in time.
 - 2. Curves shall be extended to the time required for complete discharge of all run-off stored in the detention facility.

12.04 LAND REQUIREMENTS

- A. Permanent easements for the temporary impoundment of storm water run-off shall be dedicated to the Developer, Property Owner, Homeowners' Association, or other similar entity. The permanent easement shall include all lands, structures, and facilities to be used for temporary detention and conveyance of storm drainage.
- B. Easements shall include all necessary provision and land necessary for the association or other approved entity for right-of-entry for purposes of inspection and/or maintenance. All instruments and easements shall be subject to the approval of the City.

12.05 MAINTENANCE

- A. Provisions acceptable to the city for perpetual maintenance of temporary detention facilities, outlet works, and appurtenances, shall be made.
- B. Upon completion of construction of the development, all accumulated silt shall be removed from the detention pond. Periodic maintenance shall be performed thereafter to ensure adequate storage capacity.

12.06 PERMITS

- A. Building permits for projects including temporary detention facilities may be granted by the City only after all easements have been dedicated, accepted, and recorded, and all required maintenance agreements, contracts, and bonds have been executed.

PART- 13 METHODS TO REDUCE QUANTITY OF RUN-OFF AND MINIMIZE POLLUTION

13.01 METHODS

- A. If the storm water is permitted to follow its natural hydrological process, it will inevitably result in a reduction in the quantity of storm water run-off and a reduction of pollution loading in the receiving watercourses.
- B. Storm water shall be directed into the soil preferably to the same extent as nature did prior to development, and maybe to an even greater extent. By allowing storm water to infiltrate back into the soil, it will not only reduce the quantity of run-off and recharge to water table, but the filtering properties of the soil will improve the water quality.
- C. Whatever amount cannot be so accommodated at the point of rainfall shall be detained in nearby locations for a controlled outlet to the receiving streams, with peak flows approaching the pre-development peak flows.

- D. There are a variety of methods in common use today that can effectively control peak run-off rates, while at the same time, improving quality. The following Table lists several such methods along with their effectiveness.

Measures for Reducing Quantity of Run-off and Minimize Pollution

MEASURE	Reduce Volume of Run- off	Reduce Peak Rate of Run-off	Improve- ments to Run-off Quality	AREA TYPE*				
				Res	Ins	Com	Ind	Hwy
Roof water to grassed surfaces	x	x	x	x				
Contour Grading	x	x		x				
Porous Pavement								
- interlocking stones	x	x		x	x	x	X	
- graveled surfaces	x	x		x	x	x	X	
- porous asphalt	x	x		x	x	x	X	x
Grassed Ditches	x	x	x	x	x	x	X	x
Infiltration Basins	x	x	x	x	x	x	X	x
Blue-Green Storage		x		x	x	x	X	
Ponding on flat roofs		x			x	x	X	
Ponding on roadways		x					X	
Ponding on parking lots		x			x	x	X	
Detention Ponds (dry pond)		x	x	x	x	x	X	x
Retention Ponds no freeboard			x					
Retention Ponds with freeboard		x	x	x	x	x	X	
Subsurface Disposal								

MEASURE	Reduce Volume of Run- off	Reduce Peak Rate of Run-off	Improve- ments to Run-off Quality	AREA TYPE*				
- perforated storm sewer	x	x	x	x	x	x	X	x
- infiltration trenches	x	x	x	x	x	x	X	x
- dry wells	x	x	x	x	x	x	X	x
Subsurface Detention		x	x	x	x	x	X	x

*AREA TYPES

Res – Residential Com - Commercial Hwy - Highways
Ind - Industrial Ins - Institutional

SECTION 05001

DESIGN CRITERIA - STREETS

PART- 1 SCOPE

1.01 SCOPE

- A. Street is a general term denoting a public way for purpose of vehicular travel including the entire area within the right-of-way.

PART- 2 GENERAL

2.01 GENERAL

- A. This section will consider all phases in the design of a street and problems to be considered and solved in order to complete the right-of-way and construction plans.

PART- 3 DESIGN

3.01 DESIGN TRAFFIC VOLUMES

- A. Traffic estimates used for the design of residential streets shall be expressed as ADT volumes. Design hour volumes shall be used for arterial and collector streets by making peak hour traffic assignments in lieu of ADT assignments.

3.02 DESIGN SPEED AND SIGHT DISTANCE

- A. All streets shall be designed in accordance to A Policy on Geometric Design of Highways and Streets (AASHTO), latest edition, as published by American Association of State Highway and Transportation Officials.

	<u>Relationship of Sight Distance to Design Speed</u>		
	<u>30 mph</u>	<u>40 mph</u>	<u>50 mph</u>
Minimum stopping sight distance, feet	200	275	350
Desirable stopping sight distance, feet	200	300	450
Minimum passing sight distance, feet	1,100	1,500	1,800

3.03 INTERSECTION ANGLE

- A. Street intersections shall be as near perpendicular as possible. Acute angles of intersection are subject to review and approval by the city engineer.

3.04 VISIBILITY TRIANGLE

- A. There shall be no obstruction of driver visibility within 25 feet of intersecting edges of pavement.

3.05 ALIGNMENT

- A. Terrain has considerable influence on the final choice of alignment. Generally, the topography of an area is fitted into one of the following three classifications: flat, rolling, or hilly.

RELATION OF MAXIMUM GRADES TO DESIGN SPEED					
	ARTERIAL		COLLECTOR & RESIDENTIAL STREET		
Type of Topography	Design Speed MPH		Design Speed MPH		
	40	50	30	40	50
Flat	5%	4%	8%	7%	9%
Rolling	6%	5%	9%	8%	7%
Hilly	8%	7%	11%	10%	9%

In mountainous regions, steeper grades may be allowed, but for short horizontal distance.

3.06 DESIGN TRAFFIC VOLUMES

- A. Traffic estimates used for the design of residential streets shall be expressed as ADT volumes. Design hour volumes shall be used for arterial and collector streets by making peak hour traffic assignments in lieu of ADT assignments.

PART- 4 PAVEMENT CROWN

4.01 PAVEMENT CROWN

- A. Plane sections shall be used on streets with 0.02 feet of drop per foot of width.
- B. Pavement for undivided streets, regardless of the number of lanes, is normally crowned from the centerline.

PART- 5 NUMBER OF LANES

5.01 NUMBER OF LANES

- A. The number of lanes required shall be determined by the design hour volume (DHV). DHV's shall be obtained from the Tennessee Department of Transportation (TDOT), when available and current. When not available or current, DHV's shall be determined from local studies by averaging the highest afternoon peak traffic flows for each week for a period of one year. DHV's shall be adjusted when necessary to consider future and/or seasonal traffic volumes.

Suggested Service Volumes
Initial Estimate of Number of Lanes

Type of Highway	Design Speed - Miles/Hour	Trial Service Volume - Vehicles/Lane/Hour
Other Principal Arterial	55	800*
	50	500**
Minor Arterial	40	300***
Collector	30	200***

* Assuming 60 percent green time

** Assuming no parking and 45 percent green time

*** Assuming parking and 30 percent green time

PART- 6 ROADWAY WIDTHS, MEDIANS, CURBS, GUTTERS, AND SIDEWALKS

6.01 ROADWAY WIDTHS, MEDIANS, CURBS, GUTTERS, AND SIDEWALKS

- A. Final design of all streets shall conform to the current standards of AASHTO, the institute of Transportation Engineers, and/ or prevailing design standards of other professional organizations.

PART- 7

7.01 DIMENSIONS

- A. Dimensions and other pertinent information for the various types of curbs, gutters, and sidewalks are shown on the detail drawings following this section.
- B. The need for and width of sidewalks shall be determined on the basis of specific densities of land development and volumes of pedestrian and vehicular traffic. Sidewalk widths in central business districts and other high-density areas may be determined objectively on the basis of capacity analyses. The quality and rate of pedestrian flow depend on the amount of space available per pedestrian.

PART- 8 DRIVEWAYS

8.01 LOCATION - INTERIOR LOT

- A. Minimum distance from edge of driveway to property line:
1. Residential - 5 feet.
 2. Commercial- 10 feet.

8.02 WIDTH

- A. The recommended widths for driveway:
1. Residential - minimum 10 feet, maximum 20 feet.
 2. Commercial - As determined by traffic projections.

8.03 DRIVEWAY ANGLE

- A. As near perpendicular to the street as possible. Acute angles of intersection are subject to review and approval by the city engineer.

8.04 INTERSECTING RADIUS OF PAVEMENT

- A. The driveway edge shall intersect the street edge with a radius having the following dimensions:
 - 1. Residential - minimum 5 feet, maximum 15 feet.
 - 2. Commercial- minimum 15 feet.
- B. In lieu of radii, the driveway edges may intersect the street edge using a 45-degree taper of the same dimensions noted above.

8.05 VISIBILITY TRIANGLE

- A. There shall be no obstruction of driver visibility within 25 feet of intersecting edges of pavement.

PART- 9 ACCOMMODATION OF UTILITIES

9.01 UTILITY ACCOMODATIONS

- A. Utility locations within roadway and easements shall be as discussed in TDOT Policies and Procedures for Accommodating Utilities within Highway Rights-of-Way

PART- 10 RAILROAD GRADE CROSSING

10.01 RAILROAD GRADE CROSSINGS

- A. All railroad intersections at grade require proper advance warning signs. At crossings on heavily traveled streets where conditions justify, automatic devices shall be installed. All warning signs and devices shall be installed in accordance with the Manual on Uniform Traffic Control Devices.
- B. Use grade separations at railroad crossings when train-auto conflict ratios are high.

PART- 11 STREET LIGHTING

11.01 STREET LIGHTING

- A. Breakaway light standards should be utilized on arterial streets.
- B. Light standards should not be erected along the outside of sharp curves.
- C. Where street lighting is being considered for future installation, conduits under pavements and curbs should be part of initial construction.

PART- 12 TRAFFIC CONTROL DEVICES

12.01 TRAFFIC CONTROL DEVICES

- A. Traffic control devices are all signs, signals, markings, and devices placed on, over, or adjacent to a street or highway by authority of a public body or official having jurisdiction to regulate, warn, or guide traffic.
- B. Traffic control devices should conform to the Manual on Uniform Traffic Control Devices for streets and highways. All warning signs and barricades required for Construction zones shall be furnished by the Contractor. The local regulatory authority will furnish all other traffic control devices.

PART- 13 PREPARATION OF PLANS

13.01 GENERAL

- A. In urban areas the design process is more involved, reflecting the complexities of urban conditions. Among the conditions that control urban design are:
 - 1. Traffic service.
 - 2. Land use.
 - 3. Off-street parking.
 - 4. Other transportation systems.
 - 5. Topography and geology.
 - 6. Sociological considerations.

13.02 TITLE SHEET

- A. The first sheet of a set of plans, which is known as the "title sheet," shall show a map of the area in which the project is located.
- B. The map shall show the point of beginning and point of ending; the main topographical features; county and state lines; and possible detour routes.
- C. The name and number of the project are also indicated. Provisions are also made on this sheet for the affixing of signatures approving the plans that are contained in the complete set.

13.03 INDEX

- A. An index of roadway plan sheets, bridge sheets, and tabulation of standard drawings shall be shown on or referenced on the title sheet.

13.04 TYPICAL SECTIONS AND ESTIMATED QUANTITIES

- A. Show typical sections on tangent and in curve, width of paving, curb and gutter, and minimum width of right-of-way, tabulate all estimated quantities, and all special details not covered by standard drawings.

13.05 PROPERTY MAPS

- A. Property maps are generally drawn to a scale of 1" = 200' showing the boundary of the entire property fronting on the street or road to be built.
- B. The existing right-of-way, the proposed right-of-way, and tracts numbered consecutively. A right-of-way acquisition tabulation showing tract number, name of property owner, acreage right and left,

total acres, deed acres, acreage to be acquired right and left, remainder right and left, easement (footnote if construction easement), and book and page of deed record.

13.06 PRESENT LAYOUT, PROPOSED LAYOUT, AND PROFILE SHEETS

- A. Existing topography, present right-of-way, survey centerline, drainage pipes, culverts, bridges, proposed right-of-way, proposed ramps, indicated width and end of construction, proposed paving, top of cut, and toe of fill are shown on the present layout.
- B. Base line, paper location centerline, if any, curve data, P.O.T., P.I., P.C., P.T., and T.S. and C.S. (if spirals are included), are shown on proposed layout, also proposed paving, ramps, and drainage. The ground profile, the finish grade profile, estimated grading quantities, balanced points, and drainage structures with estimated quantities are shown below proposed layout. Elevations of the top of catch basins, junction boxes, invert flow line of storm sewer pipes are to be shown on proposed layout sheet and tabulated quantities.

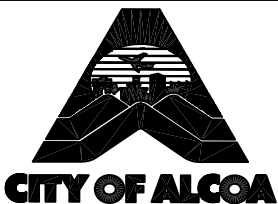
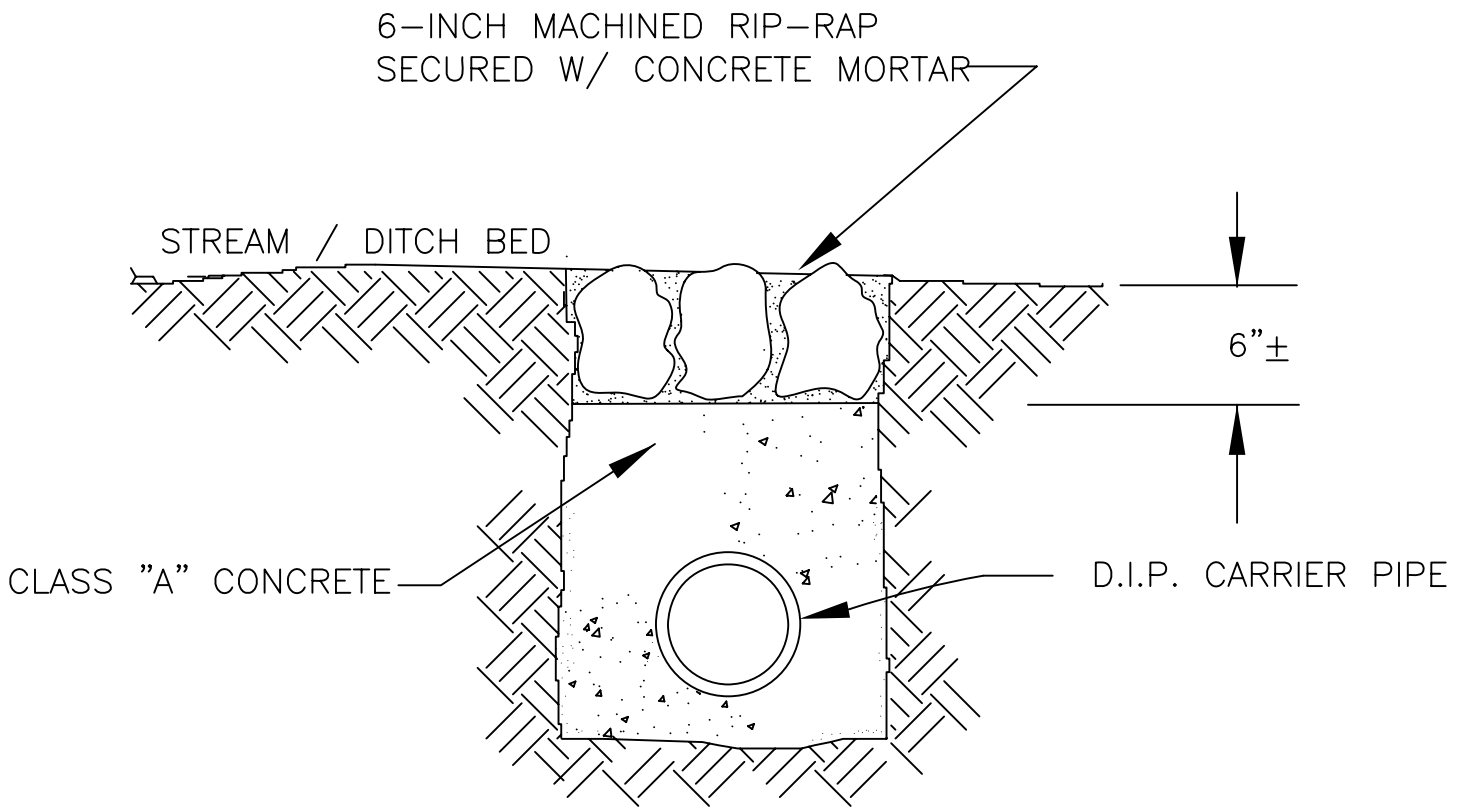
13.07 DRAINAGE CROSS-SECTION SHEETS

- A. Drainage cross-section sheets will show profiles on the centerline of the drains, roadway templates, pipes, type of endwalls, station, and skew of pipes along with estimated quantities.
- B. Cross-sections show end areas and quantities between cross-sections.

APPENDIX – STANDARD DRAWINGS

STREET & DRAINAGE - CONSTRUCTION SPECIFICATIONS

**THE CITY OF ALCOA, TENNESSEE
PUBLIC WORKS & ENGINEERING DEPARTMENT**

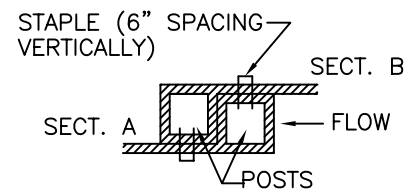


REVISED:

STREAM / DITCH
CROSSING

DRAWING NO.

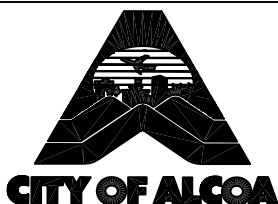
STREAM
CROSSING



JOINING TWO ADJACENT TEMPORARY FILTER BARRIERS

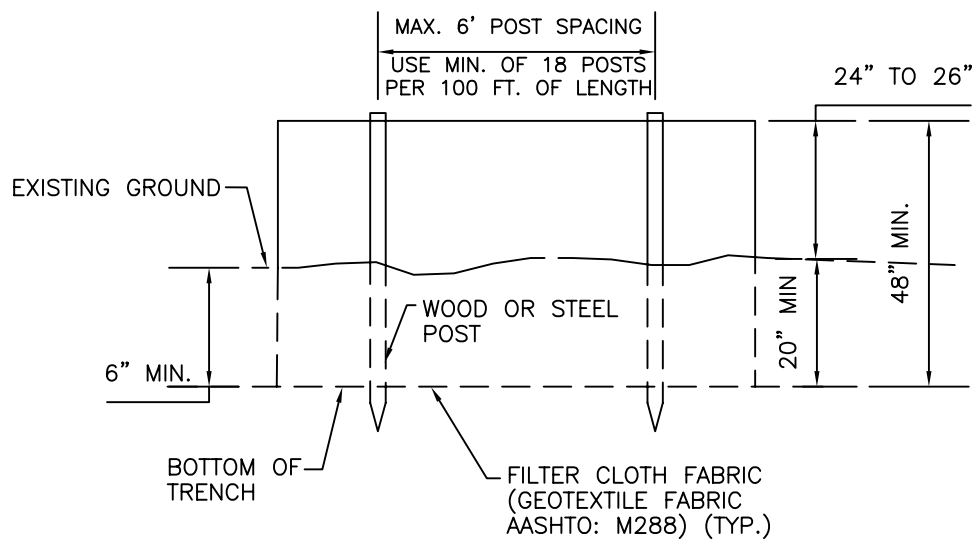


1. FILTER CLOTH SHALL MEET THE REQUIREMENTS OF THE STANDARDS FOR GEOTEXTILE, AASHTO DESIGNATION: M288, SEDIMENTS CONTROL, SELF SUPPORTED.
2. THE FILTER MATERIAL SHALL BE STAPLED TO THE WOODEN STAKES. HEAVY DUTY WIRE STAPLES WITH 1/2" LEG AND 1" WIDTH SHALL BE USED AND EVENLY SPACED WITH AT LEAST FOUR PER POST.
3. SILT FENCES AND FILTER BARRIERS SHOULD BE PLACED ALONG OR NEAR THE GROUND CONTOUR. THE BOTTOM OF THE FENCE OR BARRIER AT THE GROUND LINE SHOULD BE ON A ZERO PERCENT (0%) GRADE. $\pm .5\%$.
4. A PRE ASSEMBLED SILT FENCE OR FILTER BARRIER MEETING THE REQUIREMENTS OF THIS DRAWING IS ACCEPTABLE IN LIEU OF A FIELD CONSTRUCTED SILT FENCE OR FILTER BARRIER.
5. WHEN HEIGHT OF EMBANKMENT EXCEEDS 15 FEET THE USE OF A TEMPORARY SILT FENCE IS GENERALLY RECOMMENDED WHEN HEIGHT OF EMBANKMENT IS LESS THAN 15 FEET THE USE OF A TEMPORARY FILTER BARRIER MAY BE USED.
6. THE DRAINAGE AREA FOR THE TEMPORARY FILTER BARRIER SHALL BE 1 ACRE OF LESS OR THE MAX. DRAINAGE AREA SIZE FOR A CONTINUOUS BARRIER SHALL BE 1/8 ACRE PER 100 FEET OF BARRIER LENGTH.
7. WHEN APPROVED BY ENGINEER, MINERAL AGGREGATE MAY BE USED INSTEAD OF TRENCHING AND BACKFILLING.
8. ALL LABOR AND MATERIALS SHOWN ON THE ELEVATION AND SECTIONAL VIEWS USED TO CONSTRUCT FILTER BARRIERS ARE TO BE INCLUDED IN THE PRICE OF THE BID.
9. FILTER BARRIERS ARE USED TO INTERCEPT SMALL AMOUNTS OF SEDIMENT, AND REDUCE VELOCITY.



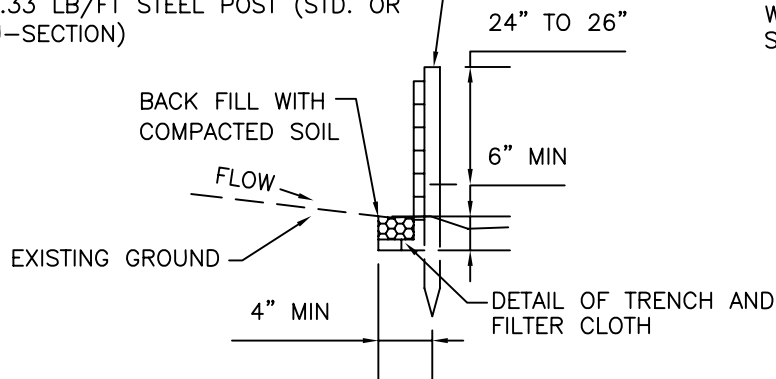
TEMPORARY
FILTER BARRIER

TEMP FILTER
BARRIER



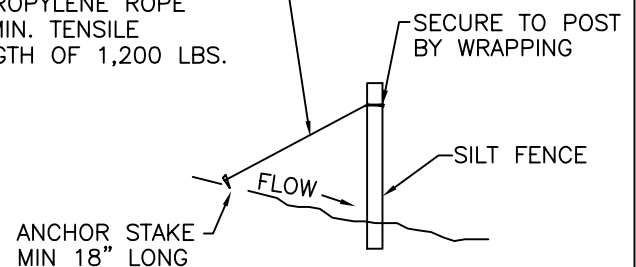
ELEVATION VIEW

MIN. 2" (NOMINAL) X 2" (NOMINAL) - (1.5" ACTUAL X 1.5" ACTUAL) OAK OR HICKORY - LENGTH 48" OR MIN. 1.33 LB/FT STEEL POST (STD. OR U-SECTION)



SECTIONAL VIEW

TIEBACK BETWEEN FENCE AND POST AND ANCHOR STAKE TO BE NO.8 (.025") HOLLOW BRAIDED POLYPROPYLENE ROPE WITH MIN. TENSILE STRENGTH OF 1,200 LBS.

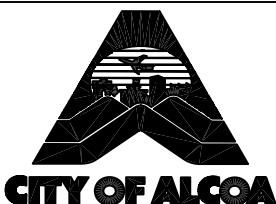


SILT FENCE TIE BACK

(WHEN REQUIRED BY THE ENGINEER OR NOTED IN THE PLANS. COST TO BE IN THE ITEMS FOR TEMPORARY SILT FENCE)

GENERAL NOTES

1. FILTER CLOTH SHALL MEET THE REQUIREMENTS OF THE STANDARDS FOR GEOTEXTILE, AASHTO DESIGNATION: M288, SEDIMENTS CONTROL, SELF SUPPORTED.
2. THE FILTER MATERIAL SHALL BE STAPLED TO THE WOODEN STAKES. HEAVY DUTY WIRE STAPLES WITH 1/2" LEG AND 1" WIDTH SHALL BE USED AND EVENLY SPACED WITH AT LEAST FOUR PER POST.
3. SILT FENCES AND FILTER BARRIERS SHOULD BE PLACED ALONG OR NEAR THE GROUND CONTOUR. THE BOTTOM OF THE FENCE OR BARRIER AT THE GROUND LINE SHOULD BE ON A ZERO PERCENT (0%) GRADE. $\pm .5\%$.
4. A PRE ASSEMBLED SILT FENCE OR FILTER BARRIER MEETING THE REQUIREMENTS OF THIS DRAWING IS ACCEPTABLE IN LIEU OF A FIELD CONSTRUCTED SILT FENCE OR FILTER BARRIER.
5. WHEN HEIGHT OF EMBANKMENT EXCEEDS 15 FEET THE USE OF A TEMPORARY SILT FENCE IS GENERALLY RECOMMENDED. WHEN HEIGHT OF EMBANKMENT IS LESS THAN 15 FEET THE USE OF A TEMPORARY FILTER BARRIER MAY BE USED.
6. THE DRAINAGE AREA FOR THE TEMPORARY SILT FENCE SHALL BE 2 ACRES OR LESS OR THE MAXIMUM DRAINAGE AREA SIZE FOR A CONTINUOUS SILT FENCE SHALL BE 1/4 ACRE PER 100 FEET OF FENCE LENGTH.
7. ALL LABOR AND MATERIALS SHOWN ON THE ELEVATION AND SECTIONAL VIEW USED TO CONSTRUCT SILT FENCE ARE TO BE INCLUDED IN THE PRICE OF THE BID.
8. SILT FENCES ARE USED TO INTERCEPT SMALL AMOUNTS OF SEDIMENT, REDUCE VELOCITY, AND HAVE A LONGER LIFE THAN TEMPORARY FILTER BARRIER.
9. WHEN STEEL POSTS ARE USED THEY SHALL HAVE A PROJECTION FOR FASTENING WIRE TO THEM. THE WIRE FASTENERS SHOULD BE EVENLY SPACED WITH AT LEAST FIVE PER POST.

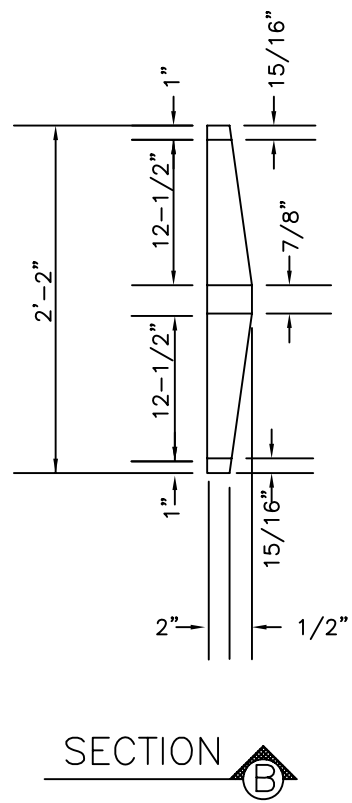
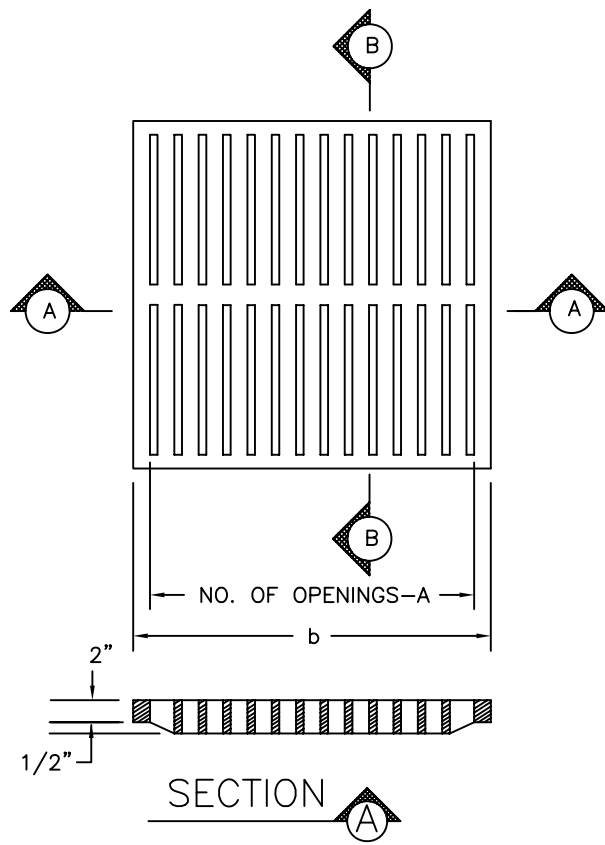


REVISED:

TEMPORARY
SILT FENCE

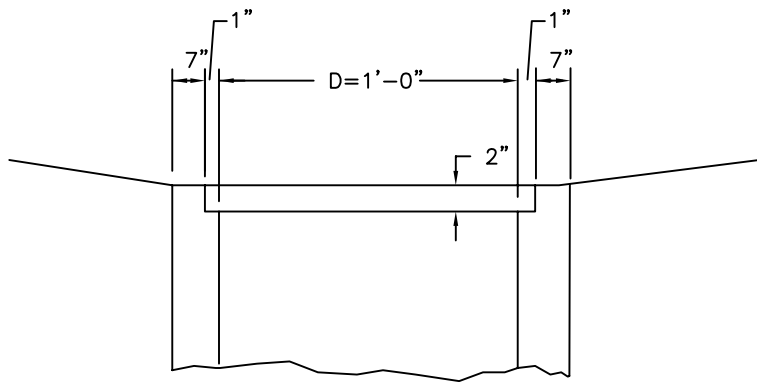
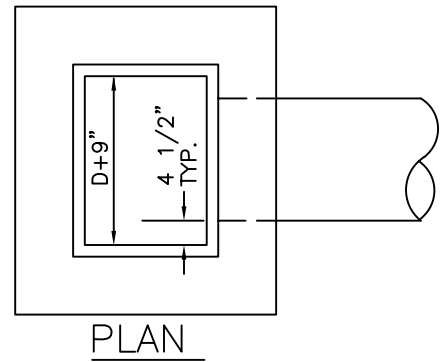
DRAWING NO.

TEMP
SILT FENCE

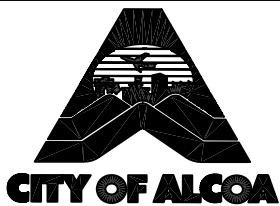
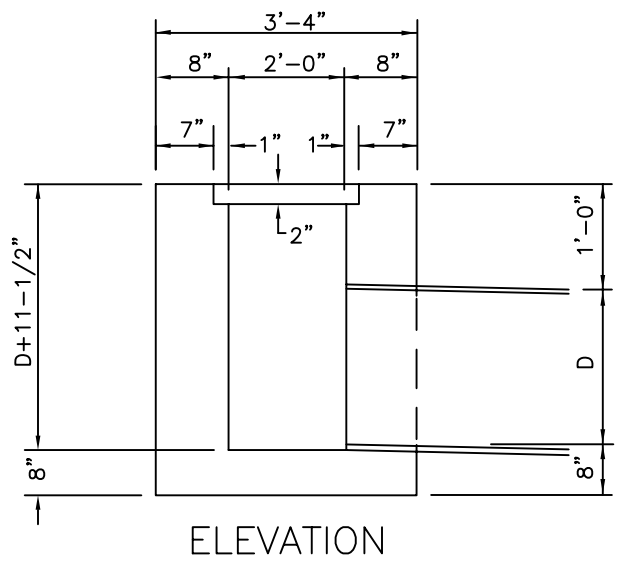


NOTES:

1. GRATE SHALL BE DESIGNED FOR ANTICIPATED FLOW.
2. SUBMIT AHOP DRAWINGS FOR REVIEW.



NOTE: TOP OF INLET TO BE LOWER THAN ADJACENT SURFACE TO FORM SUMP AS DIRECTED BY THE ENGINEER



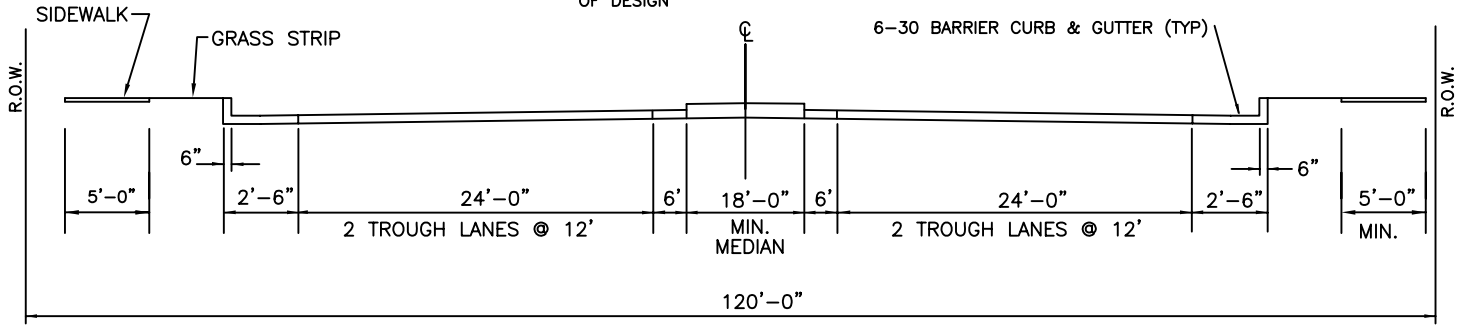
REVISED:

AREA DRAIN WITH
GRATE

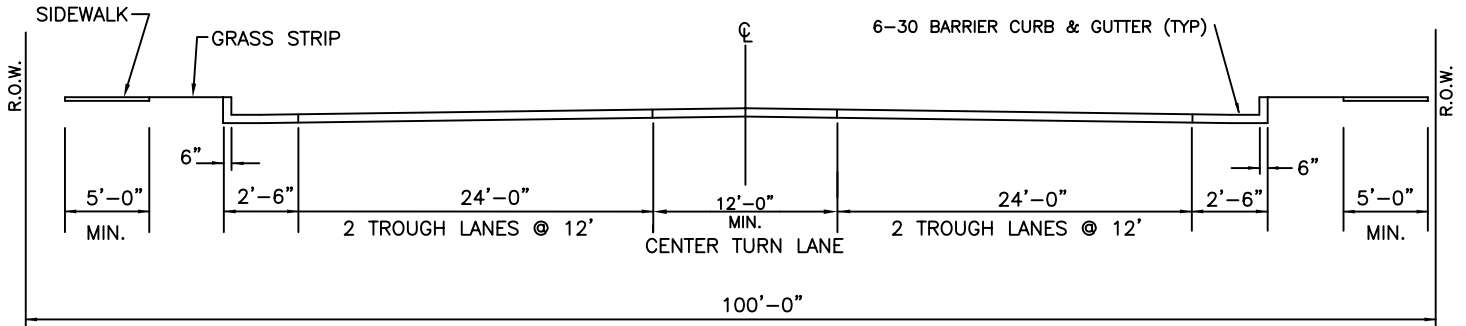
DRAWING NO.

AREA DRAIN

NOTE: SEE ALCOA SUBDIVISION REGULATIONS FOR
GENERAL REQUIREMENTS AND MINIMUM STANDARDS
OF DESIGN

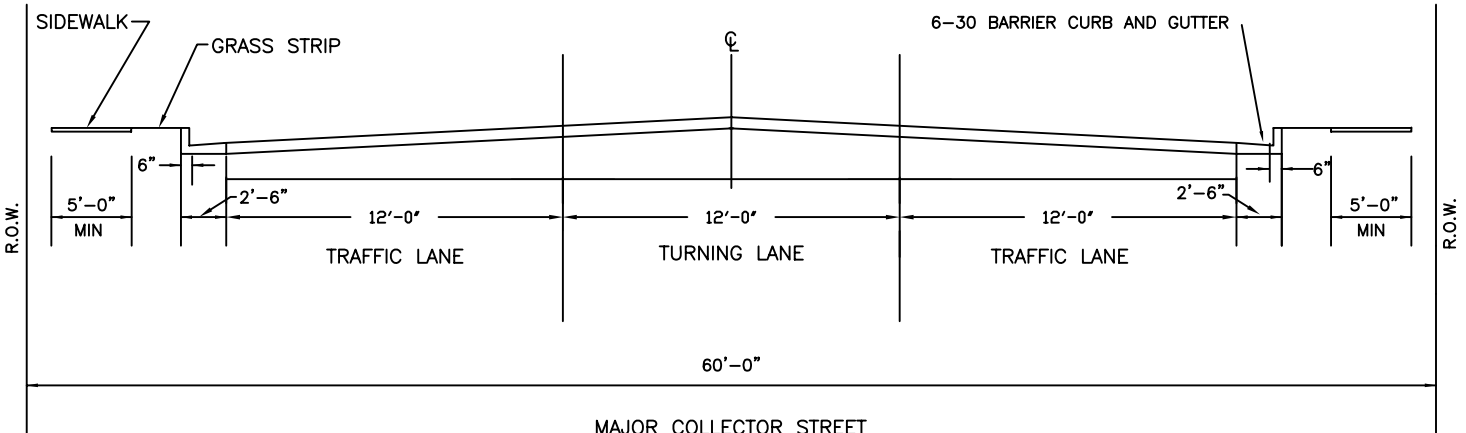


MAJOR ARTERIAL STREETS

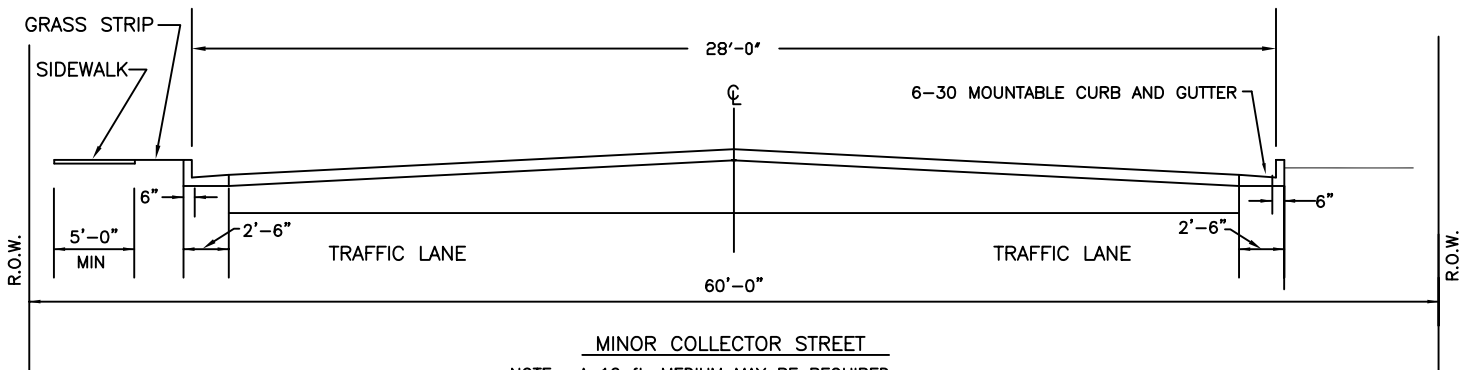


MINOR ARTERIAL STREETS

NOTE: BLOULEVARD WITH 18 ft. MEDIUM MAY BE REQUIRED.

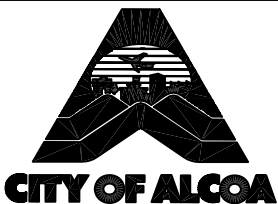


MAJOR COLLECTOR STREET



MINOR COLLECTOR STREET

NOTE: A 12 ft. MEDIUM MAY BE REQUIRED.

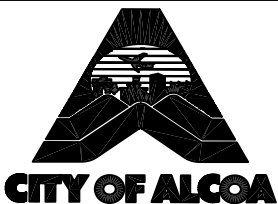
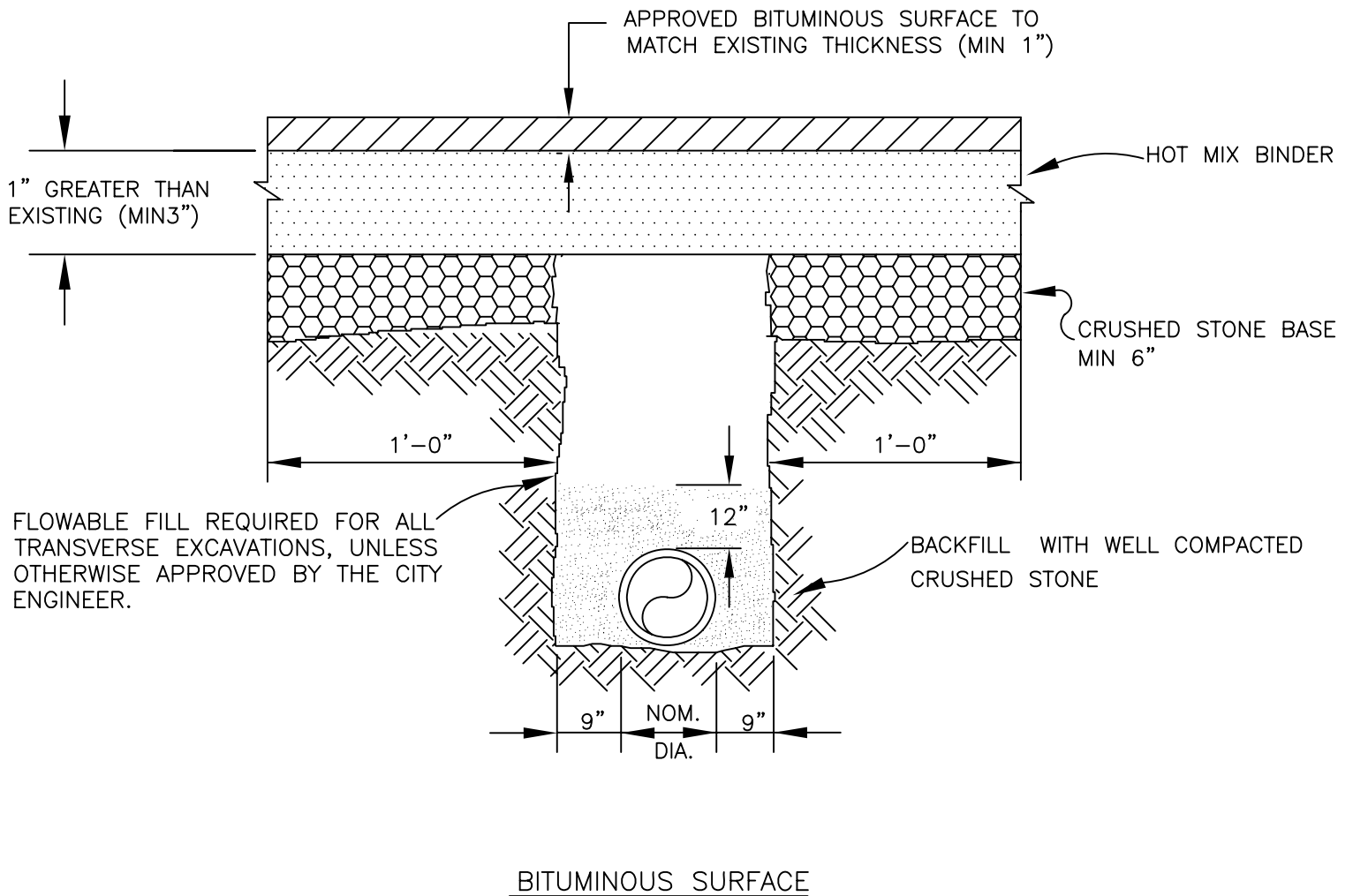


REVISED:

ROADWAY WIDTHS

DRAWING NO.

ARTERIAL
COLLECTOR
WIDTHS

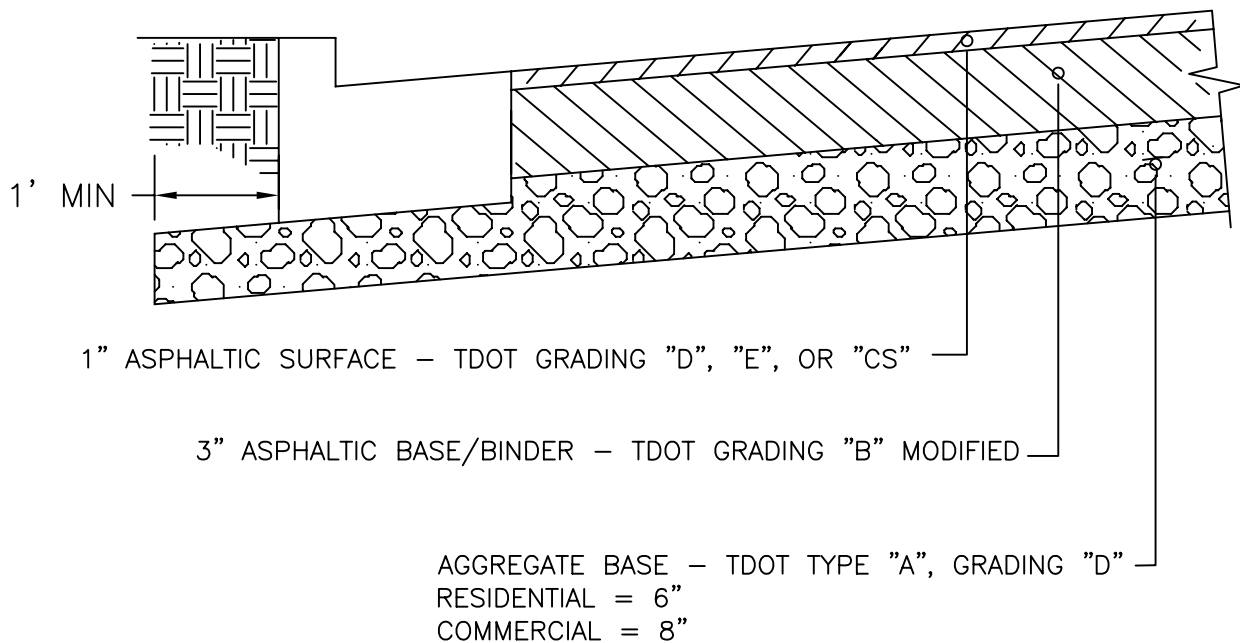


REVISED:

PAVEMENT
REPLACEMENT
BACKFILL

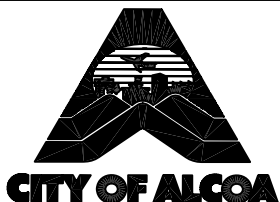
DRAWING NO.

ASPHT
BACKFILL



NOTES:

1. TACK COAT SHALL BE 403-01 BITUMINOUS MATERIAL (TC) AT 0.02 GAL PER SQ. YD.
2. TYPICAL SECTION SHOWN IS MINIMUM FOR MINOR, LOCAL RESIDENTIAL & LOCAL COMMERCIAL STREETS AND FRONTAGE ROADS. ALTERNATE DESIGNS MAY BE SUBMITTED FOR CONSIDERATION BY CITY ENGINEER.
3. DESIGNS FOR ROAD CLASSIFICATIONS OF MAJOR COLLECTOR STREET AND GREATER SHALL BE SUBMITTED FOR CONSIDERATION BY THE CITY ENGINEER.
4. ALL STREET & ROAD CONSTRUCTION SHALL COMPLY WITH THE CURRENT EDITION OF TENN. DEPT. OF TRANSPORTATION STD. SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

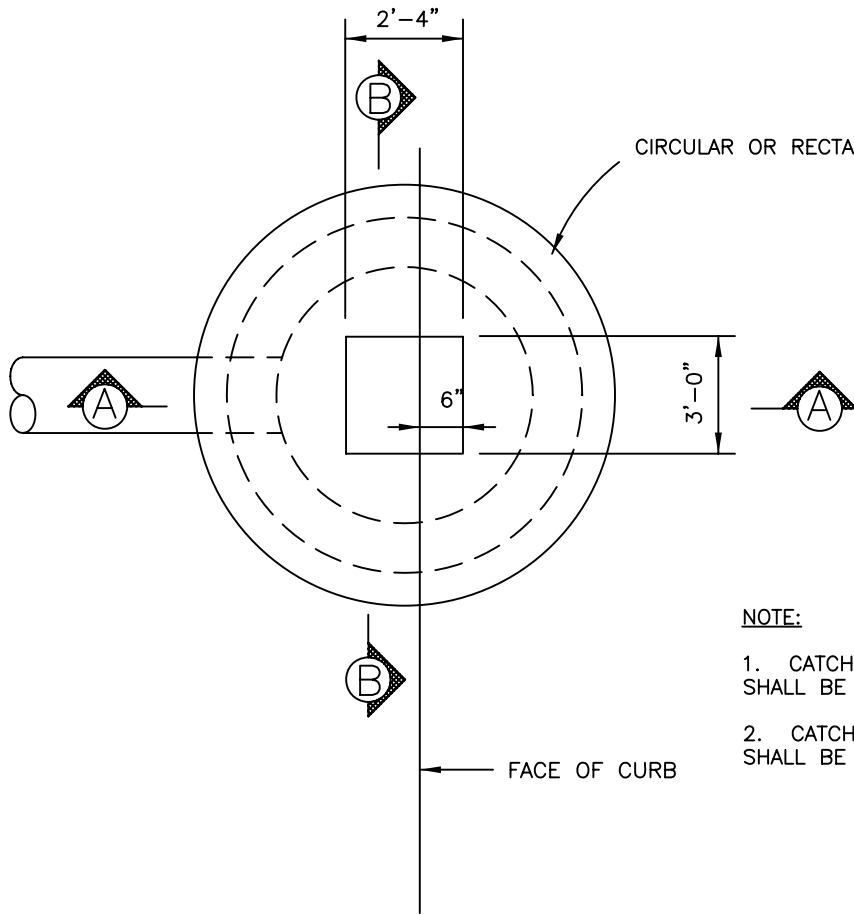


REVISED:

ASPHALT
PAVEMENT DETAIL

DRAWING NO.

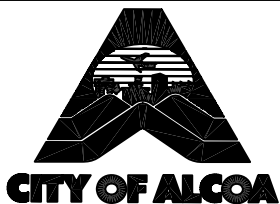
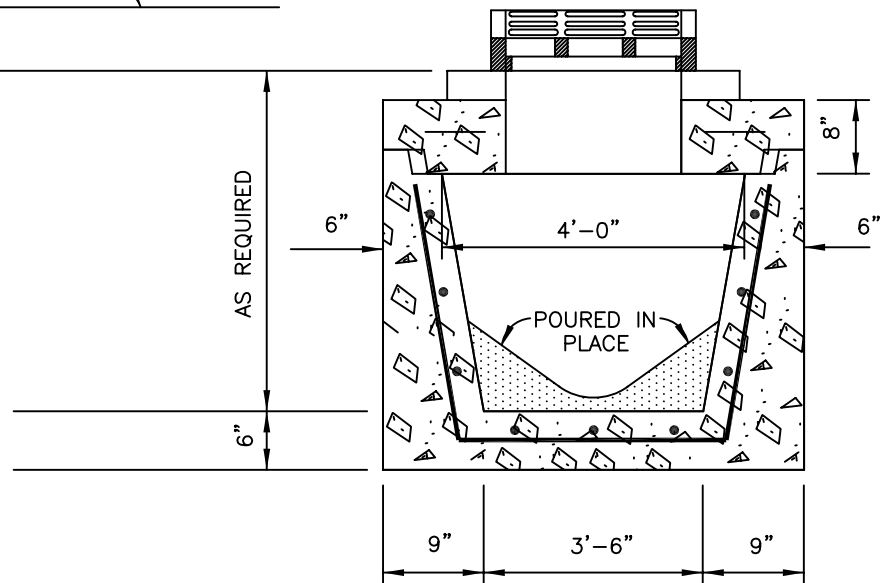
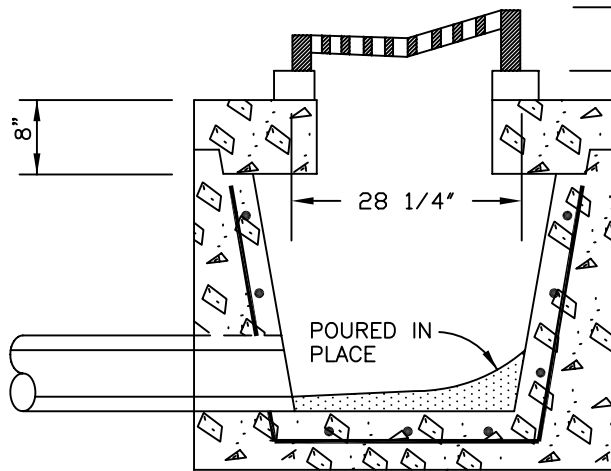
ASPH-PAVE



NOTE:

1. CATCH BASIN FRAME AND GRATE FOR A MOUNTABLE TYPE CURB SHALL BE A VULCAN V-4530-2, OR APPROVED EQUAL.
2. CATCH BASIN FRAME AND GRATE FOR A BARRIER TYPE CURB SHALL BE A VULCAN V-4060-2, OR APPROVED EQUAL.

TOP OF CURB

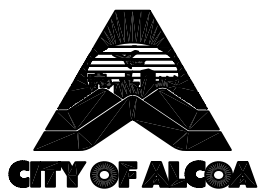
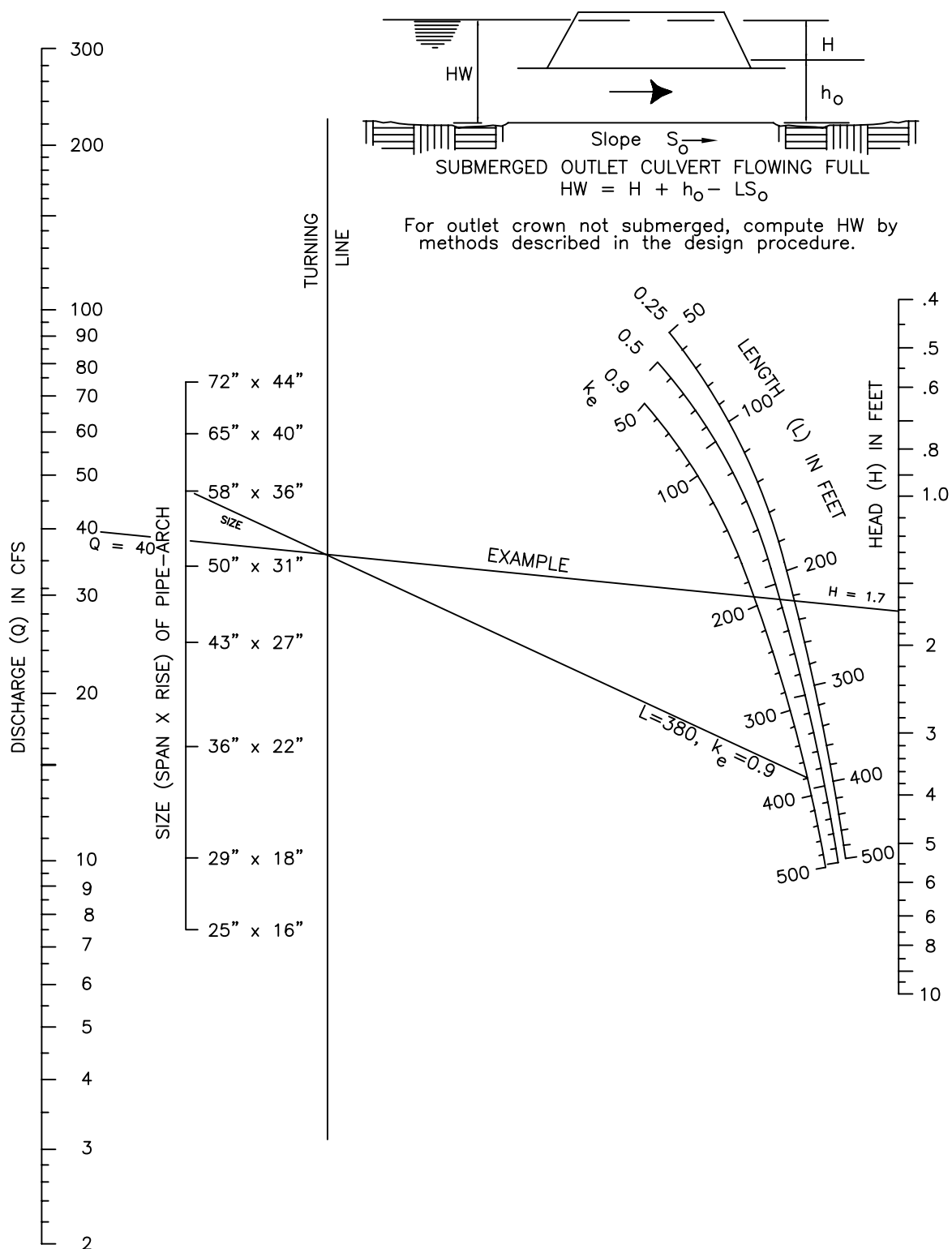


REVISED:

CATCH BASIN DETAIL
FOR CONCRETE CURB

DRAWING NO.

CATCH BASIN
CONC. CURB

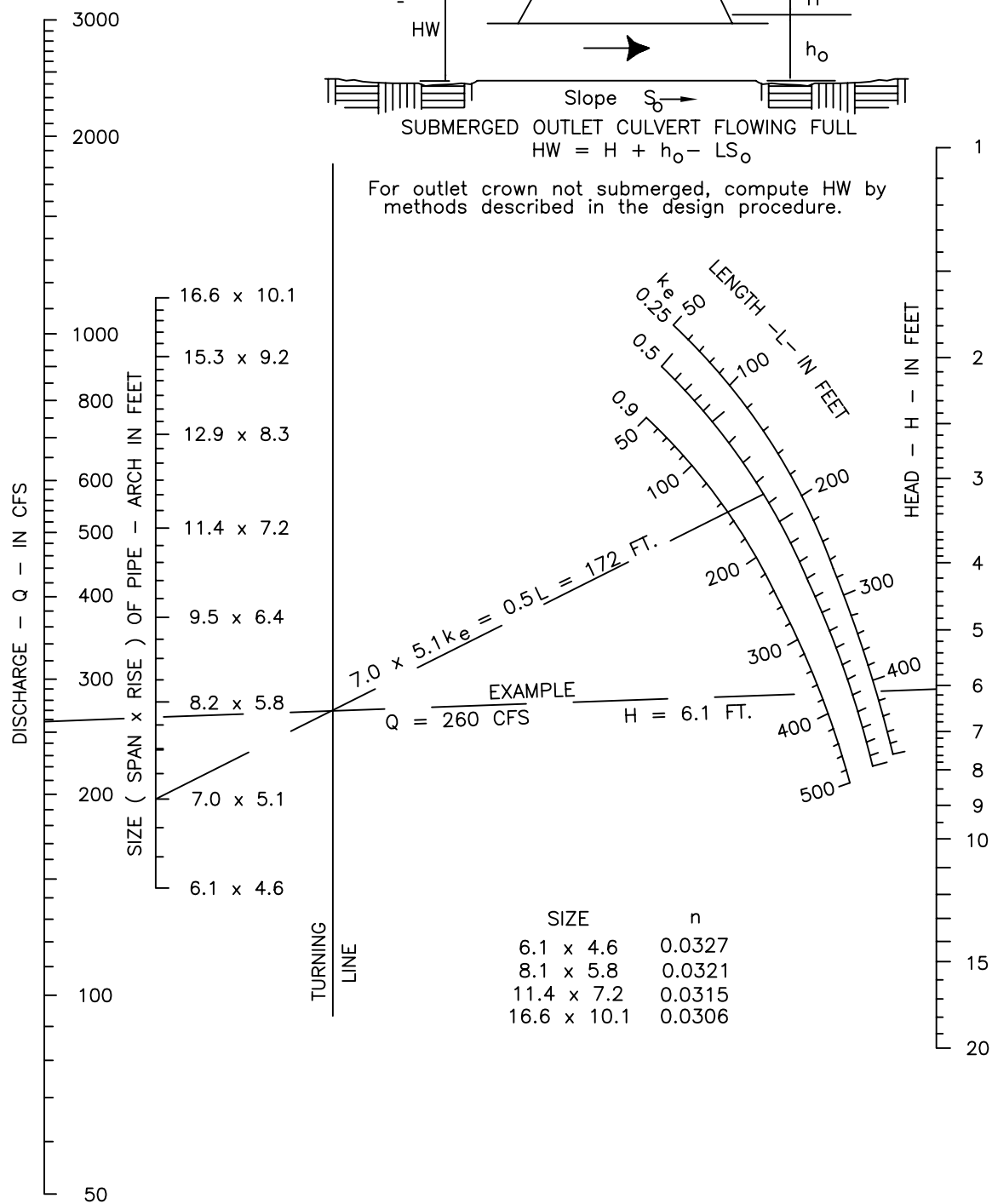


REVISED:

HEAD FOR STANDARD
CORRUGATED METAL PIPE-
ARCH CULVERTS FLOWING
FULL $n = 0.024$

DRAWING NO.

CMP ARCH-1

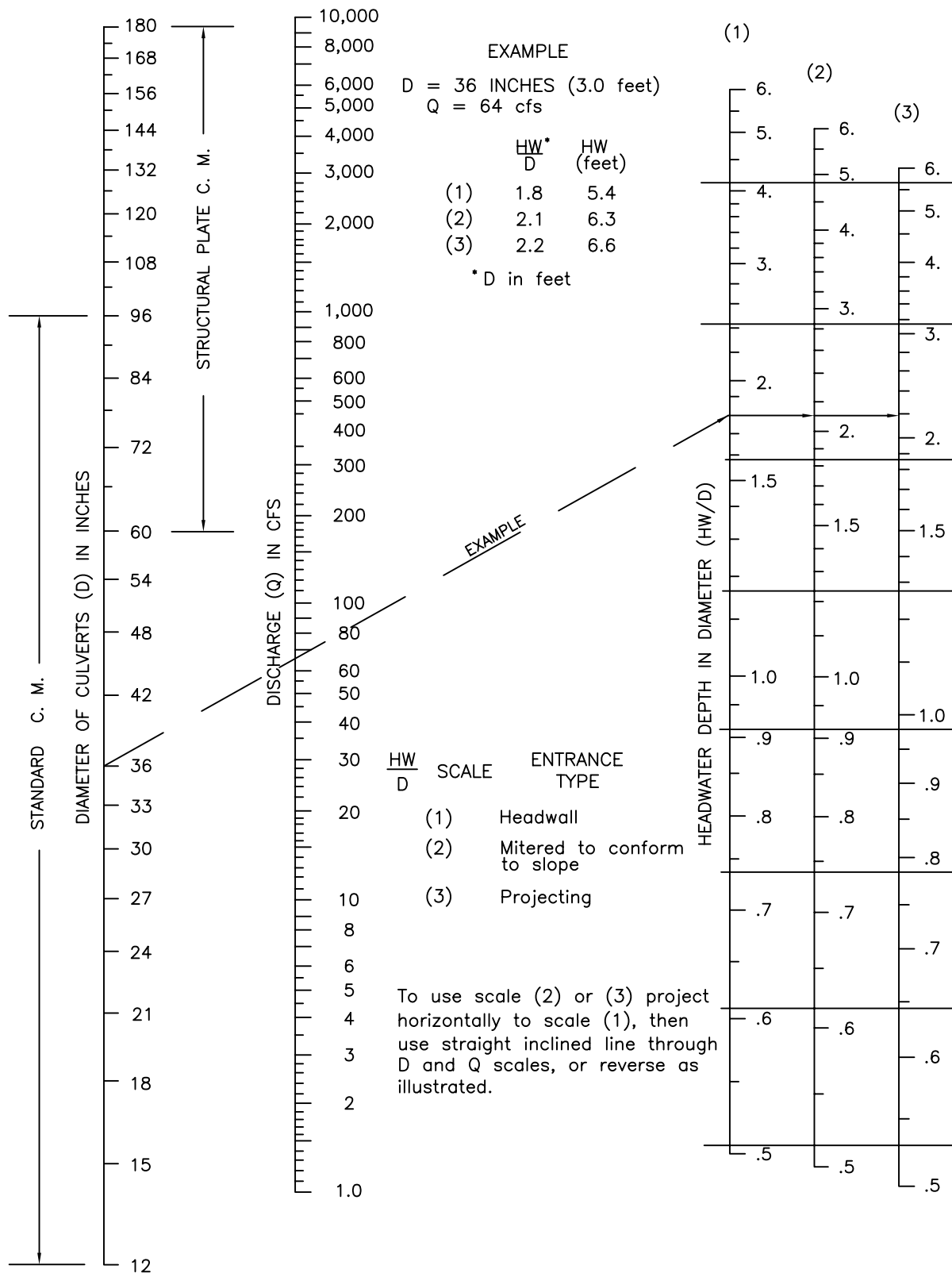


REVISED:

CORRUGATED METAL PIPE-
 ARCH CULVERTS 18 INCH
 CORNER RADIUS FLOWING
 FULL n = 0.0327 to 0.0306

DRAWING NO.

CMP ARCH-2

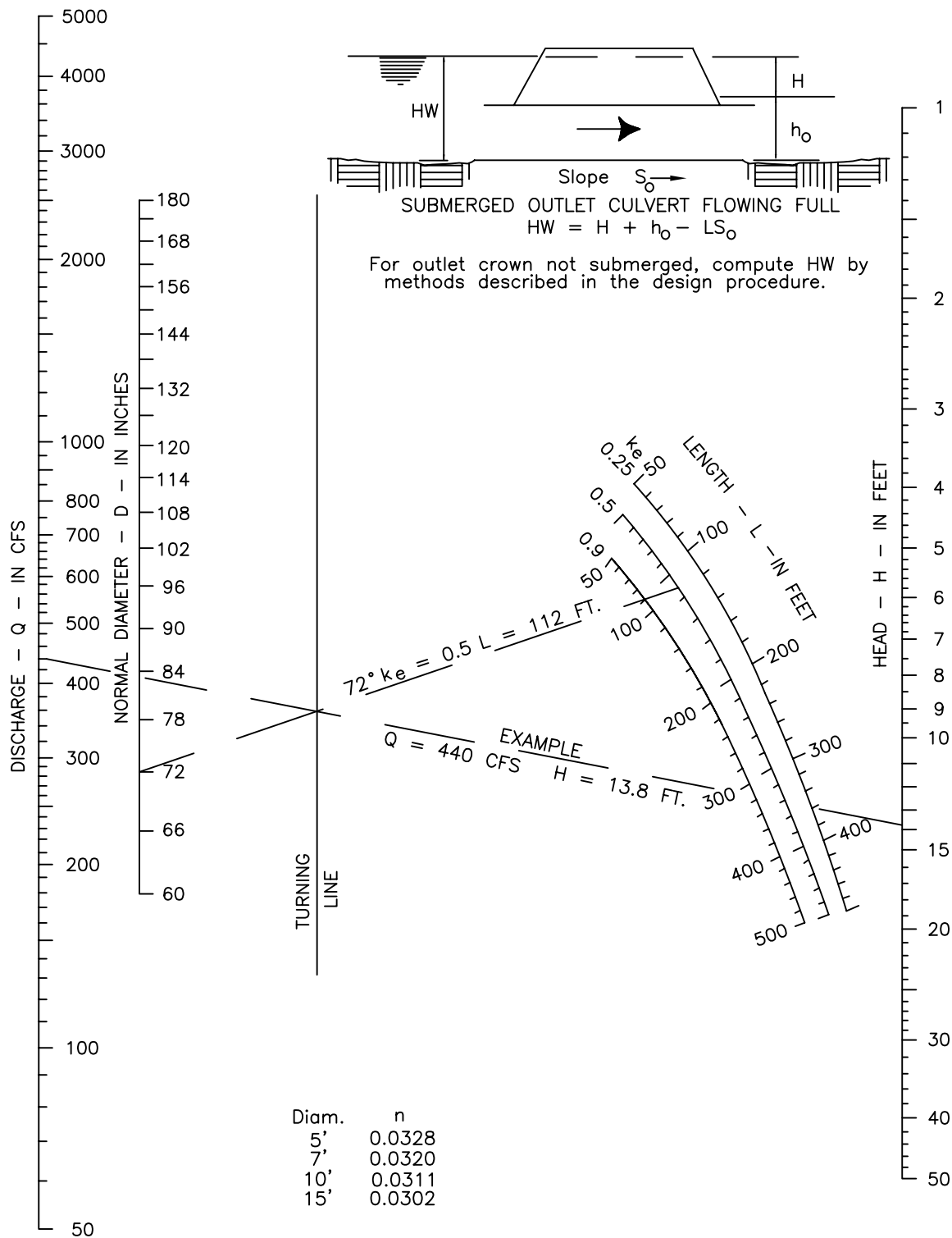


REVISED:

HEADWATER DEPTH FOR
 CORRUGATED METAL PIPE
 CULVERTS W/INLET
 CONTROL

DRAWING NO.

CMP INLET

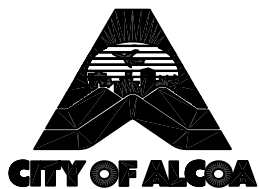
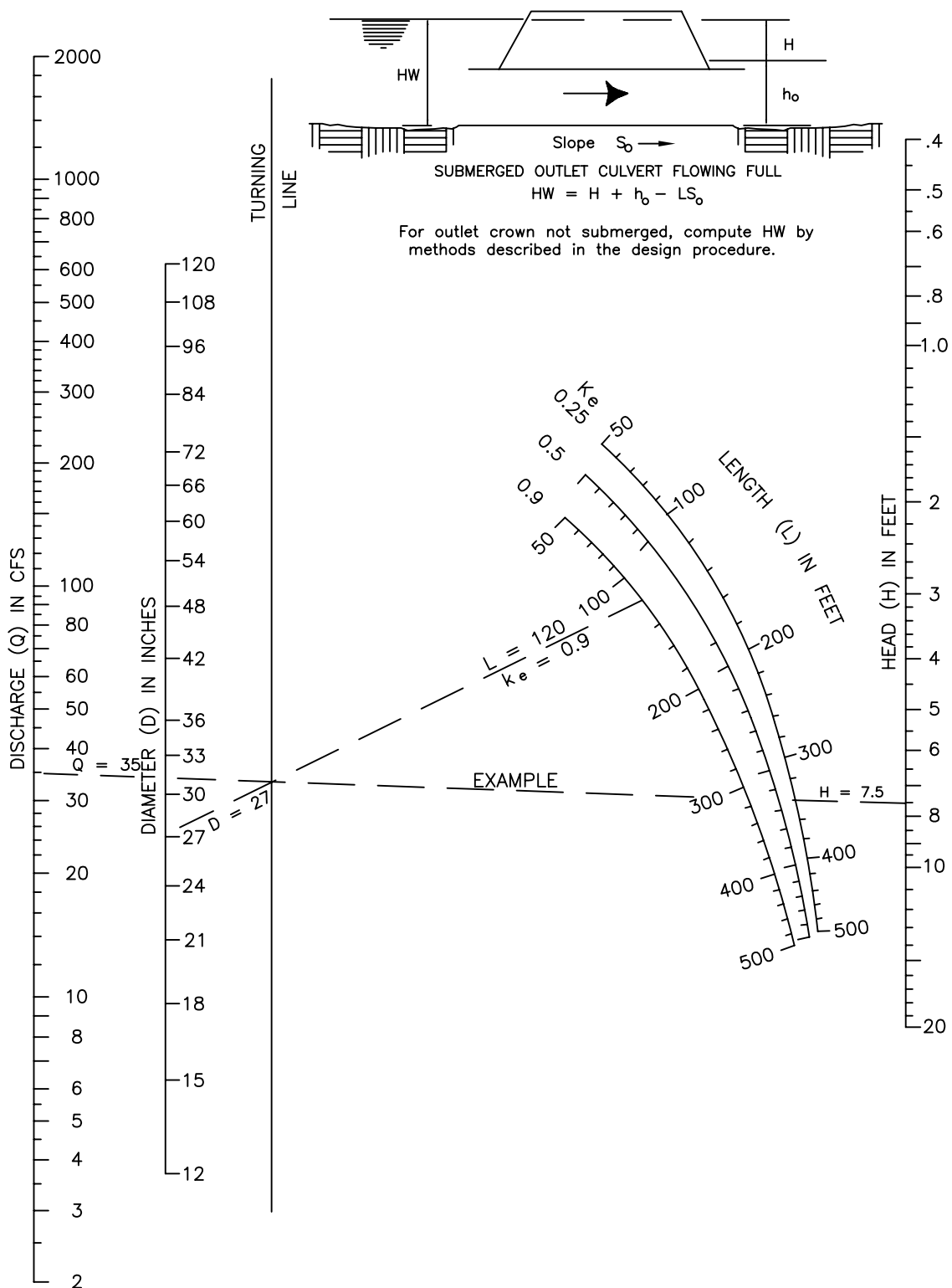


REVISED:

HEAD FOR STRUCTURAL
 PLATE CORRUGATED METAL
 PIPE CULVERTS FLOWING
 FULL n = 0.0328 to 0.0302

DRAWING NO.

CMP PLATE

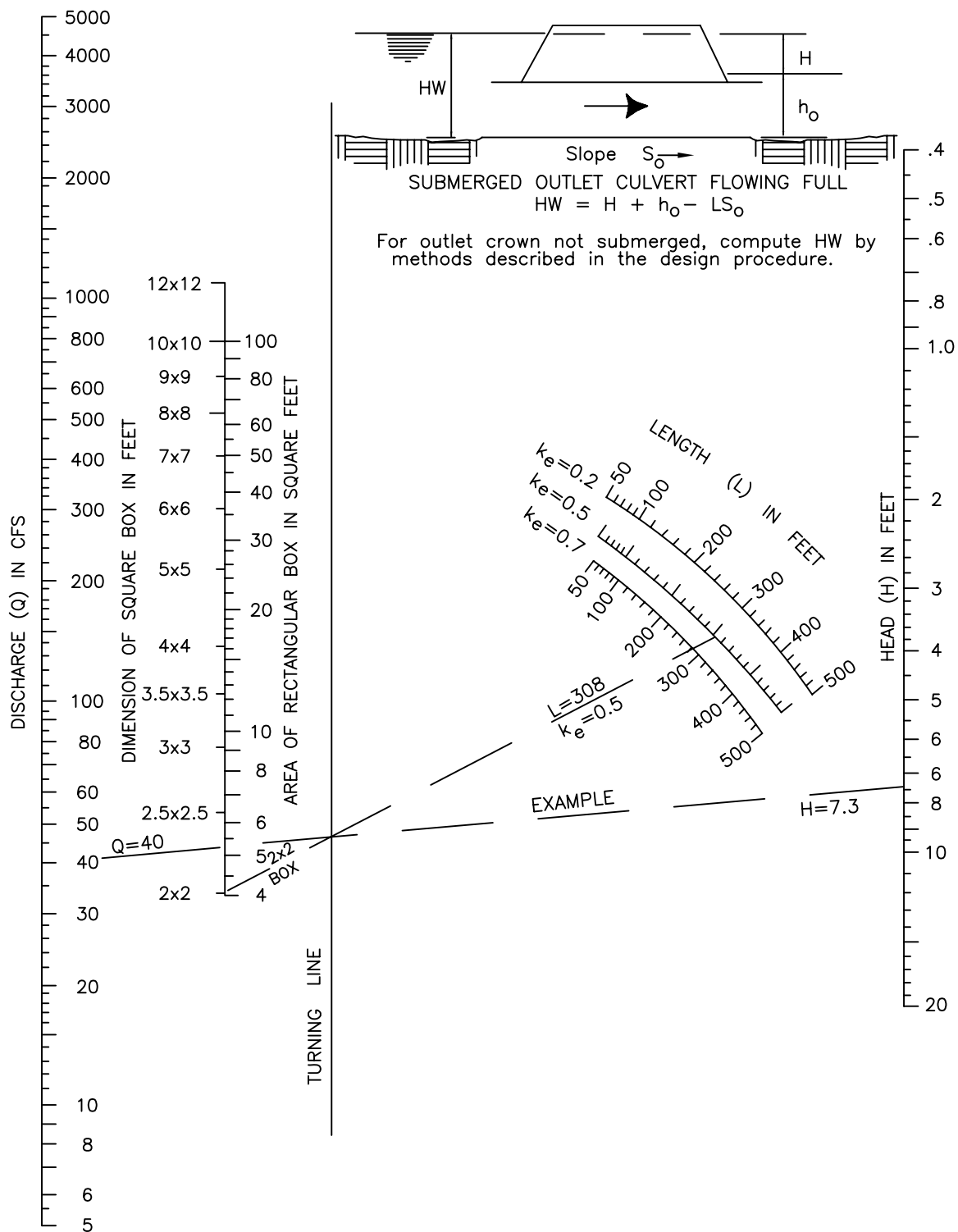


REVISED:

HEAD FOR STANDARD
CORRUGATED METAL PIPE
CULVERTS FLOWING FULL
n = 0.024

DRAWING NO.

CMP

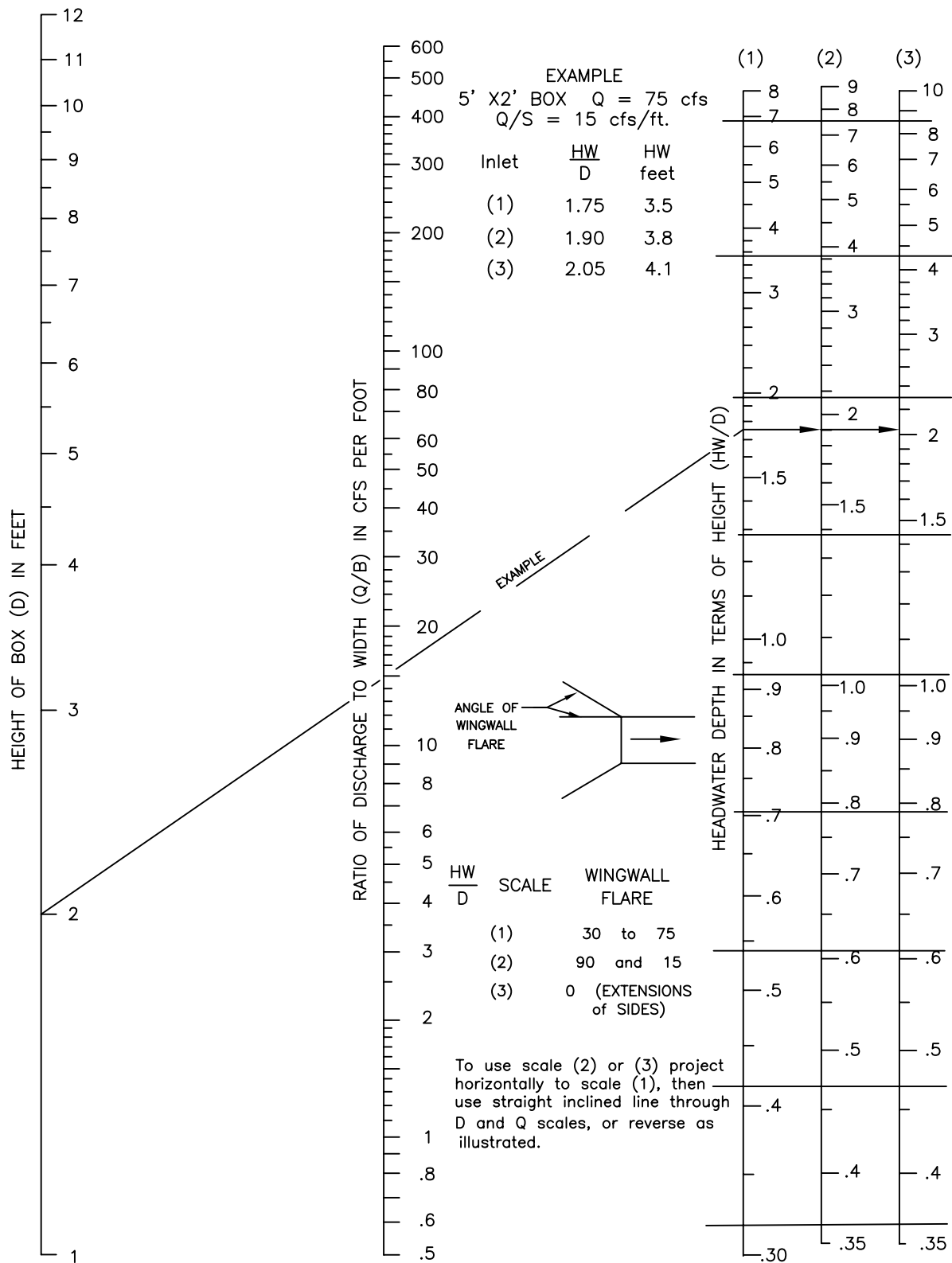


REVISED:

HEAD FOR CONCRETE BOX
CULVERTS FLOWING FULL
 $n = 0.012$

DRAWING NO.

CONC. BOX

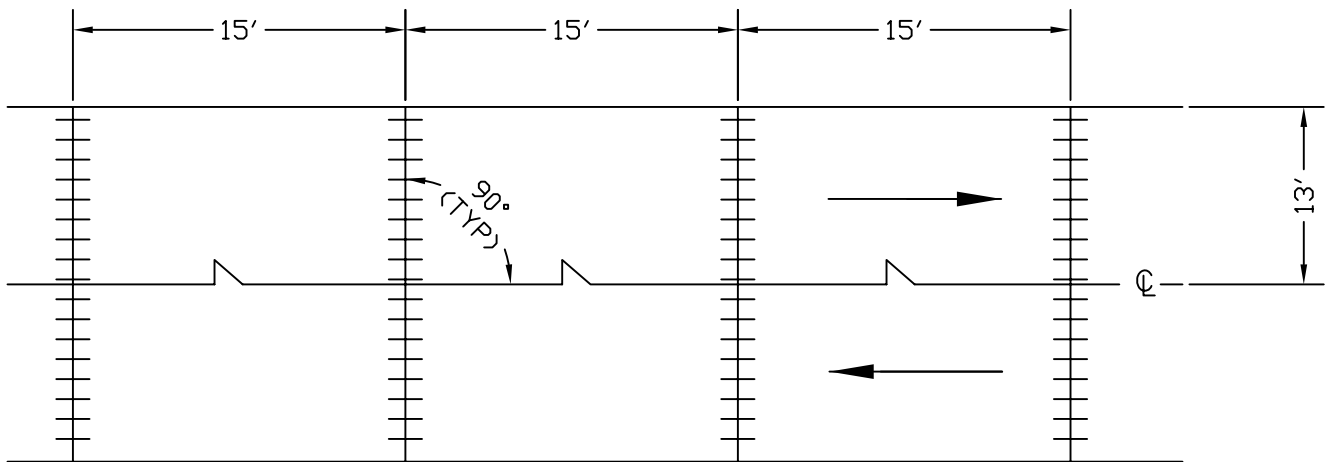


REVISED:

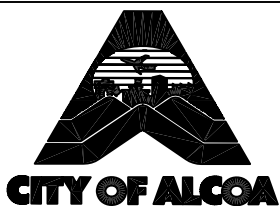
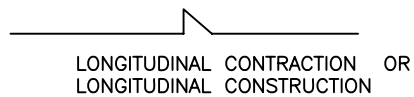
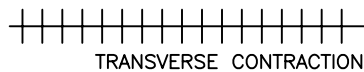
HEADWATER DEPTH FOR
BOX CULVERTS W/
INLET CONTROL

DRAWING NO.

CONC. BOX
INLET CONTROL



JOINT SYMBOLS

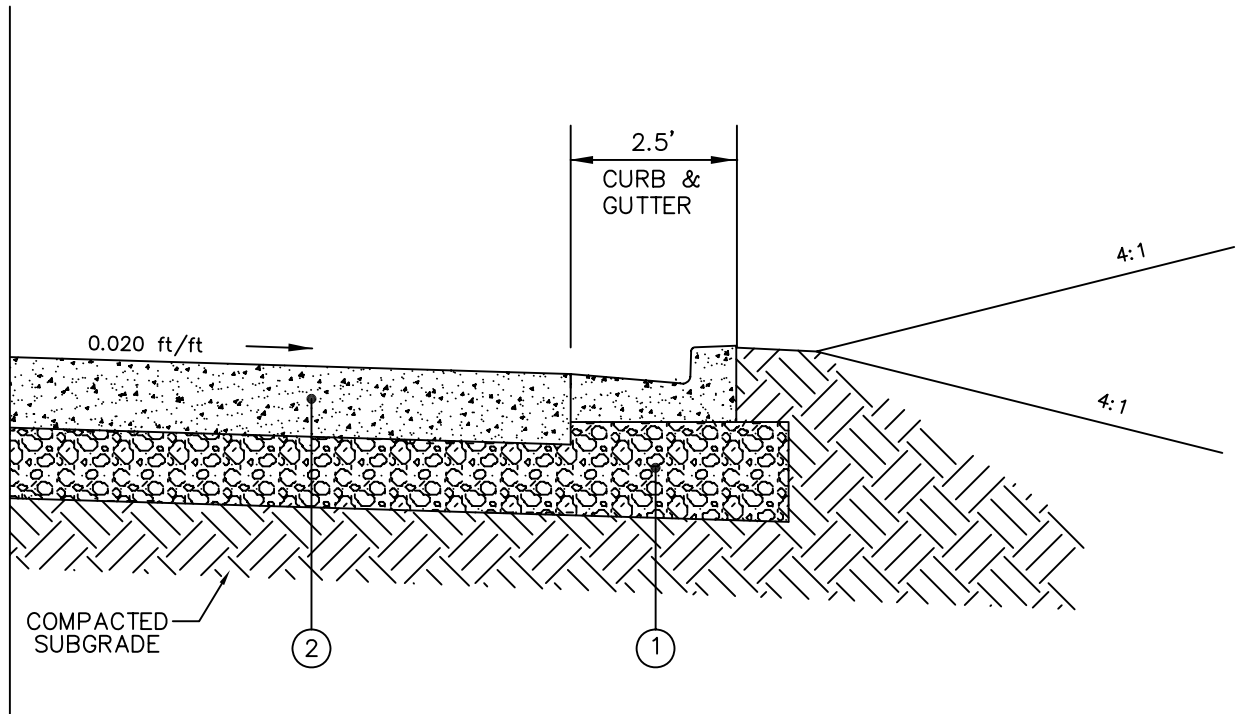


REVISED:

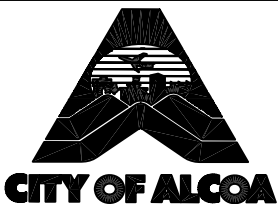
CONCRETE PAVEMENT
JOINT TYPES AND SPACING

DRAWING NO.

CONC. JOINT
TYPES



- ① MINERAL AGGREGATE, TYPE A BASE, GRADING D
(6" BASE)
- ② 7.0" CONCRETE PAVING WITH FIBER REINFORCEMENT

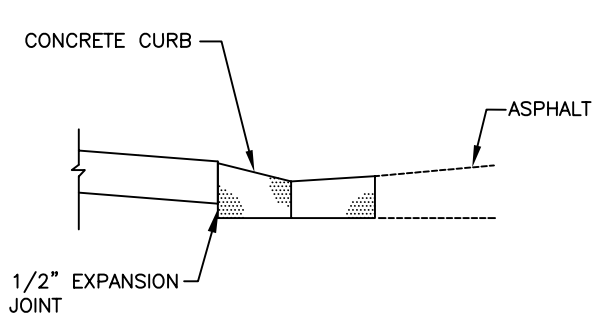


REVISED:

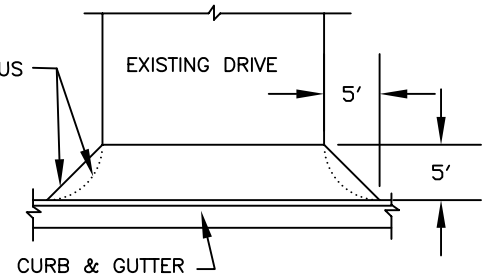
CONCRETE PAVEMENT SECTION

DRAWING NO.

CONC. PAVE

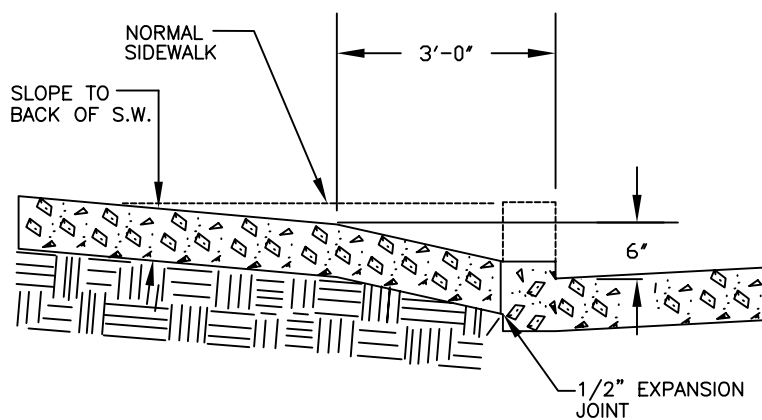
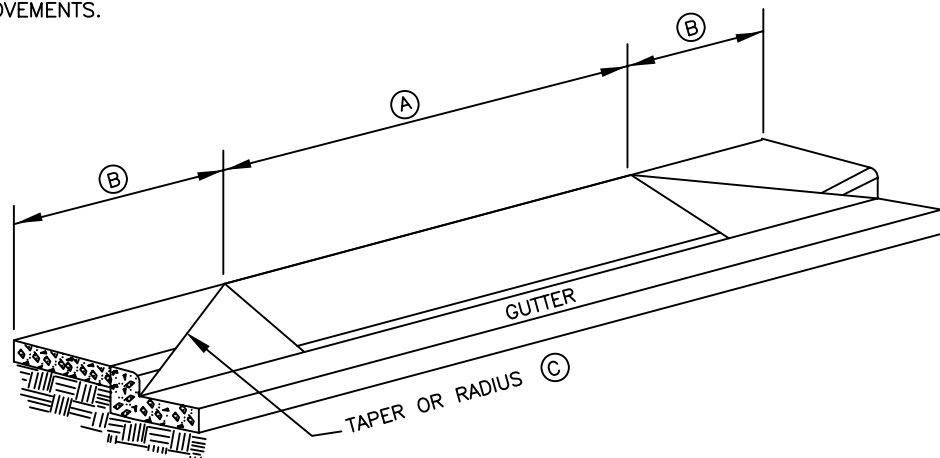


5'x5' TAPER OR 5' RADIUS



CONCRETE DRIVEWAY – MOUNTABLE CURB

NOTE: DIMENSIONS SHOWN ARE MINIMUM.
COMMERCIAL ENTRANCES SHALL BE DESIGNED TO
ACCOMMODATE PROJECTED TRAFFIC
VOLUMES/ MOVEMENTS.

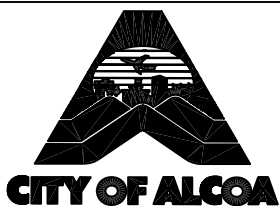


RESIDENTIAL COMMERCIAL

(A)	20'	24'
(B)	5'	10'
(C)	5'	10'

DIMENSIONS MAY BE MODIFIED
WITH APPROVAL OF CITY ENGINEER.

CONCRETE DRIVEWAY – BARRIER CURB

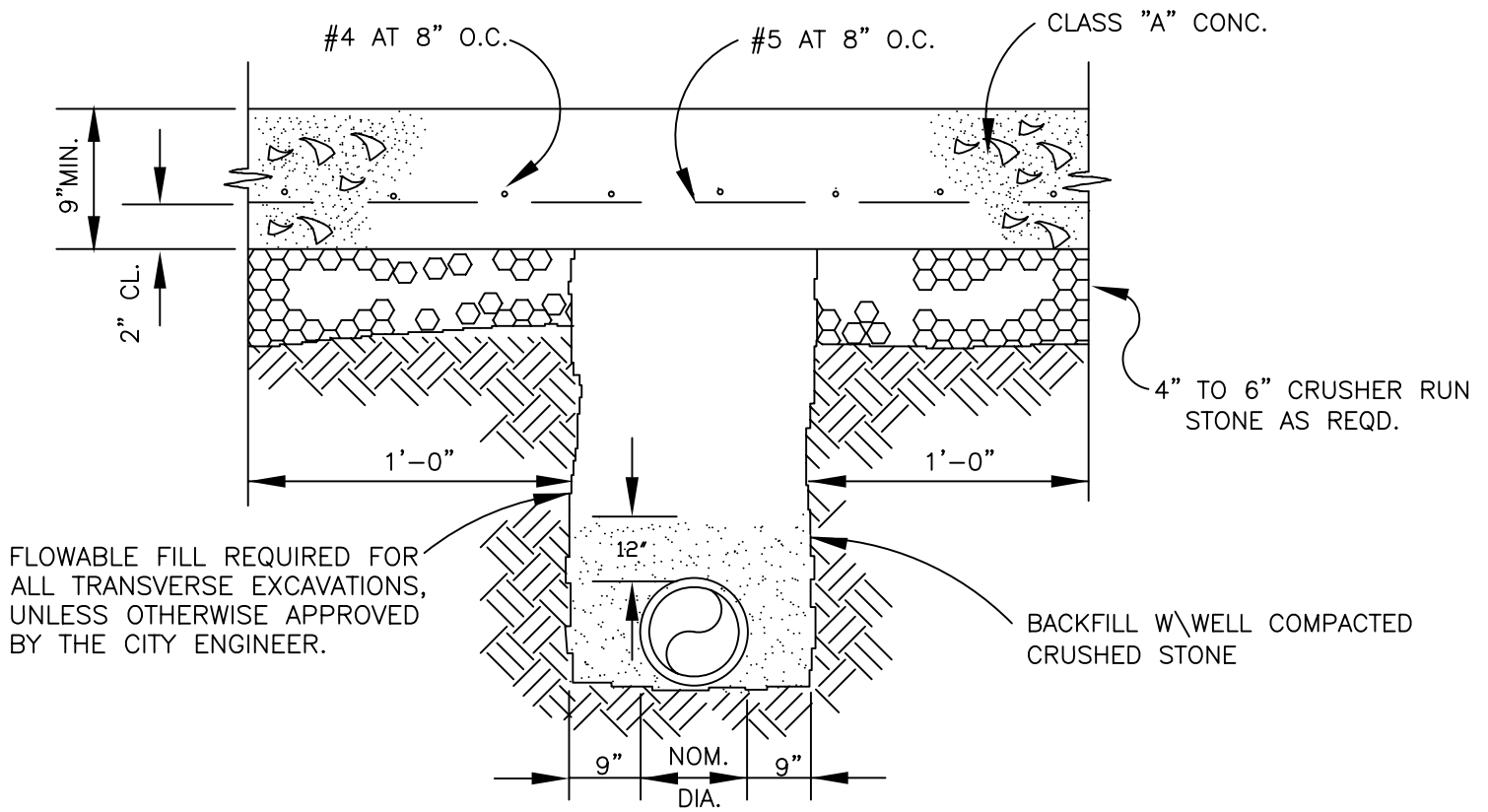


REVISED:

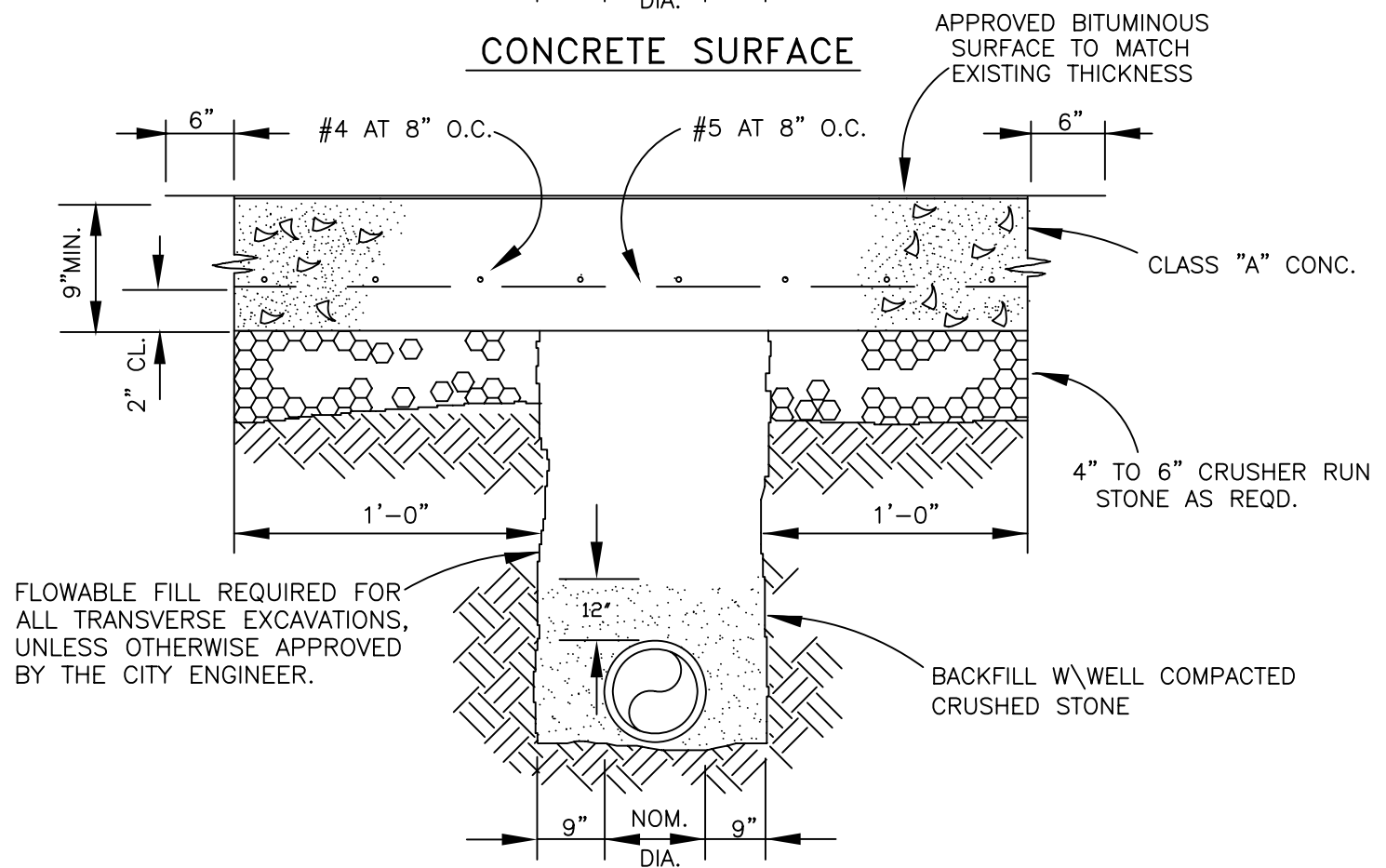
CONCRETE DRIVEWAY
DETAILS

DRAWING NO.

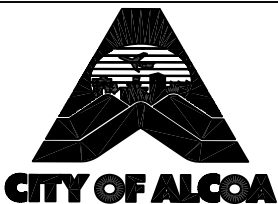
CONC-DRIVES



CONCRETE SURFACE



BITUMINOUS SURFACE - CONCRETE BASE

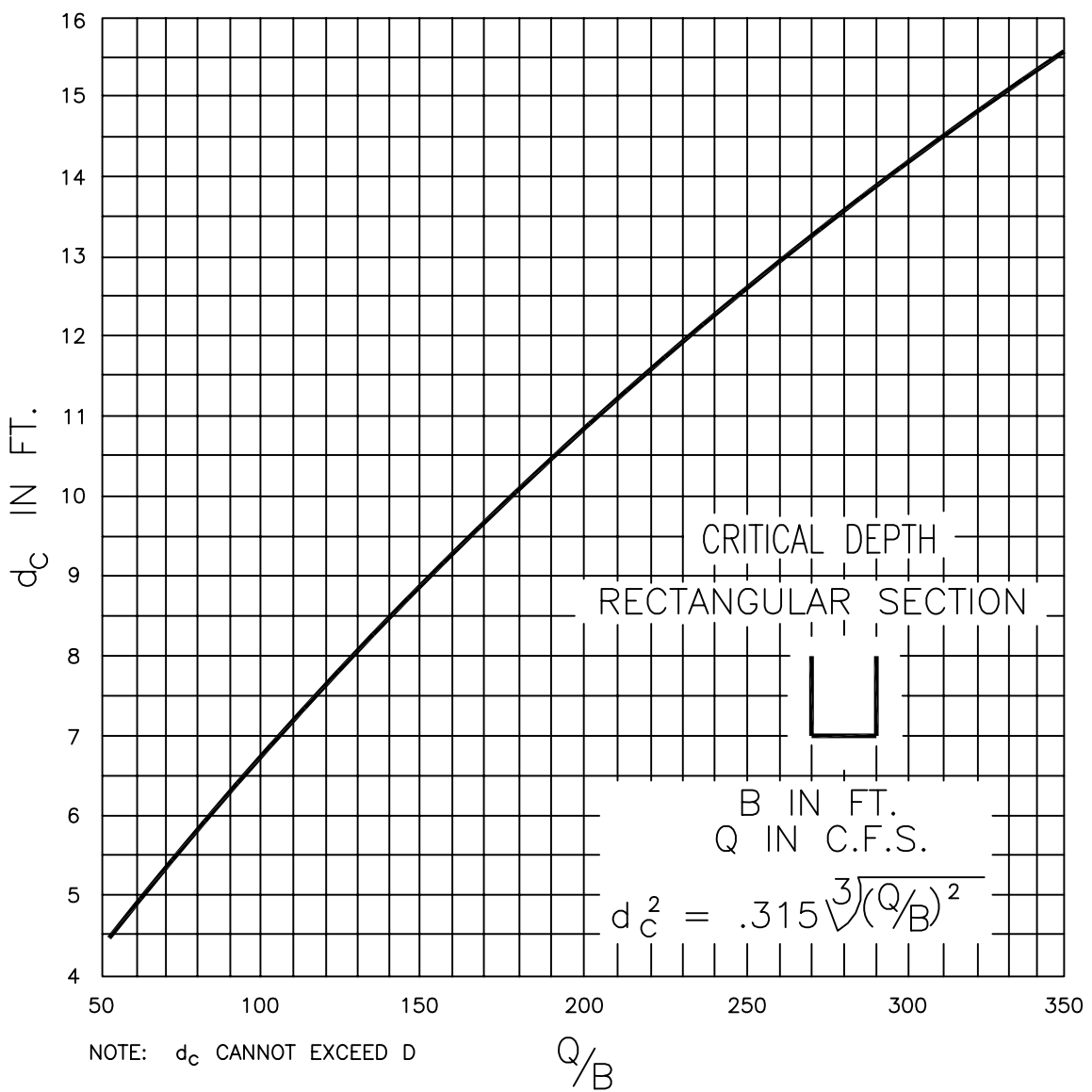
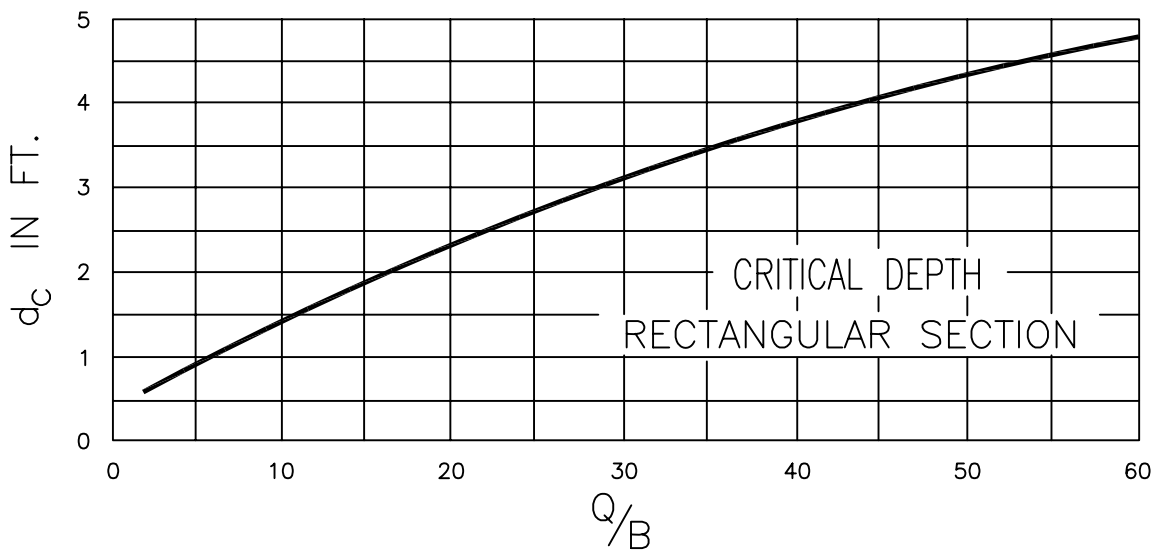


REVISED:

CONCRETE
REPLACEMENT
BACKFILL

DRAWING NO.

CONCRETE
BACKFILL

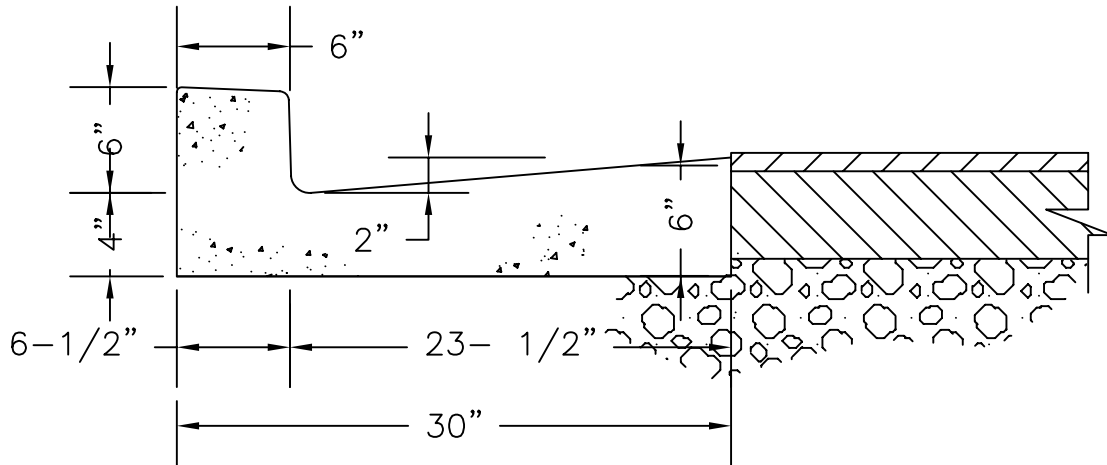


REVISED:

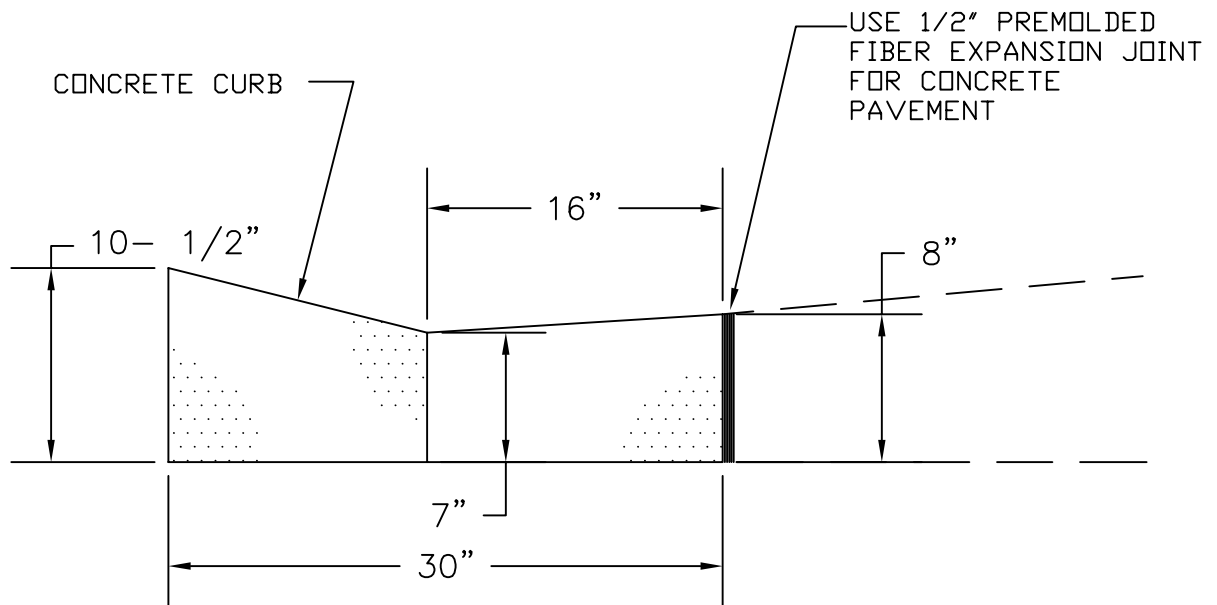
CRITICAL DEPTH
RECTANGULAR SECTION

DRAWING NO.

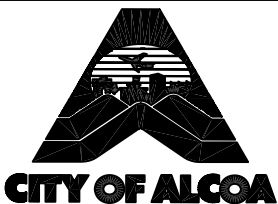
CRIT DEPTH
BOX



TYPE 6-30 CURB & GUTTER



MOUNTABLE CONC. CURB & GUTTER

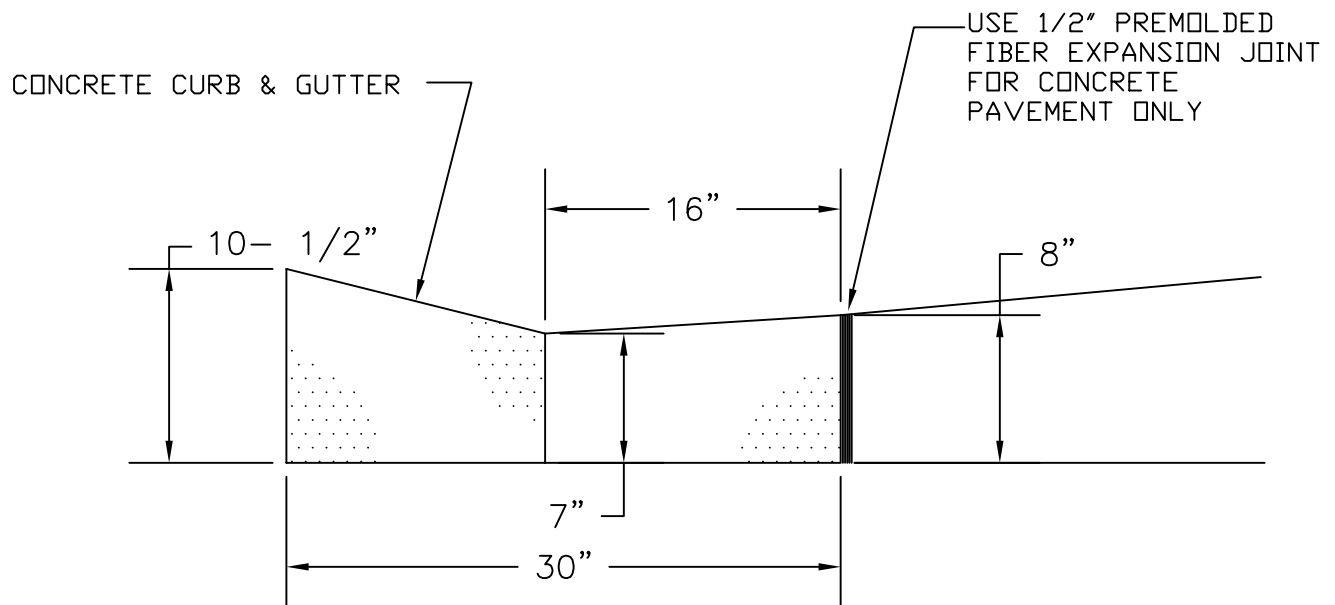


REVISED:

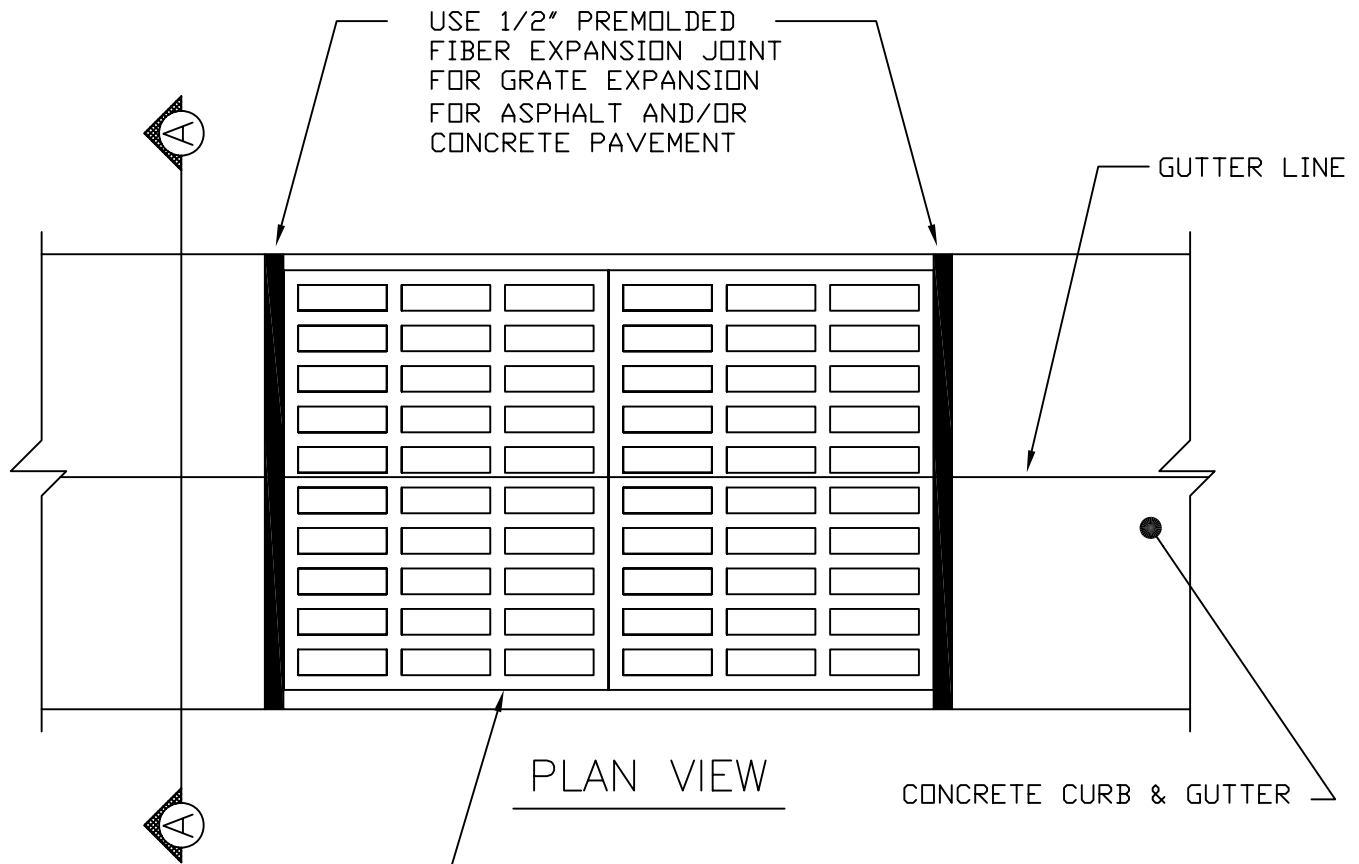
CURB AND GUTTER
DETAIL

DRAWING NO.

CURB &
GUTTER

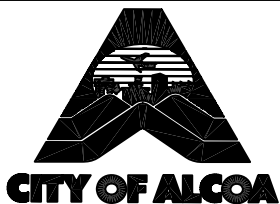


SECTION A-A



NOTE:

1. CATCH BASIN FRAME AND GRATE FOR A MOUNTABLE TYPE CURB SHALL BE A VULCAN V-4530-2, OR APPROVED EQUAL.



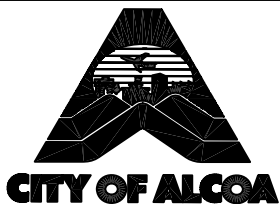
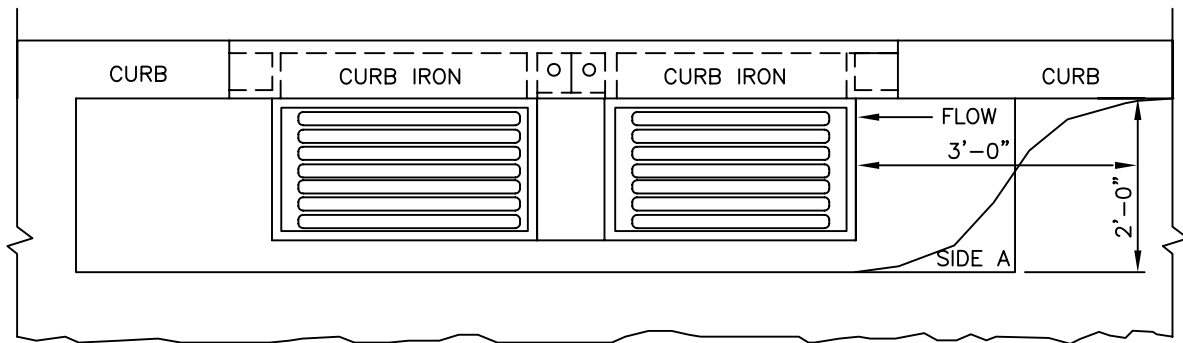
REVISED:

MOUNTABLE
CURB AND GUTTER
DETAIL

DRAWING NO.

CURB &
GUTTER 2

- NOTE: 1. THE NUMBER OF GRATES SHALL BE DETERMINED FROM DESIGN CALCULATIONS.
2. CATCH BASIN FRAME AND GRATE SHALL BE VULCAN V-4060-2, OR
APPROVED EQUAL FOR BARRIER CURBS: VULCAN V-4530-2 OR APPROVED
EQUAL FOR MOUNTABLE CURB.

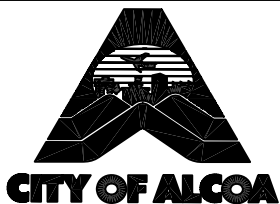
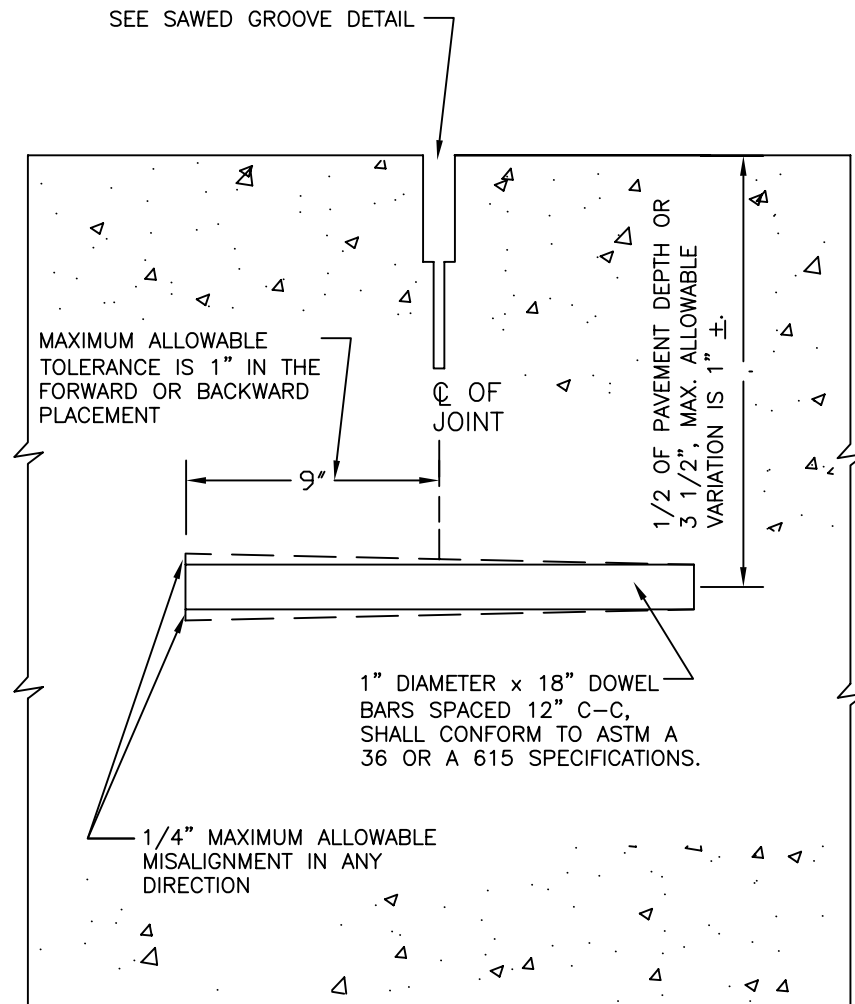


REVISED:

SINGLE & COMBINATION
CURB INLETS

DRAWING NO.

CURB INLETS

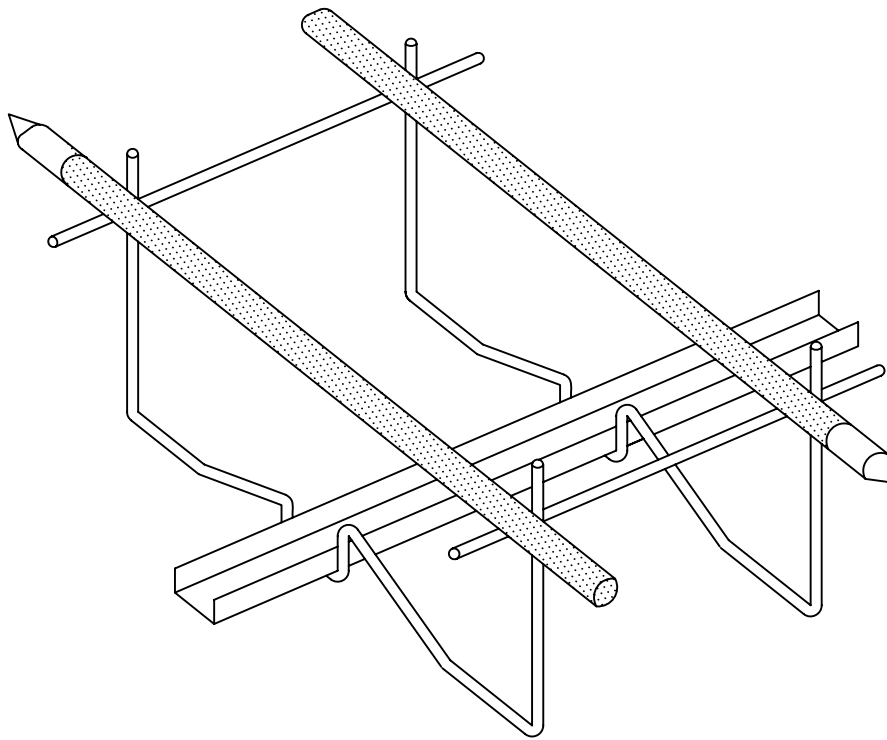


REVISED:

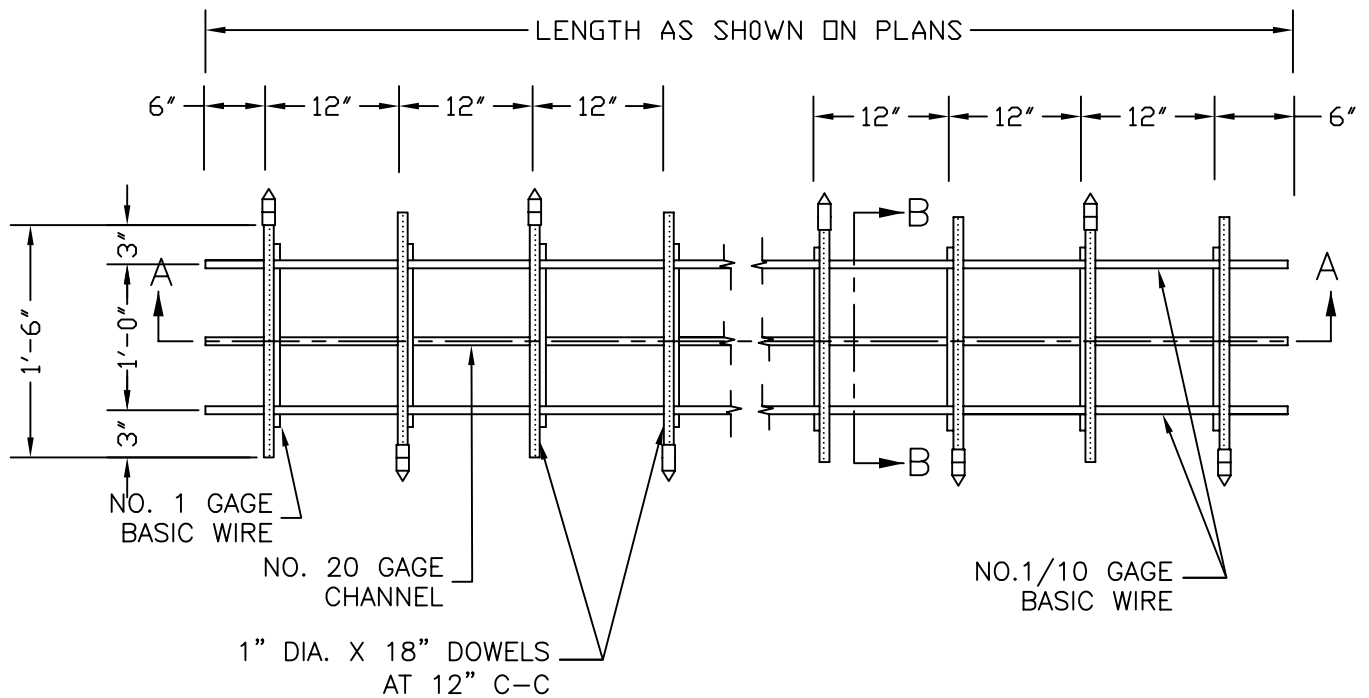
DOWEL BAR FOR TRANSVERSE CONTRACTION JOINT

DRAWING NO.

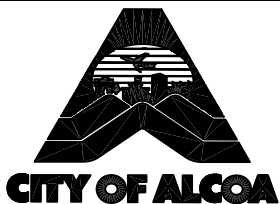
DOWEL CONTRACT JOINT



EXPANSION JOINT



PLAN

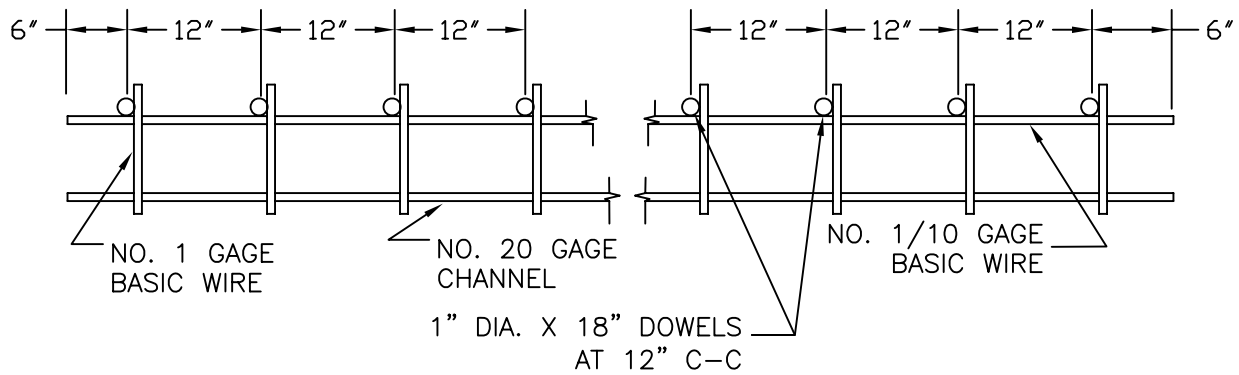


REVISED:

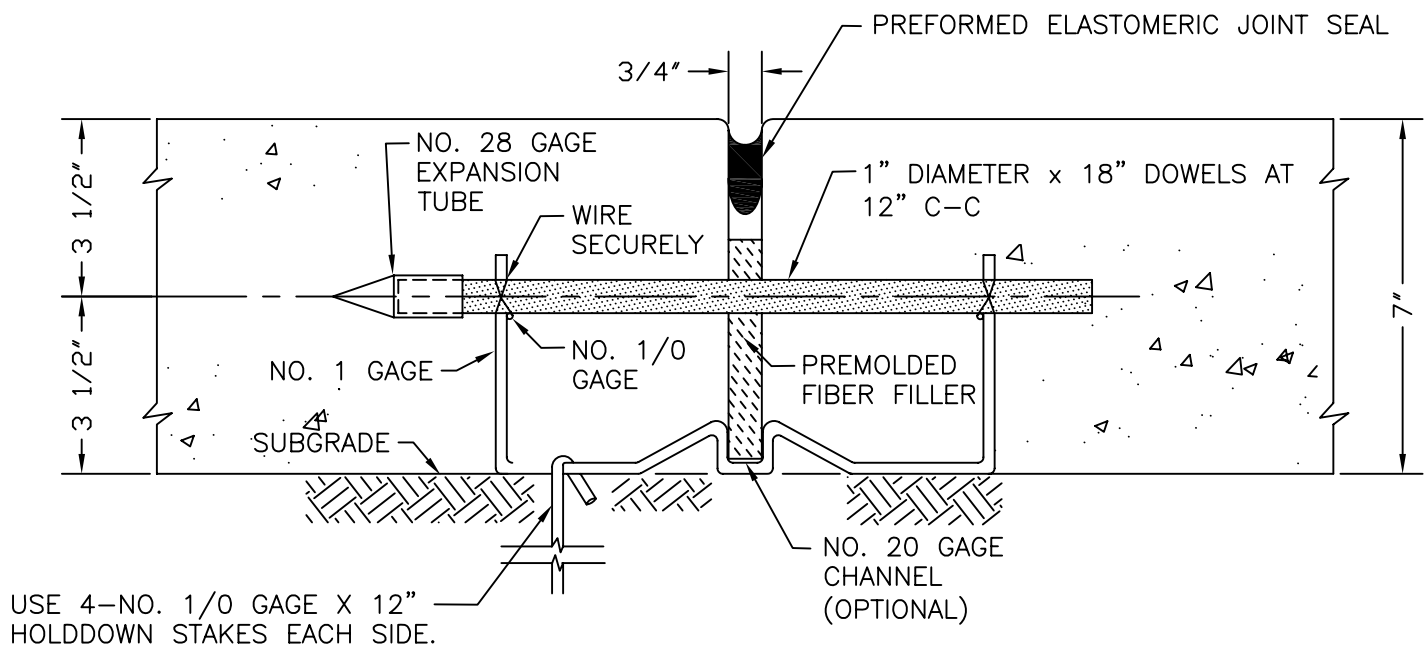
PREMOLDED 3/4" EXPANSION
JOINT WITH LOAD TRANSFERS

DRAWING NO.

EXPANSION
JOINT-1

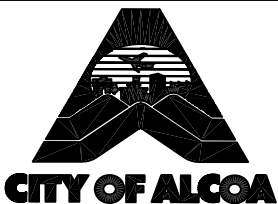


SECTION A-A



3/4" TRANSVERSE AND LONGITUDINAL EXPANSION JOINTS WITH LOAD TRANSFER DOWELS (1" DIA.) WILL BE REQUIRED AT STREET INTERSECTIONS.

SECTION B-B

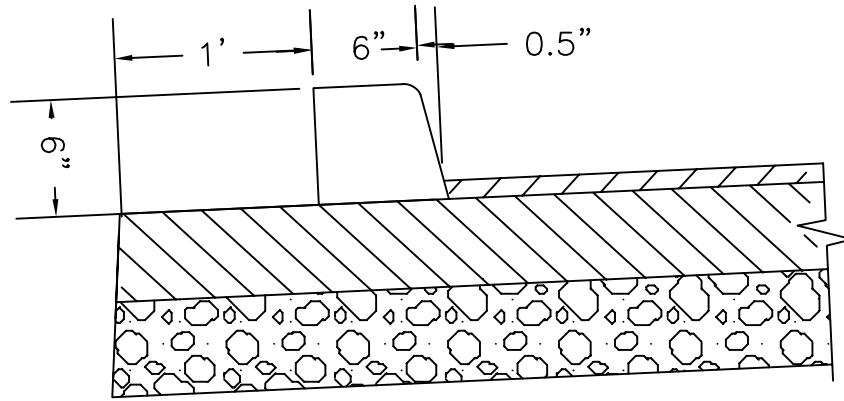


REVISED:

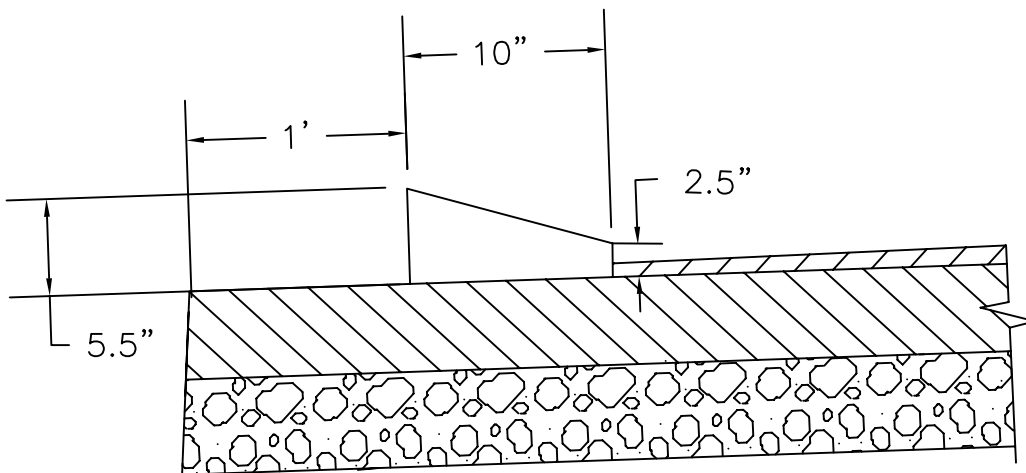
PREMOLDED 3/4" EXPANSION JOINT WITH LOAD TRANSFERS SECTIONS

DRAWING NO.

EXPANSION JOINT-2

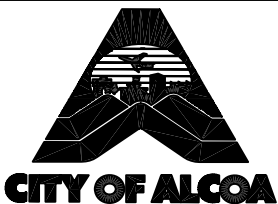


EXTRUDED CONCRETE BARRIER CURB



EXTRUDED CONCRETE MOUNTABLE CURB *

* RESIDENTIAL DEVELOPMENTS

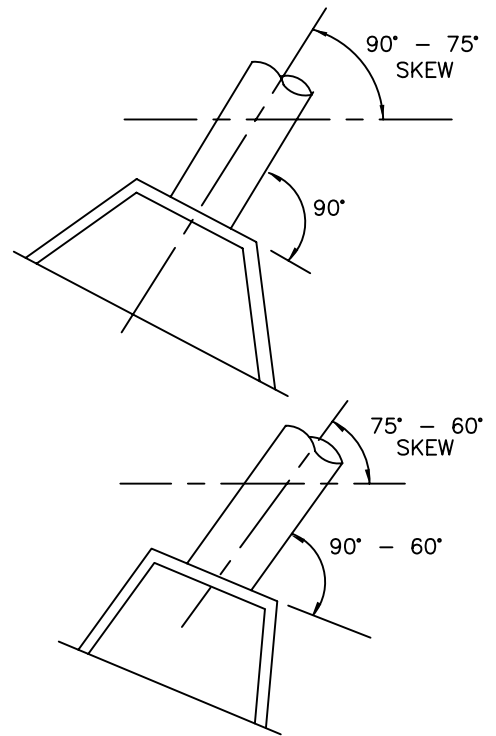


REVISED:

EXTRUDED CURB DETAIL

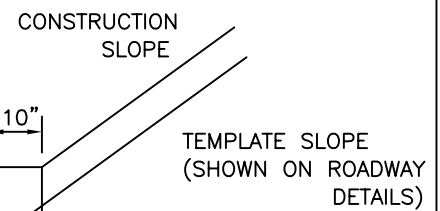
DRAWING NO.

EXTRUDED
CURB



SKEW LESS THAN 80°

SAME AS SKEW $\angle$



TIE TO SLOPE
OF STREAM BED

INLET

LEVEL

OUTLET

6" MIN.

6" MIN. DEPTH
ALONG VALLEY

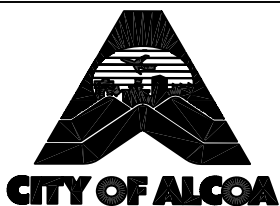
10"

12" MIN.

DIA.

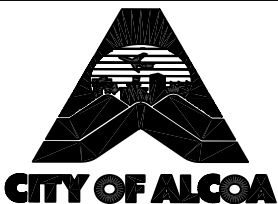
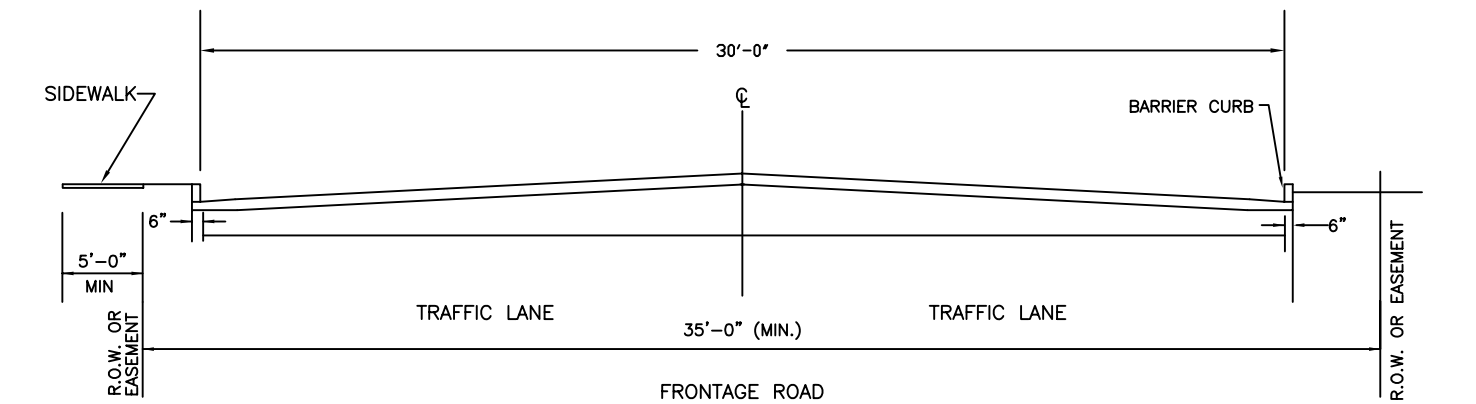
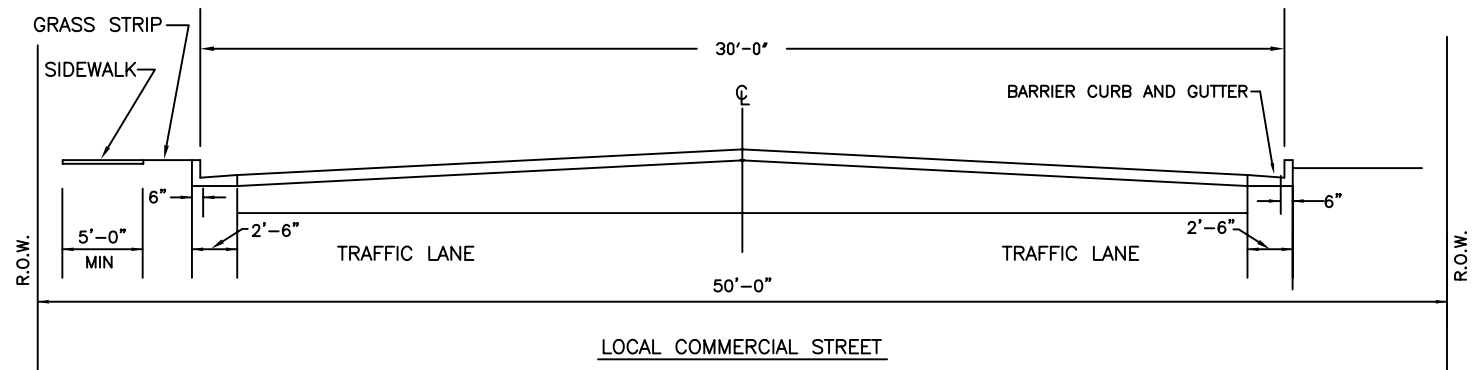
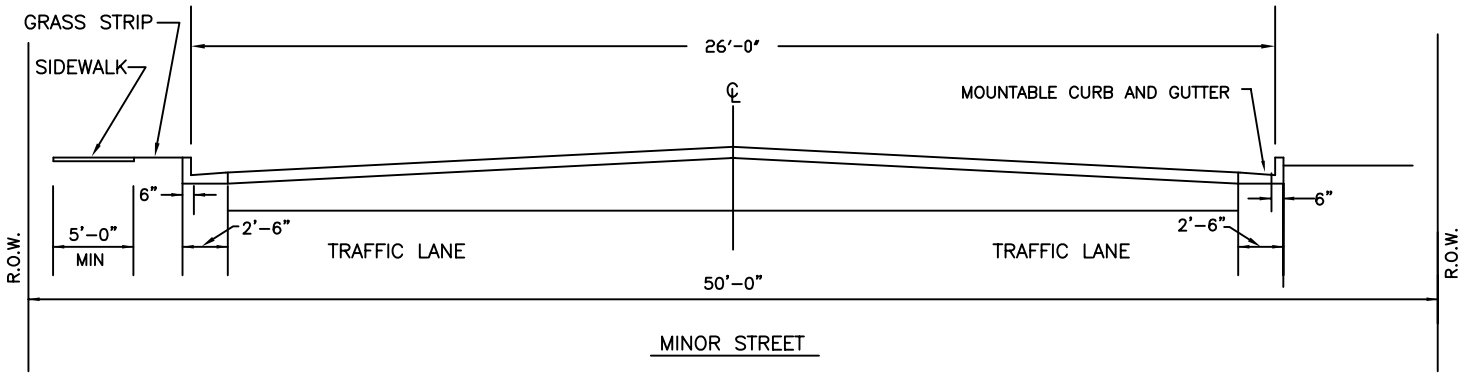
DRAIN SECTION A-A

SECTION A-A



HEADWALL

NOTE: SEE ALCOA SUBDIVISION REGULATIONS FOR
GENERAL REQUIREMENTS AND MINIMUM STANDARDS
OF DESIGN

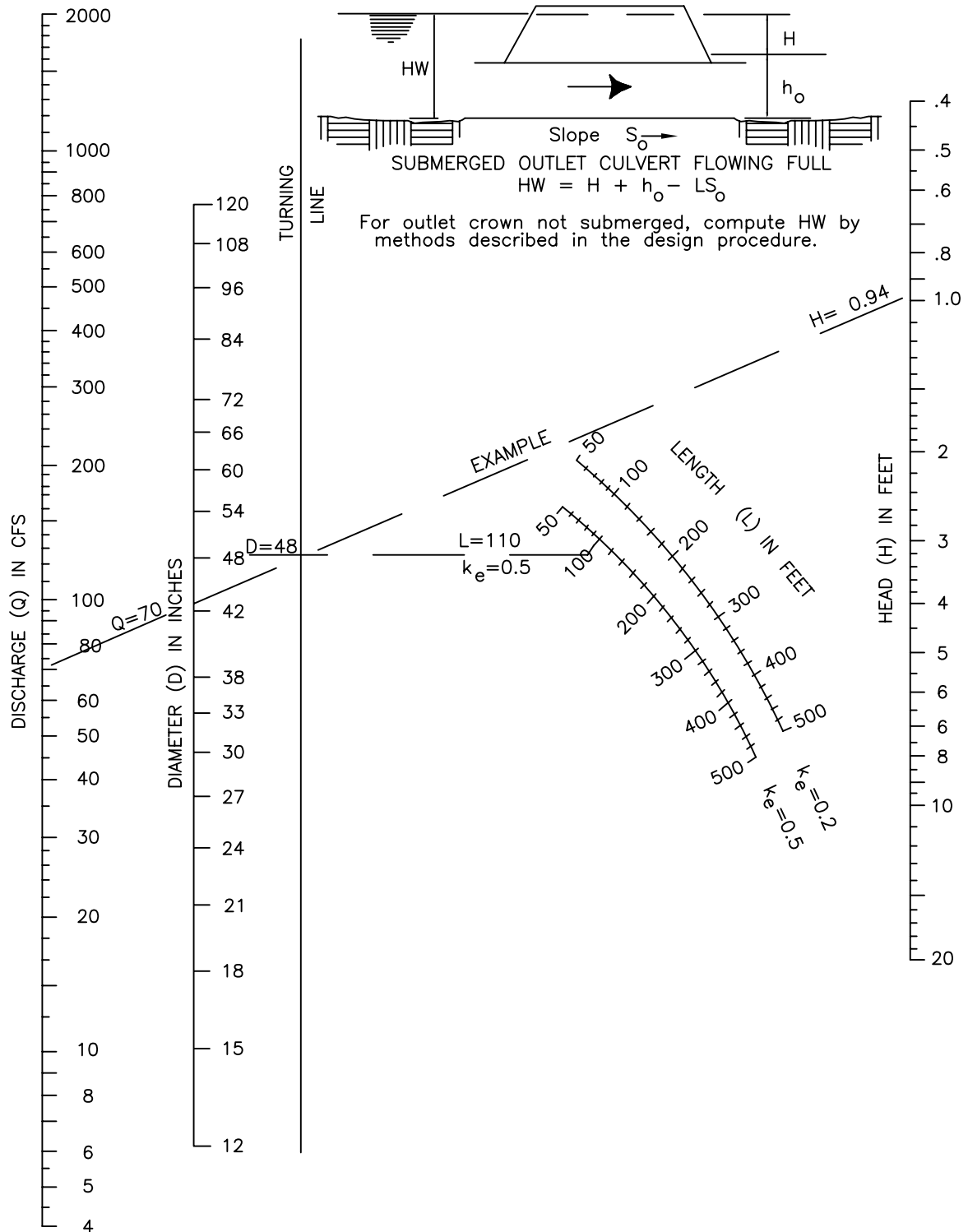


REVISED:

ROADWAY WIDTHS

DRAWING NO.

MINOR, LOCAL
ROAD WIDTHS

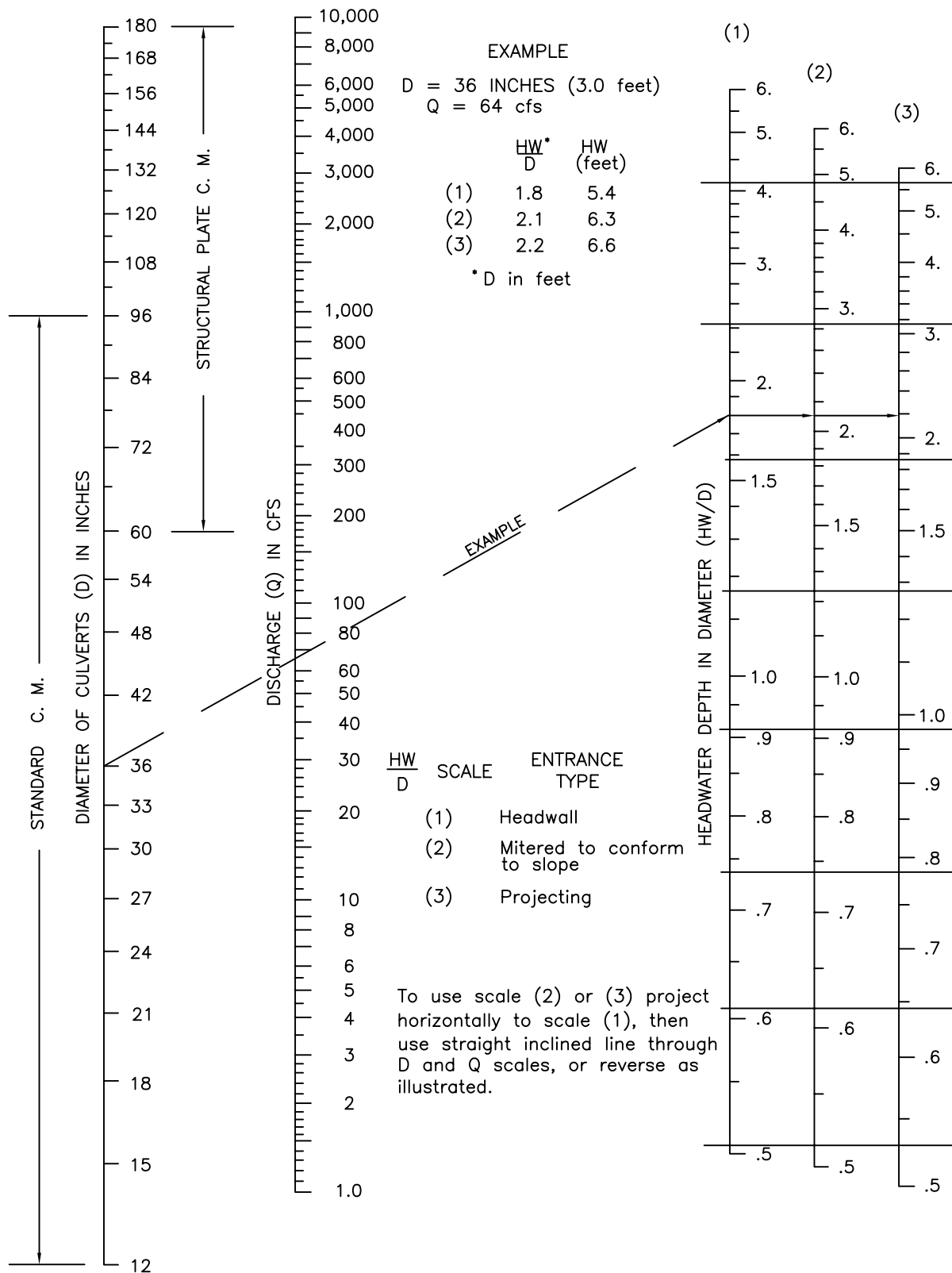


REVISED:

HEAD FOR CONCRETE PIPE
CULVERTS FLOWING FULL
 $n = 0.012$

DRAWING NO.

RCP

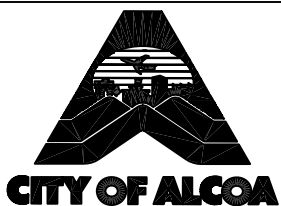
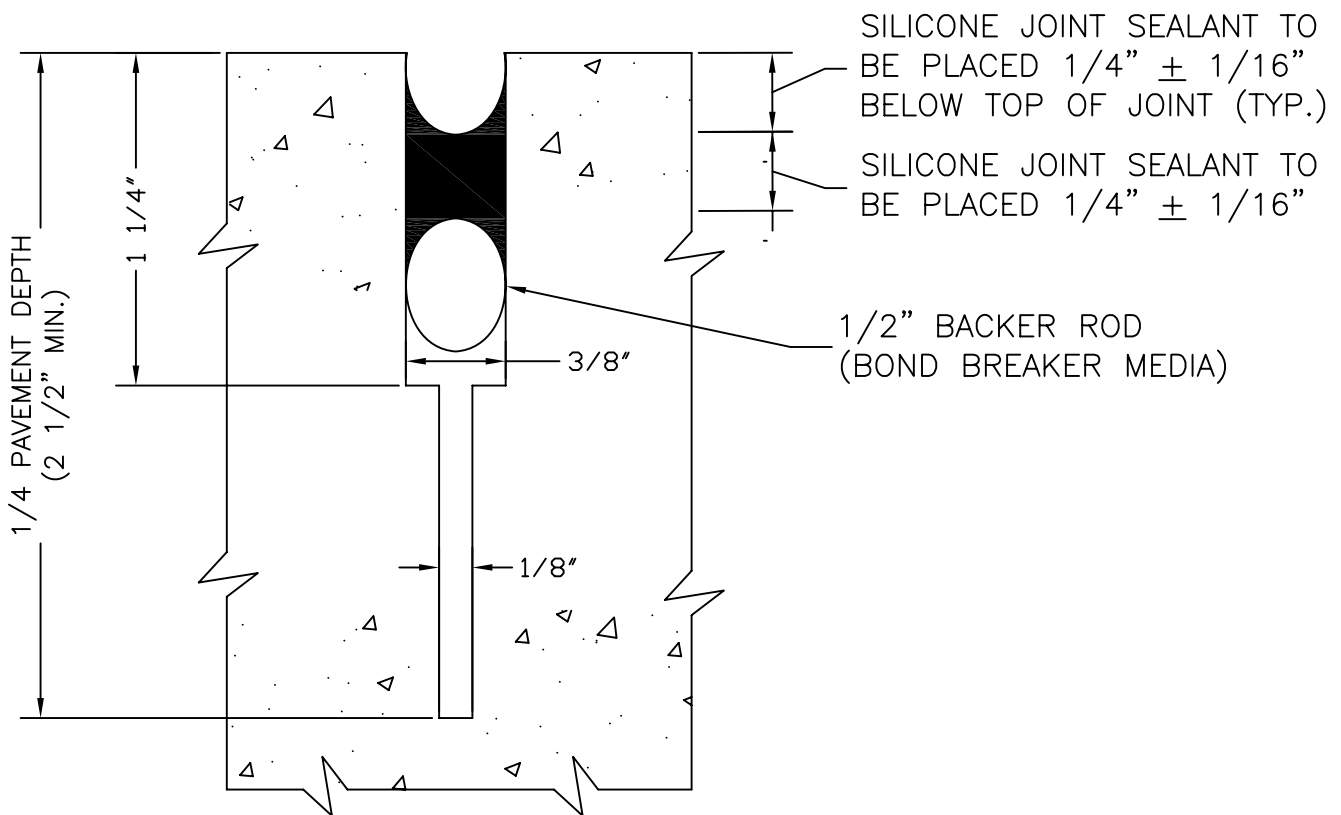


REVISED:

HEADWATER DEPTH FOR
 CORRUGATED METAL PIPE
 CULVERTS W/INLET
 CONTROL

DRAWING NO.

RCP INLET-1



REVISED:

PLAIN SAWED GROOVE
CONTRACTION JOINT

DRAWING NO.

SAWED JOINT