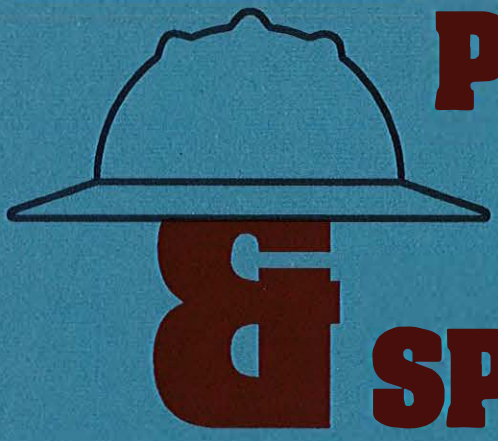
6-1994

# Public Works Standards & Specifications

Edward C. Archer
*Municipal Technical Advisory Service*

# LOCAL GOVERNMENT PUBLIC WORKS STANDARDS & SPECIFICATIONS



**June 1994**

**Compiled by Edward C. Archer**
**MTAS Public Works/Engineering Consultant**

**The University of Tennessee**
**Municipal Technical Advisory Service**
*in cooperation with*
The Tennessee Municipal League

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## LOCAL GOVERNMENT PUBLICS WORKS STANDARDS AND SPECIFICATIONS

We distribute one copy of this publication free of charge to each city. Additional copies cost $100.00 each. The publication is available in both disk and paper format, though a couple of the drawings available in the print format are not on the disk. Only one copy of the publication in either format is provided free of charge and only Tennessee cities receive any free copies.

If you receive a copy of this publication for your city, please return it to city hall or to the public works or other appropriate department when you have finished using it. This is so it will be accessible to other city staff.

THANKS!

# LOCAL GOVERNMENT PUBLIC WORKS STANDARDS AND SPECIFICATIONS

Guidelines for Construction Standards, Materials Specifications, Design Criteria, and Contract Documents to be used for Streets, Storm Sewers, Sanitary Sewers, and Water Distribution Systems

by Edward C. Archer
MTAS Public Works/Engineering Consultant

1994



MUNICIPAL TECHNICAL ADVISORY SERVICE
The University of Tennessee
Knoxville, Tennessee

in cooperation with the Tennessee Municipal League

This document is designed to aid in the development of standards for construction specifications, design and bidding of public works improvements. This document is not to be used in lieu thereof.

The Municipal Technical Advisory Service (MTAS) is a statewide agency of The University of Tennessee's Institute for Public Service. MTAS operates in cooperation with the Tennessee Municipal League in providing technical assistance services to officials of Tennessee's incorporated municipalities. Assistance is offered in areas such as accounting, administration, finance, public works, communications, ordinance codification, and wastewater management. This publication is printed in cooperation with the Tennessee Municipal League.

All MTAS publications are free to Tennessee city, county, state, and federal officials. There is a charge for all private sector requests. This report is $100.



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# INTRODUCTION

The goal and intention of this publication is for cities to have guidelines of some of the standards and specifications on construction projects. Readers should be careful in their adoption and use as these guidelines are not all-inclusive of the standards and specifications which may be necessary in a specific local community situation. It is recommended that all public works projects be developed, designed and constructed under the direction of a registered professional engineer.

This is an update of the original document as published by MTAS in 1982. The original document was developed by the consulting firm of John Coleman Hayes and Associates, Inc.

*Local Government Public Works Standards and Specifications* provides local governments with basic construction standards for public works and utility projects. These standards have potential for serving as a specific reference for the construction of public facilities and may prove especially helpful to consulting or staff engineers charged with the design and construction of facilities having predominant public use.

This document sets forth basic requirements and criteria to be followed during the development, design, and construction of public works projects. It is intended, however, that additional information and guidance will be furnished by the responsible engineer. These standards do include sufficient information to provide guidance in establishing and maintaining serviceable public works projects.

*Local Government Public Works Standards and Specifications* is well-suited as a review guide for planning commissions and as a technical guide for local governmental engineering departments. It will simplify the review process and assure uniformity in public improvement projects. Through use of the document it is anticipated that acceptable standards can be maintained that will protect the public interest.

The information is presented with three major topic areas: Construction Standards and Specifications, Design Criteria with Standard Construction Drawings, and Contract Documents. The four major areas of public works addressed are: water distribution systems, sewage collection systems, drainage systems, and street systems.

The materials in "Contract Documents" are adopted from the *Standard General Conditions of the Construction Contract*, published jointly by the Professional Engineers in Private Practice (PEPP), National Society of Professional Engineers (NSPE), American Consulting Engineers Council (ACEC), and Construction Specifications Institute (CSI). These joint publishers have given their written permission to copy their publication. This section of the *Local Government Public Works Standards and Specifications* has been amended to comply with Tennessee law.

The other sections are presented in the format followed by CSI. This was done to provide more flexibility in using the document and to take advantage of the periodic updating supplied by this organization. In addition, users are also afforded the opportunity of incorporating present and future projects with CSI specifications as needed or required.

The enumerated construction standards and specifications are not minimum standards. They are based on recognized engineering practices common to Tennessee and elsewhere, and are intended to produce quality projects requiring minimum maintenance. Standard construction drawings are included in several sections and correspond in importance to the written text of the document.

The Design Criteria section contains specific instructions that should be followed by the design engineer as a project is developed. It does not cover all areas of design, some of which will necessarily be completed by the engineer.

Each unit of local government must decide how the document can best be utilized. It is not intended that the document become a state standard or be enacted into law. Although many cities may adopt it as presented, modifications can and should be made to correspond with local conditions. However, it is recommended that the standards not be compromised or lowered.

Any unit of local government utilizing these documents and specifications should be cautioned to require that Tennessee One-Call is to be contacted before any excavation and OSHA requirements shall be enforced during excavation or trenching.

Every effort will be made to keep document information current with changes in technology, materials, and public works practices. Suggested modifications, changes, and/or updating material should be sent to The University of Tennessee's Municipal Technical Advisory Service.

# ACKNOWLEDGMENTS

Review by the joint committee of Public Works Standards and Specifications is one of the many outstanding jobs this committee has done over the years. Organizations represented on the joint committee are:

Associated General Contractors
Tennessee Chapter of American Public Works Association
Tennessee Water Quality Management Association
Tennessee Society of Professional Engineers
Consulting Engineers of Tennessee
Municipal Technical Advisory Service
Tennessee Department of Environment and Conservation
Tennessee State Planning Office

This publication and the accompanying drawings are available on a computer disk, except as noted below. The text is in WordPerfect 5.1 and the drawings are in AutoCad Release 12 (DWG or DXF files). To order, contact:

The University of Tennessee
Municipal Technical Advisory Service
ATTN: LIBRARY
600 Henley Street, Suite 120
Knoxville, Tennessee 37996-4105
615/974-0411

For private sector requests, the cost of all disks is $100.

The General Conditions, the Change Order Form, and the Application for Payments are Standards of the National Society of Professional Engineers (NSPE) and are not on the disks. These items may be purchased from the Tennessee Society of Professional Engineers (TSPE) or directly from NSPE.

# TABLE OF CONTENTS

## CONTRACT DOCUMENTS



## CONSTRUCTION STANDARDS AND SPECIFICATIONS

### Division 1: General Requirements

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# CONTRACT DOCUMENTS

# Division 0: Bidding And Contract Requirements

# INVITATION TO BIDDERS

Date _____

SEPARATE sealed BIDS for the construction of _____

_____

will be received by _____

at _____

until _____, local time, on the _____ day of _____, 19___ and then at said place publicly opened and read aloud.

The work to be done consists of _____

_____

No bids will be received or accepted after the above specified time for the opening of Bids. Bids submitted after the designated hour will be deemed invalid and returned unopened to the Bidder.

The BIDDING DOCUMENTS may be examined at the following locations:

_____

_____

Copies of BIDDING DOCUMENTS may be obtained at the office(s) of _____

_____ located at _____

_____ upon payment of $_____for each set.

The deposits of all legal bidders except the successful bidders will be entirely refunded upon receipt of BIDDING DOCUMENTS (plans and specifications) in good condition within ten (10) calendar days subsequent to opening of bids. Non-bidders will be refunded $_____ under the same conditions of return.

BIDS shall be accompanied by a cashier's or bank check or BID Guarantee bond in the amount not less than five percent (5%) of the BID made payable to _____, OWNER, and subject to the conditions provided in the INSTRUCTIONS FOR BIDDERS.

The successful bidder will be required to furnish an acceptable Performance and Payment Bond in the amount of one hundred percent (100%) of the contract price.

The project herein described is to be completed within _____ calendar days from the date of award of contract. Liquidated damages for delay of completion of contract will be in accordance with the Agreement (Contract).

No bidder may withdraw his bid within sixty (60) days after the actual bid date of the opening thereof.

All bidders must be licensed contractors to perform the type construction herein described as required by Tennessee Code Annotated.

The OWNER reserves the right to waive any irregularities or reject any or all bids.

_____

Owner

_____

Address

## INSTRUCTIONS FOR BIDDERS

### 1. DEFINED TERMS

Terms used in these Instructions for Bidders which are defined in the Standard General Conditions of the Construction Contract, NSPE-ACEC Document 1910-8, CSI 56465 (1990 editions) have the meanings assigned to them in the General Conditions. The term "Successful Bidder" means the lowest, qualified, responsible Bidder to whom the Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

### 2. COPIES OF BIDDING DOCUMENTS

2.1. Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement or Invitation may be obtained from Engineer (unless another issuing office is designated in the Advertisement or Invitation to Bid). The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents within ten days after opening of Bids.

2.2. Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of the incomplete sets of Bidding Documents.

2.3. Owner and Engineer in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

### 3. QUALIFICATIONS OF BIDDERS

To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit within five days of Owner's request written evidence, such as financial data, previous experience, and evidence of authority to conduct business in the jurisdiction where the Project is located. Each Bid must contain evidence of Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the contract.

### 4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

4.1. Before submitting a Bid, each Bidder must: (a) examine the Contract Documents thoroughly; (b) visit the site to familiarize himself with local conditions that may in any manner affect cost, progress, or performance of the Work; (c) familiarize himself with federal, state, and local laws, ordinances, rules, and regulations that may in any manner affect cost, progress, or performance of the Work; and (d) study and carefully correlate Bidder's observations with the Contract Documents.

4.2. Reference is made to the Supplementary Conditions for the identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress, or performance of the Work which have been relied upon by Engineer in preparing the Drawings and Specifications. Owner will make copies of such reports available to any Bidder requesting them. These reports are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents. Before submitting his Bid each Bidder will, at his own expense, make such additional investigations and tests as the Bidder may deem necessary to determine his Bid for performance of the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

4.3. On request, Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of his Bid.

4.4. The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Supplementary Conditions, General Requirements, or Drawings.

4.5. The submission of a bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Article 4 and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

## 5. INTERPRETATIONS

All questions about the meaning or intent of the Contract Documents shall be submitted to Engineer in writing. Replies will be issued by Addendum mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than ten days prior to the date for opening of Bids will not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

## 6. BID SECURITY

6.1. Bid Security shall be made payable to Owner, in an amount of five (5) percent of the Bidder's maximum Bid price and in the form of a certified or bank check or a Bid Bond (on form attached, if a form is prescribed) issued by a Surety meeting the requirements of the General Conditions.

6.2. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required Contract Security, whereupon it will be returned; if the successful Bidder fails to execute and deliver the Agreement and furnish the required Contract Security within 15 days of the Notice of Award, Owner may annul the Notice of Award and the Bid Security of that Bidder will be forfeited. The Bid Security of any Bidder whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the "effective date of the Agreement" (which term is defined in the General Conditions) by Owner to Contractor and the required Contract Security is furnished or the sixty-first day after the Bid opening. Bid Security of other Bidders will be returned within seven days of the Bid opening.

## 7. CONTRACT TIME

The number of days within which, or the date by which, the Work is to be completed (the Contract Time) is set forth in the Bid Form and will be included in the Agreement.

## 8. LIQUIDATED DAMAGES

Provisions for liquidated damages, if any, are set forth in the Agreement.

## 9. SUBSTITUTE MATERIAL AND EQUIPMENT

The Contract, if awarded, will be on the basis of material and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or-equal" items. When it is indicated in the Drawings or specified in the Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the "effective date of the Agreement." The procedure for submittal of any such application by Contractor and consideration by Engineer is set forth in the General Conditions which may be supplemented in the Supplementary Conditions.

## 10. SUBCONTRACTORS, ETC.

10.1. If the Supplementary Conditions require the identity of certain Subcontractors and other persons or organizations to be submitted to Owner in advance of the Notice of Award, the apparent Successful Bidder, and any other Bidder so requested, will within seven days after the day of the Bid opening submit to Owner a list of all Subcontractors and other persons or organizations (including those who are to furnish the principal items of material and equipment) proposed for those portions of the Work as to which such identification is so required. Such list shall be accompanied by an experience statement with pertinent information as to similar projects and other evidence of qualification for each such Subcontractor, person, and organization if requested by the Owner. If Owner or Engineer after due investigation has reasonable objection to any proposed Subcontractor, other person or organization, either may before giving the Notice of Award request the apparent Successful Bidder to submit an acceptable substitute without an increase in Bid price. If the apparent Successful Bidder declines to make any such substitution, the contract shall not be awarded to such Bidder, but his declining to make any such substitution will not constitute grounds for sacrificing his Bid Security. Any Subcontractor, other person or organization so listed and to whom Owner or Engineer does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer.

10.2. In contacts where the Contract Price is on the basis of Cost-of-the-Work Plus a Fee, the apparent Successful Bidder, prior to the Notice of Award, shall identify in writing to Owner those portions of the Work that such Bidder proposes to subcontract and after the Notice of Award, may only subcontract other portions of the Work with Owner's written consent.

10.3. No contractor shall be required to employ any Subcontractor, other person or organization against whom he has reasonable objection.

## 11. BID FORM

11.1. The Bid Form is attached hereto; additional copies may be obtained from Engineer.

11.2. Bid Forms must be completed in ink or by typewriter.

11.3. Bid schedules for the type Bid requested shall be submitted as follows:

a. Lump Sum - Bid Schedule shall be used for a single price project. Bid shall be in numbers and words.

b. Unit Price - Bid Schedule shall be used where multiple units are more appropriate. The following shall apply when using the Unit Price - Bid Schedule:

1. The unit quantities indicated on the Bid Schedule are approximate, and the Owner reserves the right to increase or decrease any or all unit quantities by Contract Change Order at the unit price bid. The total of payments to the Contractor for unit price bid items shall represent payment for only the actual quantities of work installed.

2. The Bid Schedule in the Bid Form lists the various divisions of construction contemplated in the Plans and Specifications, together with an estimate of the units of each. With these units as the basis, the bidder will extend each item, using the cost he inserts in the unit column. Any total cost found inconsistent with the unit cost when the bids are examined will be deemed in error and corrected to agree with the unit cost which shall be considered correct.

11.4. Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

11.5. Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.

11.6. All names must be typed or printed below the signature.

11.7. The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which shall be filled in on the Bid Form).

11.8. The address to which communications regarding the Bid are to be directed must be shown.

## 12. SUBMISSION OF BIDS

12.1 Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be included in an opaque sealed envelope, marked:

Project title.
Bidder's name and address.
Bidder's Tennessee Contractors License Number.
Bidder's License Expiration Date.
Bidder's License Classification.
Contract for which Bid is submitted.

12.2 Bids must be accompanied by the Bid Security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof.

## 13. MODIFICATION AND WITHDRAWAL OF BIDS

13.1. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to submitted at any time prior to the opening of Bids.

13.2. If, within twenty-four hours after Bids are opened, any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to a reasonable satisfaction of Owner that

there was a material and substantial mistake in the preparation of his Bid, that Bidder may withdraw his Bid and the Bid Security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work.

## 14. OPENING OF BIDS

Bids will be opened publicly and will be read aloud. An abstract of the amounts of the base Bids and major alternates (if any) will be made available after the opening of Bids.

## 15. BIDS TO REMAIN OPEN

All Bids shall remain open for sixty days after the day of the Bid opening, but Owner may, in his sole discretion, release any Bid and return the Bid Security prior to that date.

## 16. AWARD OF CONTRACT

16.1. Owner reserves the right to reject any and all Bids, to waive any and all irregularities and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, or conditional bids. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

16.2. In evaluating Bids, Owner shall consider the qualification of the Bidders, whether or not the Bids comply with the prescribed requirements, and alternates and unit prices if requested in the Bid forms. It is the Owner's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid form, but Owner may accept them in any order or combination.

16.3. Owner may consider the qualifications and experience of Subcontractors and other persons and organizations (including those who are to furnish the principal items of material or equipment) proposed for those portions of the Work as to which the identity of Subcontractors and other persons and organizations must be submitted as provided in the Supplementary Conditions. Operating costs, maintenance considerations, performance data, and guarantees of materials and equipment may also be considered by Owner.

16.4. Owner may conduct such investigations as he deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of the Bidders, proposed Subcontractors, and other persons and organizations to do the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

16.5. Owner reserves the right to reject the Bid of any Bidder who does not pass any such evaluation to Owner's satisfaction.

16.6. If the contract is to be awarded, it will be awarded to the lowest bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.

16.7. If the contract is to be award, Owner will give the Successful Bidder a Notice of Award within sixty days after the day of the Bid opening.

## 17. PERFORMANCE AND OTHER BONDS

The General Conditions and the Supplementary Conditions set forth Owner's requirements as to performance and other Bonds. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by the required Contract Security.

## 18. SIGNING OF AGREEMENT

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by at least three unsigned counterparts of the Agreement and all other Contract Documents. Within fifteen days thereafter, Contractor shall sign and deliver at least three counterparts of the Agreement to Owner with all other Contract Documents attached. Within ten days thereafter, Owner will deliver all fully signed counterparts to Engineer. Engineer will identify those portions of the Contract Documents not fully signed by Owner and Contractor and such identification shall be binding on all parties.

## 19. SPECIAL LEGAL REQUIREMENTS

Insert provisions as applicable re:

(a) Statements required by federal, state, or local law or regulation or funding agency or appropriate reference thereto.
(b) Bid pricing requirements on base bid alternatives, cash allowances, unit prices, and acceptable combinations.
(c) Prepurchasing by Owner and subsequent assignment of purchase order to Contractor.
(d) Owner's special tax exemption.
(e) Detailed description of Work with cross-reference to General Requirements.
(f) Division of Work into separate parts with cross-reference to General Requirements.

# BID FORM

CONTRACT ___

DATE:_____

Project _____ Engineer _____

Project No. _____ Address _____

Bidder

_____

(Name)

_____

(Corporation, Partnership, Individual trading as Joint Venture)

_____

(Address)

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Time indicated in this Bid and in accordance with the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Instructions for Bidders, including without limitation those dealing with the disposition of Bid Security. This Bid will remain open for sixty days after the day of BID opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within fifteen days after the date of OWNER's Notice of AWARD.

3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:

(a) BIDDER has received, read, and examined the following numbered addenda: _____, _____, _____, _____.

(b) BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules, and regulations) and the conditions affecting cost, progress, or performance of the Work and has made such independent investigations as BIDDER deems necessary; the BIDDER has carefully examined the Plans, the Technical Specifications, the General and Special Conditions, Instructions for Bidders, the form of Contract, and the form of Contract Bond, and thoroughly understands their stipulations, requirements, and provisions.

BIDDER has determined the quality and quantity of materials required; has investigated the location and determined the sources of supply of materials required; has investigated labor conditions; and has arranged for the continuous prosecution of the work herein described.

(c)[1] BIDDER understands that the quantities of work shown herein are approximate only and are subject to increase and decrease and agrees that all quantities of work, whether increased or decreased are to be performed at the unit prices stated in the following Unit Price Bid Schedule for the work described. The BIDDER agrees to perform all "Extra Work" which may be required in connection with the construction and completion of the work as required.

(d) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm, or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for himself any advantage over any other Bidder or over OWNER.

4. BIDDER understands that a price for each item in the Bid Schedule must be filled in as stated in Instruction to Bidders. Failure to indicate price for alternates, if any, may be grounds for considering the Bid irregular.

5. BIDDER will complete the Work as described in the specifications for the price(s) as shown on the Bid Schedule.

6. BIDDER agrees that:

(a) The work will be substantially complete and completed on or before the dates or within the number of calendar days indicated in the Agreement and the Notice to Proceed.

(b) The work will be completed within _____ calendar days after the date when the Contract Time commences to run.

BIDDER accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

7. The undersigned BIDDER submits herewith bid guaranty in an amount of not less than five percent (5%) of the total amount of the proposal offered and agrees and consents that the bid guaranty shall be forfeited to the Owner as liquidated damages if the required contract bond is not executed within fifteen (15) days from the date of the notice of the award and work has not been started as required. The following documents are attached to and made a condition of this BID:

(a) Required Bid Security in the form of:
_____ Certified Check or Bank Check
_____ Bid Bond

(Items (b), (c), and (d) below optional as required by Engineer and Owner.)

(b) A tabulation of Subcontractors and other persons and organizations required to be identified prior to Notice of Award as specified in the General Conditions.

(c) Required Bidder's Qualification Statement with supporting data.

(d) (Add other documents as pertinent.)

[1]This paragraph shall be omitted on a lump sum bid.

8. The terms used in this Bid, which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

If BIDDER is:

**AN INDIVIDUAL**

By _____
(SEAL)
(Individual's Name)

doing business as _____

Business Address _____

_____

Phone No. _____

**A PARTNERSHIP**

By _____
(SEAL)
(Firm Name)

_____
(General Partner)

Business Address _____

_____

Phone No. _____

**A CORPORATION**

By _____
(Corporation Name)

_____
(State in Incorporation)

By _____
(Name of Person Authorized to Sign)

_____
(Title)

(Corporate Seal)

Attest _____
(Secretary)

Business Address _____

_____

Phone No. _____

**A JOINT VENTURE**

By _____
(Name)

_____
(Address)

By _____
(Name)

_____
(Address)

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above).

# LUMP SUM BID SCHEDULE

PROJECT:_____

PROJECT NUMBER:_____

_____

_____

(NAME AND ADDRESS OF OWNER)

BIDDER hereby agrees to perform_____ _____ as shown in detail in the Construction Drawings and as specified in detail in these specifications for Lump Sum Price indicated below, complete including all incidentals and appurtenances thereto.

For _____
(Dollars in Words)

And _____
(Cents)

TOTAL LUMP SUM BID $_____

# UNIT PRICE BID SCHEDULE

PROJECT:_____

PROJECT NUMBER:_____

_____

_____

(NAME AND ADDRESS OF OWNER)

| ITEM NO. | DESCRIPTIONS | ESTIMATED QUANTITY | UNIT | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| TOTAL BID | | | | | |

# BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ _____ as CONTRACTOR, and _____ ____ as Surety, are hereby held and firmly bound unto _____ _____ as OWNER in the penal sum of payment of which, well and truly made, we hereby jointly and severally bind ourselves, successors, and assigns.

Signed, this _____ day of _____, 19____.

The Condition of the above obligation is such that whereas the principal has submitted to _____ a certain BID, attached hereto and hereby madea part hereof to enter into a contract in writing, for the _____ _____

NOW, THEREFORE,

(a) If said Bid shall be rejected, or

(b) If said Bid shall be accepted and the CONTRACTOR shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the CONTRACTOR and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____
CONTRACTOR

By _____ Witness _____

Title _____

_____
Surety

By _____ Witness _____

Title _____

IMPORTANT - Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located for federally funded projects.

Note: Bond may be declared invalid if not accompanied by Power of Attorney.

# AGREEMENT

THIS AGREEMENT, made this _____ day of _____, 19____, by and between _____ hereinafter called "OWNER" and _____ _____ doing business as (an individual) (a partnership) (a corporation) or (a joint venture) hereinafter called "CONTRACTOR."

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

**Article 1.** WORK. The Contractor will perform all Work as shown in the Contract Documents for the Completion of the Project generally described as follows:

_____
_____
_____
_____

**Article 2.** ENGINEER. The project has been designed by:

_____
_____
_____
_____

who will act as the ENGINEER in connection with completion of the project in accordance with the Contract Documents.

**Article 3.** CONTRACT TIME. The Work shall be completed within _____ calendar days after the date which the CONTRACTOR is to start the Work as provided in the Contract Documents.

**Article 4.** LIQUIDATED DAMAGES: If the CONTRACTOR shall fail to complete the work within the time stipulated in this Agreement, including any extensions of time for excusable delays as provided for in the Supplemental Conditions, the CONTRACTOR shall pay the OWNER liquidated damages in the stipulated amount of $_____/day for each calendar day of delay, until the work is substantially completed.

**Article 5.** CONTACT PRICE. The OWNER will pay the CONTRACTOR for performance of Work and completion of the Project in accordance with the Contract Documents subject to adjustment modifications as provided therein the sum of $_____ as shown in the bid schedule.

**Article 6.** PAYMENT PROCEDURES. The OWNER will make progress payments on account of the Contract Price as provided in the General Conditions as follows:

6.1. Progress and final payments will be on the basis of the CONTRACTOR's Application for Payment as approved by the ENGINEER.

6.2. On or about the _____ day of each month during construction:
_____% of the Work completed, and
_____% of material and equipment not incorporated in the Work but delivered and suitably stored, less in each case the aggregate of payments previously made.

6.3. Upon Substantial Completion, a sum sufficient to increase the total payments to the CONTRACTOR to 98% of the Contract Price less retainage as the ENGINEER shall determine for all uncompleted Work and unsettled claims.

6.4. Upon final completion of the Work and Settlement of all claims, the remainder of the Contract Price.

**Article 7.** CONTRACT DOCUMENTS. The Contract Documents which comprise the contract between the OWNER and the CONTRACTOR are attached hereto and made a part hereof and consist of the following:

7.1. This Agreement (and any Exhibits);
7.2. CONTRACTOR's Bid and Bid Bonds
7.3. Specifications consisting of:
Instructions for Bidders
General Conditions and Supplementary Conditions
Technical Specifications
7.4. Drawing and Plans
7.5. Addenda
7.6. Any modifications, including Change Orders, duly delivered after execution of this Agreement.

**Article 8.** MISCELLANEOUS.

8.1. Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.
8.2. Neither the OWNER nor the CONTRACTOR shall, without the prior written consent of the other, assign or sublet in whole or in part his interest under any of the Contract Documents and, specifically, the CONTRACTOR shall not assign any moneys due or to become due without the prior written consent of the OWNER.
8.3. The OWNER and the CONTRACTOR each binds himself, his partners, successors, assigns, and legal representatives to the other party hereto in respect of all covenants, agreements, and obligations contained in the Contract Documents.
8.4. The Contract Documents constitute the entire agreement between the OWNER and the CONTRACTOR and may only be altered, amended, or repealed by a duly executed written instrument.

Article 9. OTHER PROVISIONS. (If applicable)

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in (_____) each of which shall be deemed an original on the date first above written.

| | |
|---|---|
| OWNER_____ | CONTRACTOR[2]_____ |
| By_____ | By_____ |
| Title_____ | Title_____ |
| [CORPORATE SEAL] | [CORPORATE SEAL] |
| Attest_____ | Attest_____ |
| By_____ | By_____ |
| Title_____ | Title_____ |

[2]This is an example of the signature for a corporation. If the entity acting as Contractor is an individual, a partnership, or a joint venture, see the examples for signatures in the Bid Form.

# PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____, hereinafter called CONTRACTOR,
(Corporation, Partnership, Individual, or Joint Venture)

and _____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

_____
(Name of Owner)

_____
(Address of Owner)

hereinafter called OWNER, in the penal sum of _____ Dollars, $(_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the CONTRACTOR has entered into a certain contract with the OWNER, dated the _____ day of _____, 19____, a copy of which is hereto attached and made a part of here of for the construction of:

_____
_____
_____
_____

NOW, THEREFORE, if the Contractor shall well, truly, and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the one year guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full-force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the Work to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any wise affect its obligation on this

BOND, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the Work or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____ (number) counterparts, each one of which shall be deemed an original, this the _____ day of _____ _____, 19___.

ATTEST:

_____
(Contractor) Secretary
(SEAL)

_____
Witness to Contractor

_____
Address

_____

_____
Contractor

By_____

Title_____

Address_____

_____

_____
Surety

By_____
Attorney-in-fact

Address_____

_____

_____
Witness to Surety

_____
Address

_____

Note: Date of BOND must not be prior to date of Contract. If CONTRACTOR is Partnership all partners should execute BOND.

BOND is not valid unless accompanied by Power of Attorney.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the Project is to be located.

# PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____, hereinafter called CONTRACTOR,
(Corporation, Partnership, Individual, or Joint Venture)

and _____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

_____
(Name of Owner)

_____
(Address of Owner)

hereinafter called OWNER, in the penal sum of _____ Dollars, $(_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the CONTRACTOR has entered into a certain contract with the OWNER, dated the _____ day of _____, 19____, a copy of which is hereto attached and made a part of here of for the construction of:

_____
_____
_____
_____

NOW, THEREFORE, if the CONTRACTOR shall promptly make payment to all persons, firms, Subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the Work provided for in such contract, and any authorized extension or modification thereof, including all amounts due to material, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment, and tools, consumed or used in connection with the construction of such Work, and all insurance premiums on said Work, and for all labor, performed in such Work whether by Subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the Work to be performed

thereunder or the SPECIFICATIONS accompanying the same shall in any wise affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the contract or to the Work or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____

counterparts, each one of which shall be deemed an original, this the _____ day of _____, 19____.

ATTEST:

_____
(Contractor) Secretary

_____
Contractor

(SEAL)

By_____

Title_____

Address_____

_____

_____
Witness to Contractor

_____
Address

_____

_____
Surety

By_____
Attorney-in-fact

Address_____

_____

_____
Witness to Surety

_____
Address

_____

Note: Date of BOND must not be prior to date of Contract. If CONTRACTOR is Partnership all partners should execute BOND.

BOND is not valid unless accompanied by Power of Attorney.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the Project is to be located.

This document has important legal consequences: consultation with an attorney is encouraged with respect to its completion or modification.

# STANDARD
# GENERAL CONDITIONS
# OF THE
# CONSTRUCTION CONTRACT

Prepared by

Engineers Joint Contract Documents Committee

and

Issued and Published Jointly By

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
*A practice division of the*
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

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AMERICAN CONSULTING ENGINEERS COUNCIL

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AMERICAN SOCIETY OF CIVIL ENGINEERS

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CONSTRUCTION SPECIFICATIONS INSTITUTE

This document has been approved and endorsed by

The Associated General Contractors of America

These General Conditions have been prepared for use with the Owner-Contractor Agreements (No. 1910-A-1 or 1910-8-A-2) (1990 Editions). Their provisions are interrelated and a change in one may necessitate a change in the others. Comments concerning their usage are contained in the Commentary on Agreements for Engineering Services and Contract Documents (No. 1910-9) (1986 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. 1910-17) (1990 Edition). When bidding is involved, the Standard Form of Instructions to Bidders (No. 1910-12) (1990 Edition) may be used.

# TABLE OF CONTENTS OF GENERAL CONDITIONS

# INDEX TO GENERAL CONDITIONS

# GENERAL CONDITIONS

## ARTICLE 1—DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents.

1.2. *Agreement*—The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3. *Application for Payment*—The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

1.5. *Bid*—The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6. *Bidding Documents*—The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

1.7. *Bidding Requirements*—The advertisement or invitation to Bid, instructions to bidders, and the Bid form.

1.8. *Bonds*—Performance and Payment bonds and other instruments of security.

1.9. *Change Order*—A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.10. *Contract Documents*—The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and clarifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1.1 and 4.2.2.2 are not Contract Documents.

1.11. *Contract Price*—The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

1.12. *Contract Times*—The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.13. *CONTRACTOR*—The person, firm or corporation with whom OWNER has entered into the Agreement.

1.14. *defective*—An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

1.15. *Drawings*—The drawings which show the scope, extent and character of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop drawings are not Drawings as so defined.

1.16. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

1.17. *ENGINEER*—The person, firm or corporation named as such in the Agreement.

1.18. *ENGINEER's Consultant*—A person, firm or corporation having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.19. *Field Order*—A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.20. *General Requirements*—Sections of Division 1 of the Specifications.

1.21. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

1.22. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

1.23. *Liens*—Liens, charges, security interests or encumbrances upon real property or personal property.

1.24. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.25. *Notice of Award*—The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.26. *Notice to Proceed*—A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.27. *OWNER*—The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.28. *Partial Utilization*—Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

1.29. *PCBs*—Polychlorinated biphenyls.

1.30. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

1.31. *Project*—The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.32. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

1.33. *Resident Project Representative*— The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

1.35. *Shop Drawings*—All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

1.36. *Specifications*—Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.37. *Subcontractor*—An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.38. *Substantial Completion*—The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.39. *Supplementary Conditions*—The part of the Contract Documents which amends or supplements these General Conditions.

1.40. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.41. *Underground Facilities*—All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

1.42. *Unit Price Work*—Work to be paid for on the basis of unit prices.

1.43. *Work*—The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.44. *Work Change Directive*—A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.

1.45. *Written Amendment*—A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

## ARTICLE 2—PRELIMINARY MATTERS

*Delivery of Bonds:*

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

*Copies of Documents:*

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

*Commencement of Contract Times; Notice to Proceed:*

2.3. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

*Starting the Work:*

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

*Before Starting Construction:*

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or reasonably should have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2.6.2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.7. Before any Work at the site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6 and 5.7.

*Preconstruction Conference:*

2.8. Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference

attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.6, procedures for handling Shop Drawings and other submittals, processing Applications for Payment and maintaining required records.

*Initially Acceptable Schedules:*

2.9. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until the schedules are submitted to and acceptable to ENGINEER as provided below. The progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor. CONTRACTOR's schedule of Shop Drawing and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the required submittals. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance.

## ARTICLE 3—CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

*Intentt:*

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases which have a well- known technical or construction industry or trade meaning are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. *Reference to Standards and Specifications of Technical Societies; Reporting and Resolving Discrepancies:*

3.3.1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

3.3.3. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and:

3.3.3.1. the provisions of any such standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

3.3.3.2. the provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

No provision of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or

performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

***Amending and Supplementing Contract Documents:***

3.5. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1. a formal Written Amendment,

3.5.2. a Change Order (pursuant to paragraph 10.4), or

3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1. a Field Order (pursuant to paragraph 9.5),

3.6.2. ENGINEER's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

***Reuse of Documents:***

3.7. CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

## ARTICLE 4—AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

***Availability of Lands:***

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

**4.2. *Subsurface and Physical Conditions:***

4.2.1. *Reports and Drawings:* Reference is made to the Supplementary Conditions for identification of:

4.2.1.1. *Subsurface Conditions:* Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents; and

4.2.1.2. *Physical Conditions:* Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by ENGINEER in preparing the Contract Documents.

4.2.2. *Limited Reliance by CONTRACTOR Authorized; Technical Data:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

4.2.2.1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto, or

4.2.2.2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or

4.2.2.3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

4.2.3. *Notice of Differing Subsurface or Physical Conditions:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the site that is uncovered or revealed either:

4.2.3.1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, or

4.2.3.2. is of such a nature as to require a change in the Contract Documents, or

4.2.3.3. differs materially from that shown or indicated in the Contract Documents, or

4.2.3.4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then

CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

4.2.4. *ENGINEER's Review:* ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5. *Possible Contract Documents Change:* If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition that meets one or more of the categories in paragraph 4.2.3., a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6. *Possible Price and Times Adjustments:* An equitable adjustment in the Contract Price or in the Contract Times, or both, will be allowed to the extent that the existence of such uncovered or revealed condition causes an increase or decrease in CONTRACTOR's cost of, or time required for performance of, the Work; subject, however, to the following:

4.2.6.1. such condition must meet any one or more of the categories described in paragraphs 4.2.3.1 through 4.2.3.4, inclusive;

4.2.6.2. a change in the Contract Documents pursuant to paragraph 4.2.5 will not be an automatic authorization of nor a condition precedent to entitlement to any such adjustment;

4.2.6.3. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.10 and 11.9; and

4.2.6.4. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Times if;

4.2.6.4.1. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a bid or becoming bound under a negotiated contract; or

4.2.6.4.2. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test or study of the site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

4.2.6.4.3. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.2.3.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

**4.3. *Physical Conditions—Underground Facilities:***

4.3.1. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on

information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2. The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2. *Not Shown or Indicated:* If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.23), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Price or Contract Times, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages incurred or sustained by CONTRACTOR on or in connection with any other project or anticipated project.

***Reference Points:***

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

**4.5. Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:**

4.5.1. OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought to the site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2. CONTRACTOR shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23), and (ii) notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustinent, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefor as provided in Articles 11 and 12.

4.5.3. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefor as provided in Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's

Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5. The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

## ARTICLE 5—BONDS AND INSURANCE

***Performance, Payment and Other Bonds:***

5.1. CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

**5.3.** ***Licensed Sureties and Insurers; Certificates of Insurance:***

5.3.1. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

***CONTRACTOR's Liability Insurance:***

5.4. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1. claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.4.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.4.4. claims for damages insured by customary personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;

5.4.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

5.4.6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7. with respect to insurance required by paragraphs 5.4.3 through 5.4.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers and employees of all such additional insureds;

5.4.8. include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

5.4.9. include completed operations insurance;

5.4.10. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.12, 6.16 and 6.31 through 6.33;

5.4.11. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12; and

5.4.13. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

***OWNER's Liability Insurance:***

5.5. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.4, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

***Property Insurance:***

5.6. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework and Work in transit and shall insure against at least the following perils fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

5.6.3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.4. cover materials and equipment stored at the site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5.6.5. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

5.8. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be cancelled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.11.

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraphs 5.6 or 5.7, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

**5.11.** ***Waiver of Rights:***

5.11.1. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraphs 5.6 and 5.7 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2. In addition, OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them, for:

5.11.2.1. loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by OWNER; and

5.11.2.2. loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured peril covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.10, after substantial completion pursuant to paragraph 14.8 or after final payment pursuant to paragraph 14.13.

Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in this paragraph 5.11.2 shall contain provisions to the effect that in the event of payment of any such loss, damage or consequential loss the insurers will have no rights of recovery against any of CONTRACTOR, Subcontractors, ENGINEER, ENGINEER'sConsultants and the officers, directors, employees and agents of any of them.

**Receipt and Application of Insurance Proceeds**

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

***Acceptance of Bonds and Insurance; Option to Replace:***

5.14. If either party (OWNER or CONTRACTOR) has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was

required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

*Partial Utilization—Property Insurance:*

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account of any such partial use or occupancy.

## ARTICLE 6—CONTRACTOR'S RESPONSIBILITIES

*Supervision and Superintendence:*

6.1. CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications to the superintendent shall be as binding as if given to CONTRACTOR.

*Labor, Materials and Equipment:*

6.3. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

*Progress Schedule:*

6.6. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.9 as it may be adjusted from time to time as provided below:

6.6.1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.6.2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of paragraph 12.1. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.7. *Substitutes and "Or-Equal" Items:*

6.7.1. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by ENGINEER under the following circumstances:

6.7.1.1. *"Or-Equal":* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2. *Substitute Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under subparagraph 6.7.1.1, it will be considered a proposed substitute item. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the ENGINEER will include the following as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall first make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

6.7.1.3. *CONTRACTOR's Expense:* All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense.

6.7.2. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.7.1.2.

6.7.3. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.7.1.2 and 6.7.2. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitutes proposed or submitted by CONTRACTOR pursuant to paragraphs 6.7.1.2 and 6.7.2 and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER accepts a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute item.

***Concerning Subcontractors, Suppliers and Others:***

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials or equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be adjusted by the difference in the cost occasioned by such

substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9.1. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.9.2. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

***Patent Fees and Royalties:***

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents.

***Permits:***

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

***Laws and Regulations:***

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses and damages caused by, arising out of or resulting therefrom; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.3.2.

***Taxes:***

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of

the Project which are applicable during the performance of the Work.

*Use of Premises:*

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. CONTRACTOR shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

*Record Documents:*

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to ENGINEER for OWNER.

*Safety and Protection:*

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all persons on the Work site or who may be affected by the Work;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

*Safety Representative:*

6.21. CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and

responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

*Hazard Communication Programs:*

6.22. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with Laws or Regulations.

*Emergencies:*

6.23. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

**6.24.** ***Shop Drawings and Samples:***

6.24.1. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

**6.25.** ***Submittal Procedures:***

6.25.1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

6.25.1.1. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto,

6.25.1.2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

6.25.1.2. all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2. Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contact Documents with respect to CONTRACTOR'S review and approval of that submittal.

6.25.3. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by ENGINEER as required by paragraph 2.9. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where a particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract

Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

***Continuing the Work:***

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as OWNER and CONTRACTOR may otherwise agree in writing.

**6.30.** ***CONTRACTOR's General Warranty and Guarantee:***

6.30.1. CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

6.30.1.1. abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or

6.30.1.2. normal wear and tear under normal usage.

6.30.2. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

6.30.2.1. observations by ENGINEER;

6.30.2.3. recommendation of any progress or final payment by ENGINEER;

6.30.2.3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4. use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5. any acceptance by OWNER or any failure to do so;

6.30.2.6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13;

6.30.2.7. any inspection, test or approval by others; or

6.30.2.8. any correction of *defective* Work by OWNER.

***Indemnification:***

6.31. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused by, arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage: (i) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and (ii) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.32. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.33. The indemnification obligations of CONTRACTOR under paragraph 6.31 shall not extend to the liability of ENGINEER and ENGINEER's Consultants, officers, directors, employees or agents caused by the professional negligence, errors or omissions of any of them.

***Survival of Obligations:***

6.34. All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with

the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

## ARTICLE 7—OTHER WORK

*Related Work at Site:*

7.1. OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefor which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, then: (i) written notice thereof will be given to CONTRACTOR prior to starting any such other work, and (ii) CONTRACTOR may make a claim therefor as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

*Coordination:*

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1. the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2. the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3. the extent of such authority and responsibilities will be provided.

Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

## ARTICLE 8—OWNER'S RESPONSIBILITIES

8.1. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of physical conditions in existing structures at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9. The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10. OWNER'S responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Materials uncovered or revealed at the site is set forth in paragraph 4.5.

8.11. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

## ARTICLE 9—ENGINEER'S STATUS DURING CONSTRUCTION

***OWNER's Representative:***

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

***Visits to Site:***

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against *defective* Work. ENGINEER's visits and on-site observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.13, and particularly, but without limitation, during or as a result of ENGINEER's on-site visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

***Project Representative:***

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.13 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other person will be as provided in the Supplementary Conditions.

***Clarifications and Interpretations:***

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER or CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree to the amount or extent thereof, if any, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or Article 12.

***Authorized Variations in Work:***

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR who shall perform the Work involved promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree as to the amount or extent thereof, OWNER or CONTRACTOR may make a written claim therefor as provided in Article 11 or 12.

***Rejecting Defective Work:***

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be *defective*, or

that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

*Shop Drawings, Change Orders and Payments:*

9.7. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

9.9. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

*Determinations for Unit Prices:*

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other and to ENGINEER written notice of intention to appeal from ENGINEER's decision and: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in Exhibit GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to ENGINEER's decision, unless otherwise agreed in writing by OWNER and CONTRACTOR. Such appeal will not be subject to the procedures of paragraph 9.11.

*Decisions on Disputes:*

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and Claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within thirty days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. ENGINEER's written decision on such claim, dispute or other matter will be final and binding upon OWNER and CONTRACTOR unless: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in EXHIBIT GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within thirty days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty days of the date of such decision, unless otherwise agreed in writing by OWNER and CONTRACTOR.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 or 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16.

**9.13.** *Limitations on ENGINEER's Authority and Responsibilities:*

9.13.1. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by ENGINEER shall create, impose or give rise to any duty owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them.

9.13.2. ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.13.4. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and Other documentation required to be delivered by paragraph 14.12 will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, the Contract Documents.

9.13.5. The limitations upon authority and responsibility set forth in this paragraph 9.13 shall also apply to ENGINEER's Consultants, Resident Project Representative and assistants.

## ARTICLE 10—CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefor as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.5 and 3.6 except in the case of an emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1. changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

## ARTICLE 11—CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after the start of such occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the adjustment claimed covers all known amounts to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will

be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive);

11.3.2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2);

11.3.3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 11.6).

*Cost of the Work:*

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen and other personnel employed full- time at the site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids, if any, will be accepted. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof—all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4—all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of *defective* Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

11.6. The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or

11.6.2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2, the CONTRACTOR's fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR's fee shall be five percent;

11.6.2.3. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.4.1, 11.4.2, 11.4.3 and 11.6.2 is that the Subcontractor who actually performs or furnishes the Work, at whatever tier, will be paid a fee of fifteen percent of the costs incurred by such Subcontractor under paragraphs 11.4.1 and 11.4.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

11.6.2.4. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.5. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and

11.6.2.5. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1 through 11.6.2.5, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraphs 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

*Cash Allowances:*

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

11.8.1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

**11.9.** ***Unit Price Work:***

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

11.9.3. OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2. there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

## ARTICLE 12—CHANGE OF CONTRACT TIMES

12.1. The Contract Times (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times (or Milestones) shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefor as provided in paragraph 12.1. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER be liable to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of CONTRACTOR, or (ii)

delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

## ARTICLE 13—TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF *DEFECTIVE* WORK

13.1. *Notice of Defects:* Prompt notice of all *defective* Work of which OWNER or ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective* Work may be rejected, corrected or accepted as provided in this Article 13.

***Access to Work:***

13.2. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

***Tests and Inspections:***

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

13.4.1. for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3. as otherwise specifically provided in the Contract Documents.

13.5. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6. If any Work (or the work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

13.7. Uncovering Work as provided in paragraph 13.6 shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

***Uncovering Work:***

13.8. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefor as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

***OWNER May Stop the Work:***

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work

shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any surety or other party.

*Correction or Removal of Defective Work:*

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

**13.12.** ***Correction Period:***

13.12.1. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

13.12.2. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.12.3. Where *defective* Work (and damage to other Work resulting therefrom) has been corrected, removed or replaced under this paragraph 13.12, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

*Acceptance of Defective Work:*

13.13. If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all claims, costs, losses and damages attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

*OWNER May Correct Defective Work:*

13.14. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors and ENGINEER and ENGINEER's Consultants access to the site to enable OWNER to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by OWNER in exercising such rights and remedies will be charged against CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefor as provided in Article 11. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

## ARTICLE 14—PAYMENTS TO CONTRACTOR AND COMPLETION

*Schedule of Values:*

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and

will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

*Application for Progress Payment:*

14.2. At least twenty days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

*CONTRACTOR's Warranty of Title:*

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

*Review of Applications for Progress Payment:*

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

14.5.1. the Work has progressed to the point indicated,

14.5.2. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation), and

14.5.3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER's recommendation of any payment, including final payment, shall not mean that ENGINEER is responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.5. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5. claims have been made against OWNER on account of CONTRACTORs performance or furnishing of the Work,

14.7.6. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens,

14.7.7. there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.7.1 through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

*Substantial Completion:*

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

*Partial Utilization:*

14.10. Use by OWNER at OWNER's option of any substantially completed part of the Work which: (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

*Final Inspection:*

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all

particulars in which this inspection reveals that the Work is incomplete or *defective*. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

*Final Application for Payment:*

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu of such releases or waivers of Liens and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

*Final Payment and Acceptance:*

14.13. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after the presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance and with ENGINEER's recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

*Waiver of Claims:*

14.15. The making and acceptance of final payment will constitute:

14.15.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from *defective* Work appearing after final inspection pursuant to paragraph 14.11, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

## ARTICLE 15—SUSPENSION OF WORK AND TERMINATION

*OWNER May Suspend Work:*

15.1. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes an approved claim therefor as provided in Articles 11 and 12.

*OWNER May Terminate:*

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as adjusted from time to time pursuant to paragraph 6.6);

15.2.2. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.2. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.4. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by OWNER arising out of or resulting from completing the Work such excess will be paid to CONTRACTOR. If such claims, costs, losses and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

15.4.1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

15.4.2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

15.4.3. for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

15.4.4. for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

*CONTRACTOR May Stop Work or Terminate:*

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven day's written notice to OWNER and ENGINEER stop the Work until payment of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

## ARTICLE 16—DISPUTE RESOLUTION

If and to the extent that OWNER and CONTRACTOR have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution method and procedure, if any, shall be as set forth in Exhibit GC-A, "Dispute Resolution Agreement," to be attached hereto and made a part hereof. If no such agreement on the method and procedure for resolving such disputes has been reached, and subject to the provisions of paragraphs 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise

such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

## ARTICLE 17—MISCELLANEOUS

*Giving Notice:*

17.1. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

*Computation of Times:*

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

*Notice of Claim:*

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

*Cumulative Remedies:*

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.12, 6.16, 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

*Professional Fees and Court Costs Included:*

17.5. Whenever reference is made to "claims, costs, losses and damages," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

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# EXHIBIT GC-A to Gener l Conditions of the Agreement Between OWNER and CONTRACTOR Dated_____ For use with EJCDC No. 1910-8 (1990 ed.)

DISPUTE RESOLUTION AGREEMENT

OWNER and CONTRACTOR hereby agree that Article 16 of the General Conditions to the Agreement between OWNER and CONTRACTOR is amended to include the following agreement of the parties:

16.1. All claims, disputes and other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment as provided by paragraph 14.15) will be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining, subject to the limitations of this Article 16. This agreement so to arbitrate and any other agreement or consent to arbitrate entered into in accordance herewith as provided in this Article 16 will be specifically enforceable under the prevailing law of any court having jurisdiction.

16.2. No demand for arbitration of any claim, dispute or other matter that is required to be referred to ENGINEER initially for decision in accordance with paragraph 9.11 will be made until the earlier of (a) the date on which ENGINEER has rendered a written decision or (b) the thirty-first day after the parties have presented their evidence to ENGINEER if a written decision has not been rendered by ENGINEER before that date. No demand for arbitration of any such claim, dispute or other matter will be made later than thirty days after the date on which ENGINEER has rendered a written decision in respect thereof in accordance with paragraph 9.11; and the failure to demand arbitration within said thirty days' period will result in ENGINEER's decision being final and binding upon OWNER and CONTRACTOR. If ENGINEER renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but will not supersede the arbitration proceedings, except where the decision is acceptable to the parties concerned. No demand for arbitration of any written decision of ENGINEER rendered in accordance with paragraph 9.10 will be made later than ten days after the party making such demand has delivered written notice of intention to appeal as provided in paragraph 9.10.

16.3. Notice of the demand for arbitration will be filed in writing with the other party to the Agreement and with the American Arbitration Association, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the thirty-day or ten- day period specified in paragraph 16.2 as applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

16.4. Except as provided in paragraph 16.5 below, no arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder or in any other manner any other person or entity (including ENGINEER, ENGINEER's Consultant and the officers, directors, agents, employees or consultants of any of them) who is not a party to this contract unless:

16.4.1. the inclusion of such other person or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration, and

16.4.2. such other person or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings, and

16.4.3. the written consent of the other person or entity sought to be included and of OWNER and CONTRACTOR has been obtained for such inclusion, which consent shall make specific reference to this paragraph; but no such consent shall constitute consent to arbitration of any dispute not specifically described in such consent or to arbitration with any party not specifically identified in such consent.

16.5. Notwithstanding paragraph 16.4 if a claim, dispute or other matter in question between OWNER and CONTRACTOR involves the Work of a Subcontractor, either OWNER or CONTRACTOR may join such Subcontractor as a party to the arbitration between OWNER and CONTRACTOR hereunder. CONTRACTOR shall include in all subcontracts required by paragraph 6.11 a specific provision whereby the Subcontractor consents to being joined in an arbitration between OWNER and CONTRACTOR involving the Work of such Subcontractor. Nothing in this paragraph 16.5 nor in the provision of such subcontract consenting to joinder shall create any claim, right or cause of action in favor of Subcontractor and against OWNER, ENGINEER or ENGINEER's Consultants that does not otherwise exist.

16.6. The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal.

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16.7. OWNER and CONTRACTOR agree that they shall first submit any and all unsettled claims, counterclaims, disputes and other matters in question between them arising out of or relating to the Contract Documents or the breach thereof ("disputes"), to mediation by The American Arbitration Association under the Construction Industry Mediation Rules of the American Arbitration Association prior to either of them initiating against the other a demand for arbitration pursuant to paragraphs 16.1 through 16.6, unless delay in initiating arbitration would irrevocably prejudice one of the parties. The respective thirty and ten day time limits within which to file a demand for arbitration as provided in paragraphs 16.2 and 16.3 above shall be suspended with respect to a dispute submitted to mediation within those same applicable time limits and shall remain suspended until ten days after the termination of the mediation. The mediator of any dispute submitted to mediation under this Agreement shall not serve as arbitrator of such dispute unless otherwise agreed.

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# SUPPLEMENTARY CONDITIONS

## GENERAL

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. 1910-8, 1990 ed.) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full-force and effect. These Supplementary Conditions and the paragraphs herein bear comparable numbers to those of the General Conditions.

## 2.7 INSURANCE CERTIFICATES

Delete paragraph 2.7 of the General Conditions in its entirety and insert the following in its place:

> 2.7 Before any WORK at the site is started, CONTRACTOR shall deliver to OWNER, with a copy to ENGINEER, certificates (and other evidence of insurance requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.3 through 5.7.

## 4.2 SUBSURFACE AND PHYSICAL CONDITIONS

Add the following language at the end of Article 4.2 of the General Conditions:

> Neither OWNER nor ENGINEER makes any warranties or representations about any subsurface conditions that may be encountered within the scope of the Work. The CONTRACTOR shall satisfy himself of subsurface conditions that may be encountered by performing on-site inspections, core drillings, or other methods. The risk of encountering and correcting such subsurface conditions shall be borne solely by the CONTRACTOR, and the Contract Price shall include the cost of performing the work complete in place within the Contract Time and in accordance with the terms and conditions of the Contract Documents.

## 4.3 PHYSICAL CONDITIONS - UNDERGROUND FACILITIES

Delete paragraph 4.3.2 and add the following at the end of article 4.3 of the General Conditions:

> Neither OWNER nor ENGINEER makes any warranties or representations about any underground facilities that may be encountered within the scope of the Work. The CONTRACTOR shall satisfy himself of underground facilities that may be encountered by performing on-site inspections, core drillings or other methods. The risk of encountering and correcting such underground facilities shall be borne solely by the CONTRACTOR, and the Contract Price shall include the cost of performing the work complete in place within the Contract Time and in accordance with the terms and conditions of the Contract Documents.

## 5.4 CONTRACTOR'S LIABILITY INSURANCE

The limits of liability for the insurance required by paragraph 5.4 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law:

5.4.1 and 5.4.2 workers' compensation, etc., under paragraphs 5.4.1 and 5.4.2 of the General Conditions:

| | |
|---|---|
| a. State | Statutory |
| b. Applicable Federal (e.g.,Longshoreman's) | Statutory |
| c. Employer's Liability | $_____ |

5.4.3, 5.4.4, and 5.4.5. Comprehensive General Liability, under paragraphs 5.42 through 5.4.5 of the General Conditions:

| | | |
|---|---|---|
| (1) | General Aggregate (Except Products--Completed Operations) | $_____ |
| (2) | Products - Completed Operations Aggregate | $_____ |
| (3) | Personal and Advertising Injury (Per Person/Organization) | $_____ |
| (4) | Each Occurrence (Bodily Injury & Property Damage) | $_____ |
| (5) | Property Damage liability insurance will provide Explosion, Collapse and Underground coverage where applicable | |
| (6) | Excess Liability | |
| | General Aggregate | $_____ |
| | Each Occurrence | $_____ |

5.4.6 Automobile Liability:

(1) Bodily Injury

$_____Each Person

$_____Each Accident

Property Damage

$_____Each Accident

or

(2) Combined Single Limit
(Bodily Injury & Property Damage)

$_____Each Accident

5.4.10 Contractual Liability Insurance

The Contractual Liability coverage required by paragraph 5.4.10 of the General Conditions shall provide coverage for not less than the following amounts:

(1) General Aggregate $_____

(2) Each Occurrence
(Bodily Injury and Property Damage) $_____

**5.5 OWNER'S LIABILITY INSURANCE**

Delete paragraph 5.5 of the General Conditions in its entirety and insert the following in its place:

5.5. The CONTRACTOR shall provide for additional liability coverage for OWNER and ENGINEER as will protect OWNER and ENGINEER against claims which may arise from operations under the Contract Documents. Such insurance coverage shall be provided by endorsement as additional insureds on CONTRACTOR's General Liability Policy or by a separate "Owner's Protection Policy."

**5.6 PROPERTY INSURANCE**

Delete paragraph 5.6 of the General Conditions in its entirety and insert the following in its place:

5.6. CONTRACTOR shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework and Work in transit and shall insure against at least the following perils: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

5.6.3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.4. cover materials and equipment in transit for incorporation in the Work or stored at the site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5.6.5. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this paragraph 5.6 shall comply with the requirements of paragraph 5.8.

## 5.7 BOILER AND MACHINERY INSURANCE

Delete paragraph 5.7 of the General Conditions in its entirety and insert the following:

5.7. CONTRACTOR shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

## 5.10 OTHER SPECIAL INSURANCE

Delete paragraph 5.10 of the General Conditions in its entirety and insert the following in its place:

5.10. Any special insurance to be included in the property insurance policy shall be procured by CONTRACTOR. CONTRACTOR shall be solely responsible for determining the need for such other special insurance.

## 6.20 SAFETY AND PROTECTION

Add the following language immediately after the fourth sentence of paragraph 6.20 of the General Conditions:

The Contractor shall abide by all applicable provisions of TCA, Chapter 31, "Underground Utility Damage Prevention" and all amendments

thereto. Obtaining a permit does not relieve CONTRACTOR of the responsibility of complying with this law.

**13.4 TESTS AND INSPECTIONS**

Add the following language at the end of the second sentence of paragraph 13.4 of the General Conditions:

"Such testing and inspections shall be for, but not limited to, the determination of source, suitability and applicability of the material and equipment."

**13.5 TESTS AND INSPECTIONS**

Organizations proposed for inspections, tests and approvals shall also be acceptable to ENGINEER.

## CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned, _____, the duly authorized and legal representative of

_____, do hereby certify as follows:
(OWNER)

I have examined the attached contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

Signed _____
(Attorney)

Date _____

# NOTICE OF AWARD

Dated _____, 19____

TO _____
(Bidder)

OWNER'S PROJECT NO. _____

PROJECT _____

OWNER'S CONTRACT NO. _____

CONTRACT FOR _____

_____

You are notified that your Bid dated _____ 19____ for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for

_____

_____

_____

(Indicate total Work, alternates, or sections of Work awarded)

The Contract Price of your contract is _____

_____ Dollars ($_____).

Three copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. Three sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within fifteen (15) days of the date of this Notice of Award, that is by _____, 19____.

1. You must deliver to the OWNER three fully executed counterparts of the Agreement including all the Contract Documents. This includes the triplicate sets of Drawings.
2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Instructions for Bidders, General Conditions and Supplementary Conditions.
3. (List other conditions precedent.)

Failure to comply with these conditions within the time specified will entitle OWNER to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten (10) days after you comply with those conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

_____
(OWNER)

By _____
(Authorized Signature)

_____
(Title)

# NOTICE TO PROCEED

Dated _____, 19____

TO _____
(CONTRACTOR)

OWNER'S PROJECT NO._____

PROJECT _____

OWNER'S CONTRACT NO. _____

CONTRACT FOR _____

You are notified that the Contract Time under the above contract will commence to un on _____ _____, 19____. By that date, you are to start pe forming the Work and your other obligations under the Contract Documents. The dates of Substantial Completion and Final Completion are set forth in the Agreement; they are _____, 19____ and _____ 19____, respectively.

Before you may start any Work on the site, you must deliver to the OWNER (with copies to ENGINEER) ce tificates of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Also before you may start any Work at the site, you must (add other requirements here).

Work at the site must be started by _____, 19____ as indicated in the Contract Documents.

_____
(OWNER)

By _____
(Authorized Signature)

_____
(Title)

## APPLICATION FOR PAYMENT NO. _____

To _____ (OWNER)

Contract for _____.

OWNER's Contract No. _____. ENGINEER's Project No. _____.

For Work accomplished through the date of _____.

| ITEM | CONTRACTOR's Schedule of Values | | | Work Completed | |
|---|---|---|---|---|---|
| | Unit Price | Quantity | Amount | Quantity | Amount |
| | $ | | $ | | $ |
| Total (Orig. Contract) | | | $ | | $ |
| C.O. No. 1 | | | | | |
| C.O. No. 2 | | | | | |

Accompanying Documentation:

_____
_____
_____
_____

| | |
|---|---|
| GROSS AMOUNT DUE ..... | $ _____ |
| LESS ____ % RETAINAGE ..... | $ _____ |
| AMOUNT DUE TO DATE ..... | $ _____ |
| LESS PREVIOUS PAYMENTS ..... | $ _____ |
| AMOUNT DUE THIS APPLICATION .... | $ _____ |

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of Work done under the Contract referred to above have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with Work covered by prior Applications for Payment numbered 1 through _____ inclusive; (2) title to all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to OWNER at time of payment free and clear of all liens, claims, security interest and encumbrances (except such as are covered by Bond acceptable to OWNER indemnifying OWNER against any such lien, claim, security interest or encumbrance); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and not *defective* as that term is defined in the Contract Documents.

Dated _____, 19____ _____
CONTRACTOR

By _____
(Authorized Signature)

Payment of the above AMOUNT DUE THIS APPLICATION is recommended.

Dated _____, 19____ _____
ENGINEER

By _____
(Authorized Signature)

EJCDC No. 1910-8-E (1990 Edition)
Prepared by the Engineers Joint Contract Documents Committee and endorsed by The Associated General Contractors of America.

# CHANGE ORDER

(Instructions on reverse side) No._____

PROJECT .....

DATE OF ISSUANCE ..... EFFECTIVE DATE .....

OWNER .....

OWNER's Contract No. .....

CONTRACTOR ..... ENGINEER .....

You are directed to make the following changes in the Contract Documents.

Description:

Reason for Change Order:

Attachments: (List documents supporting change)

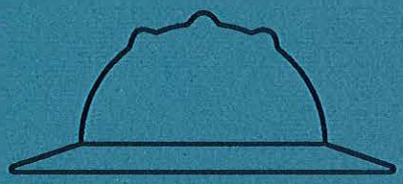
| CHANGE IN CONTRACT PRICE: | CHANGE IN CONTRACT TIMES: |
|---|---|
| Original Contract Price<br>$ _____ | Original Contract Times<br>Substantial Completion: _____<br>Ready for final payment: _____<br>days or dates |
| Net changes from previous Change Orders No. ____ to No. ____<br>$ _____ | Net change from previous Change Orders No. ____ to No. ____<br>_____<br>days |
| Contract Price prior to this Change Order<br>$ _____ | Contract Times prior to this Change Order<br>Substantial Completion: _____<br>Ready for final payment: _____<br>days or dates |
| Net Increase (decrease) of this Change Order<br>$ _____ | Net Increase (decrease) of this Change Order<br>_____<br>days |
| Contract Price with all approved Change Orders<br>$ _____ | Contract Times with all approved Change Orders<br>Substantial Completion: _____<br>Ready for final payment: _____<br>days or dates |

| RECOMMENDED: | APPROVED: | ACCEPTED: |
|---|---|---|
| By: _____<br>Engineer (Authorized Signature) | By: _____<br>Owner (Authorized Signature) | By: _____<br>Contractor (Authorized Signature) |
| Date: _____ | Date: _____ | Date: _____ |

EJCDC No. 1910-8-B (1990 Edition)
Prepared by the Engineers Joint Contract Documents Committee and endorsed by The Associated General Contractors of America.

# CONSTRUCTION STANDARDS AND SPECIFICATIONS

# Division 1: General Requirements



# 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.

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)

# 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 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 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<br>Transportation and Transportation Officials<br>444 North Capitol Street, N.W.<br>Washington, DC 20001 |
| ANSI | American National Standards Institute<br>(Formerly American Standards Association--ASA)<br>11 W. 42nd Street<br>New York, NY 10036 |
| AREA | American Railway Engineering Association<br>50 F Street, N. W. , Suite 7702<br>Washington, DC 20001 |
| ASCE | American Society of Civil Engineers<br>345 East 47th Street<br>New York, NY 10017 |
| ASTM | American Society for Testing and Materials<br>1916 Race Street<br>Philadelphia, PA 19103-1187 |

| | |
|---|---|
| AWWA | American Water Works Association<br>6666 W. Quincy Avenue<br>Denver, CO 80235 |
| CLFMI | Chain Link Fence Manufacturing Institute<br>1776 Massachusetts Avenue, N. W. , #500<br>Washington, D. C. 20036 |
| FHWA | Federal Highway Administration<br>249 Cumberland Bend Drive<br>Nashville, TN 37228 |
| FSS | Federal Supply Service Bureau<br>Specification Section<br>470 East L'Enfant Plaza, S. W.<br>Suite 8100<br>Washington, DC 20407 |
| TDOT | Tennessee Department of Transportation<br>James K. Polk Building, 7th Floor<br>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, Retainages, and Final Payment.

C. Section 01370: Schedule of Values.

D. Section 01700: Contract Closeout.

### 1.03 FORMAT AND DATA REQUIRED

A. Submit applications typed on NSPE Document 1910-8-E, Application for Payment, with itemized data typed on 8-1/2" x 11" white paper continuation 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 off values 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: Five copies of each Application.

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 implement 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, nor 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: NSPE Document 1910-8-B.

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 will sign and date the Change Order as authorization for the Contractor to proceed with the changes.

C. Contractor may 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 may 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 cite the applicable unit prices.

2. 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 revised 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. Promptly after award of the Contract, prepare and submit to Engineer estimated construction progress schedules for the Work, with subschedules 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 subschedules for each separate stage of work specified in Section 01010.

D. Provide subschedules 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 which is not applicable to the 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 which 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 or signed, 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.

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 which 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 subvalues 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 subschedule 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 subschedule 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)

# 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.

1. Parties requiring additional photography or prints will pay photographer directly.

## PART 2 - PRODUCTS

2.01 PRINTS

A. Color:

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, to 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 regulation.

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 to 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. Materials to Contractor's option, minimum fence height 6 feet.

2.03 BARRIERS

A. 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 of 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. Protect premises from entry by unauthorized persons.

B. Comply with local security requirements.

1.02 RELATED REQUIREMENTS

A. Section 01510: Temporary Utilities.

B. Section 01530: Barriers.

1.03 MAINTENANCE OF SECURITY

A. Initiate security program in compliance with Owner's system, 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 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 - PRODUCT

(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 and 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.

a. 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 spillages, 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.

## 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 - PRODUCT

### 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 on 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.

### 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 drainway.

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 the event 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.

B. Section 01560: Temporary Controls.

### 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 FLAGMEN

A. Provide qualified and suitably equipped flagmen 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 flagmen 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 personnels' 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, establish public thoroughness 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, 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.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.

C. Rough Hardware: Galvanized.

D. 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 sign, 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.

      1. 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 waste basket 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. Designated existing spaces 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 weathertight 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 reinspect the Work.

D. When the Engineer finds that the Work is substantially complete, he will:

1. Prepare and deliver to Owner a tentative Certificate of Substantial Completion with a tentative list of items to be completed before final payment.

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 definite Certificate 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 reinspect 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 reinspection 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 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 interior spaces 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; rack clean other surfaces of the grounds.

D. Prior to final completion, or Owner occupance, 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. Addends.
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.

### 1.02 RELATED REQUIREMENTS

A. Section 01340: Shop Drawings, Product Data, and Samples.

B. 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 felt-tip marking 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**

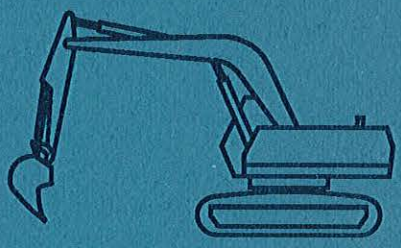
(Not Used)

**PART 3 - EXECUTION**

(Not Used)

# CONSTRUCTION STANDARDS AND SPECIFICATIONS

# Division 2: Sitework



# 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 of demolition work will not be made.

B. Payment for demolition work shown on the drawings or specified herein shall be by the contract lump sum price.

# 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 the area bounded by lines five feet 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

A. Promptly remove cleared debris from site.

B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.

3.05 MEASUREMENT AND PAYMENT

A. Measurement of clearing and grubbing area will not be made.

B. Payment for clearing and grubbing shown on the drawings or specified herein shall be by the contract lump sum price.

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., even though 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-section 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 satisfactory manner.

C. Dispose of excess material created by trimming slopes, resloping, 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. Measure accepted excavation in its original position on the basis of the cubic yard by cross-sectioning the area excavated. Determine cross sections by conventional manual surveys, aerial surveys, or a combination of the two, as designated by the Engineer. Compute volumes from the cross section measurements by the average end area method.

1. No measurement for payment for hauling of excavation and borrow materials shall be made except overhaul of Road and Drainage Excavation (unclassified or additional material) which will be paid for as provided below.

2. Measurement for payment of road and drainage excavation (unclassified) will include overbreakage of rock not attributable to carelessness of the Contractor which has been removed and disposed of.

3. Measurement for payment of excavation required to bench side-hill slopes of embankments will be in accordance with the following requirements:

a. Excavation in solid rock will be paid for as Road and Drainage Excavation (unclassified) whether the excavation material is bladed and dozed or picked up and hauled.

b. Excavation other than solid rock will be paid for as Road and Drainage Excavation (unclassified) only when it is picked up and hauled.

4. Measurement for payment of solid rock excavation will be made only when it is provided for on the Bid Form.

5. Excavation required to correct slides or prevent potential slides, provided blasting is not required, and the dressing, reshaping, or flattening of the affected slopes will be paid for as Road and Drainage Excavation (additional material):

   a. At a rate equal to 1.2 times the unit price bid for Road and Drainage Excavation (unclassified).

   b. If it becomes necessary to flatten a slope to correct a slide or prevent a potential slide after the cut has been started but not completed, payment under Road and Drainage Excavation (additional material) will be limited to material removed by the original staked slope lines and the newly established slope line above the elevation to which the cut has been made.

   c. Seeding, sod, and other incidental items required to repair the slide area will be paid for at the contract unit price bid for the respective items.

B. Payment for accepted quantities of excavation and grading as provided above will be at contract unit price for:

1. Excavation - per cubic yard.

2. Embankment - will not be paid for directly.

3. Borrow Excavation (Unclassified) - per cubic yard.

4. Borrow Excavation (Solid Rock) - per cubic yard.

5. Channel Excavation - per cubic yard.

6. Excavating under grade - per cubic yard.

7. Finishing - per station (100 linear feet).

8. Clean-up - per station (100 linear feet).

9. Solid Rock Excavation (if provided on Bid Form) - per cubic yard.

# 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
AASHTOM-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 | 3/4 | ½ | 3/8 | 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 3/4 | | | 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 3/4 | | | | | 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 ½ | | | | | | 100 | 90-100 | 20-55 | 0-10 | 0-5 | | | | | |
| 56 | 1 to 3/8 | | | | | | 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 | 3/4 to 3/8 | | | | | | | 100 | 90-100 | 20-55 | 0-15 | 0-5 | | | | |
| 67 | 3/4 to No. 4 | | | | | | | 100 | 90-100 | | 20-55 | 0-10 | 0-5 | | | |
| 68 | 3/4 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 | 3/8 to No. 8 | | | | | | | | | 100 | 85-100 | 10-30 | 0-10 | 0-5 | | |
| 89 | 3/8 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:

| Sieve Size | Grading C Percent Passing by Weight |
|---|---|
| 1-1/2" | 100 |
| 1" | 90-100 |
| 3/8" | 40-65 |
| No. 100 | 4-15 |

| Sieve Size | Grading D Percent Passing by Weight |
|---|---|
| 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 sulphate 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 C or 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:

| Test | Method |
|---|---|
| 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 recompact.

C. Moisten and aerate the subgrade material as necessary during mixing and compacting to provide optimum moisture content.

D. Rework or remove, replace, and recompact 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 recompact 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 the 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, thicknesses, 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 test 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 thicknesses 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--SUBGRADE PREPARATION AND STABILIZATION

A. Measurement for payment of approved subgrade construction and preparation will be by 100 foot stations measured along the centerline.

B. Payment for approved subgrade construction and preparation will be on the basis of the Contract unit price per 100 foot station.

3.10 MEASUREMENT AND PAYMENT--AGGREGATE BASES

A. Measurement for payment of mineral aggregate base placed and approved will be by the ton.

B. Payment for placing and compacting aggregate will be on the basis of the contract unit price per ton for the various types specified on the Bid Form.

3.11 MEASUREMENT AND PAYMENT--CEMENT STABILIZED BASE

A. Measurement for payment of approved cement stabilized base will be by the square yard complete in place. No measurement for cement adjustment will be made.

B. Payment for cement stabilized base will be based on the Contract unit price per square yard for various thickness classifications stipulated on the Bid Form. Payment for cement adjustment will be made on the basis of the Contract lump sum price.

# 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 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 gravels with a maximum particle dimension of 1-1/2 inches, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.

C. Class III Material: Fine sand and clayey gravels, 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.

**PART 3 - EXECUTION**

3.01 PREPARATION

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

B. Protect and maintain all bench marks 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 unforseen 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.

C. 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.

D. Exercise due care in excavating adjacent to existing obstructions and do not disturb same unless absolutely necessary.

E. 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.

F. 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.

G. 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 embedment.

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, VCP, 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 VCP and 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.

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.

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 whips out 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, AND BACKFILLING

A. Pipeline trenching, bedding, and backfilling including solid rock excavation, hauling, and placing, but excluding undercut bedding and crushed stone for payment maintenance and shoulder replacement will not be measured for payment.

B. Payment for trenching, bedding, and backfilling as stipulated above, will be included in the contract unit price for the items with which they are associated.

## 3.15 MEASUREMENT AND PAYMENT - UNDERCUT BEDDING

A. Crushed stone used for undercut bedding where unsuitable material is excavated, including hauling, placing, and compacting, will be measured for payment by the ton in place. This item does not include bedding on solid rock undercut which is not measured for payment.

B. Crushed stone for undercut bedding as above stipulated will be paid for at the contract unit price per tone as determined by weight tickets.

## 3.16 MEASUREMENT AND PAYMENT - CRUSHED STONE FOR PAVEMENT MAINTENANCE AND SHOULDER REPLACEMENT

A. Crushed stone for pavement maintenance and shoulder replacement including hauling, placing, blading, and compacting will be measured for payment by the ton in place.

B. Crushed stone for pavement maintenance and shoulder replacement as above stipulated will be paid for at the contract unit price per ton as determined by weight tickets.

# 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 organics or other deleterious substances.

2. Sand for grout: uniformly graded from coarse to fine within the following limits:

| Sieve Size | Total Percent Passing by Weight |
|---|---|
| 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: | |
| Turbindimeter | 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 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 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 for payment of rip-rap installed and approved including grout, if required, will be by the cubic yard, complete in place.

B. Payment for rip-rap as stipulated above will be by the Contract unit price for each classification.

| | |
|---|---|
| Rip-Rap (Plain or Grouted) | Per Cubic Yard |
| Sacked Sand-Cement Rip-Rap | Per Cubic Yard |

# 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.

1.02 RELATED WORK

A. Appropriate Piped Utility Sections (02700 Numbers).

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 extend 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:

| Nominal Diameter (inches) | Minimum Thickness (inches) |
|---|---|
| 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 |

C. 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. Increase a minimum of 0.063" except for diameters under 12 3/4".

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

2.02 CARRIER PIPE

A. Carrier pipe installed in the casing pipe shall be as specified under the appropriate Piped Utility Section (02700 numbers) and as shown on the drawings.

## 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.

E. Test the carrier pipe according to the appropriate Piped Utility Sections (02700 numbers).

## 3.03 MEASUREMENT AND PAYMENT

A. Boring and jacking, including all work necessary for the installation and testing of the casing and carrier pipe, will be measured for payment by the linear foot installed.

B. Boring and jacking as above stipulated will be paid for by the Contract unit price per linear foot.

# 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. Set post to within 6" from concrete footing bottom.

F. Position fabric bottom 2" above finished grade with tension wire stretched taut between posts.

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. Chain link fences will be measured for payment by the linear foot installed and accepted, including fittings and hardware.

B. Chain link fences as above stipulated will be paid for at the Contract unit price per linear foot for the various classifications shown on the Bid Form.

C. Gates will be measured for as each separate unit installed.

D. Gates will be paid for at the contract unit price for the various classifications shown on the Bid Form.

# SECTION 02451

# GUARDRAILS

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. Constructing anchor blocks and approach ends.

B. Guardrail assembly including appurtenant work to make connections to existing structures, if 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 inches and a depth of not less than 3".

B. Class "A"guardrail: not less than 10 gauge; Class "B" guardrail not less then 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, weigh, coating weight per square foot, and manufacturers heat number.

G. Requirements for Beam Strength:

| Class | Traffic Face Up Maximum Gauge of Sheet | Load lb. | Deflection Inches | Traffic Face Down Maximum Load lb. | Deflection Inches |
|---|---|---|---|---|---|
| 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 for payment of guardrails installed and accepted including all appurtenances will be the linear foot.

B. Payment for guardrails as stipulated above will be by the Contract unit price:

| | |
|---|---|
| Guardrails | Per Linear Foot |
| Guardrail Anchors | Per Each |

# 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. Colors shall conform to the current manual of "Uniform Traffic Control Devices."

B. Both legend and background shall be reflectorized.

2.04 FABRICATION

A. AASHTO M-2;68 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. Highway signs shall be measured for payment by the square feet of sign installed and accepted.

B. Post and fittings shall be measured for payment by the pounds actually installed and accepted.

C. Highway signs as above stipulated shall be paid for at the Contract unit price for the various units as shown on the bid form.

# 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 |
|---|---|
| GROUP "A" | |
| Lespedeza (common or Korean) | 20% |
| Sericea Lespedeza | 15% |
| Kentucky 31 Fescue | 40% |
| English Rye | 25% |
| GROUP "B" | |
| Kentucky 31 Fescue | 55% |
| Redtop | 15% |
| English Rye | 30% |
| GROUP "C" | |
| 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. Inoculant 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.

| | | |
|---|---|---|
| Moisture Content | 10.0% | ±2.0% |
| Organic Matter | 99.4% | ±0.2% |
| Ash Content | 0.6% | ±0.2% |
| Water Hold Capacity (per hundred... | 1050 grams minimum | 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 that 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.

## 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 the soil for a depth of approximately 1/2" at the rate of:

1. Not less than 20 pounds per 1000 square feet 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 as preparation of the seedbed has been completed.

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 square yard 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 percent 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 the 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 two-to-one 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. Landscaping shall be measured for payment on the basis of area and volume measurements for work performed and accepted including fertilizing, mulching, and water as required.

B. Payment for landscaping as stipulated above will be by the contract unit price for the various classifications shown on the Bid Form.

| | | |
|---|---|---|
| 1. | Seeding with mulch | 1,000 square feet |
| 2. | Seeding without mulch | 1,000 square feet |
| 3. | Sprigging | Square yard |
| 4. | Sodding | Square yard |
| 5. | Topsoil | Cubic yard |

# 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. Minerage 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 Article 2.01.

B. Hot mix ingredients: fine and coarse aggregate, chemical additive (if required), fill (if required), and asphalt cement of penetration grade 60-7 or 85-100 meeting the requirements of AASHTO M-20 for the grade used.

C. Chemical additive: heat-stable, anti-stripping containing no ingredient harmful to or altering the characteristics of the bituminous material. Use the percentage of additive recommended by the manufacturer.

D. Hot Mix Plant:

1. Storage tanks capable of heating and maintaining the bituminous material at a uniform temperature between 275 and 325 degrees F. before being introduced into the mixer.

2. Heat and dry aggregates to a uniform temperature between 225 and 325 degrees F. without damaging or contaminating the aggregate.

3. For batch plants, include a means of accurately weighing each size aggregate and the bituminous material. Use platform truck scales at continuous mixing plants.

4. Use twin pugmill type mixers that adequately heat and produce a uniform mixture with a temperature of not less than 275 degrees F. at the time it is discharged from the mixer. In the case of aggregates containing absorbed moisture causing boiling or foaming, the discharge temperature may be reduced to 225 degrees F.

5. Mixing time: batch plants - as required to produce a uniform non-segregated mix that is satisfactory to the Engineer; continuous mixing plants - as determined by current AASHTO requirements.

2.03 HOT MIX BASE

A. Conform to Articles 2.01 and 2.02.

B. Coarse aggregate (retained on the No. 4 sieve): crushed stone, crushed slag, crushed gravel, or a combination of these materials with a sodium sulphate soundness loss not exceeding 9% and no crushed slag containing more than 20%, by weight, of glassy particles.

C. Fine aggregate: crushed stone or crushed slab, stockpiled separately from the coarse aggregate with sodium sulphate soundness loss not exceeding 15%.

D. Combined coarse and fine aggregate grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 2" | 100 |
| 1-1/2" | 75-100 |
| 3/4" | 45-70 |
| 3/8" | 30-55 |
| No. 4 | 20-40 |
| No. 8 | 10-30 |
| No. 30 | 5-20 |
| No. 200 | 0-8 |

E. Proportions, by weight, of the total mixture:

| | |
|---|---|
| Mineral Aggregate | 94.0 to 97.5% |
| Asphalt Cement | 2.5 to 6.0% |

2.04 HOT MIX BINDER

A. Conform to Articles 2.01 and 2.02.

B. Coarse aggregate (retained on the No. 4 sieve): crushed stone, crushed slag, crushed gravel, or a combination of these materials with a sodium sulphate soundness loss not exceeding 9% and no crushed slag containing more than 20%, by weight, of glassy particles.

C. Fine aggregate: natural sand, sand manufactured from stone gravel or slag, or a combination of these materials with a sodium sulphate soundness loss not exceeding 15%, and natural sand finer than 200 mesh not exceeding 5%.

D. Combined coarse and fine aggregate grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 1-1/2" | 100 |
| 3/4" | 65-90 |
| No. 4 | 30-55 |
| No. 8 | 20-45 |
| No. 30 | 8-25 |
| No. 100 | 1-12 |
| No. 200 | 0-7 |

E. The combination of aggregates and bitumen will be such that the mixture shall have a stability of at least 1,000 pounds when tested in accordance with ASTM D-1559.

F. Proportions, by weight, of the total mixture:

| | |
|---|---|
| Mineral Aggregate | 94.0 to 97.5% |
| Asphalt Cement | 2.5 to 6.0% |

2.05 HOT MIX LEVELING COURSE

A. Conform to Articles 2.01 and 2.02.

B. Course Aggregate: as in Article 2.04, Hot Mix Binder.

C. Fine Aggregate: as in Article 2.04, Hot Mix Binder.

D. Combined coarse and fine aggregate grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3/4" | 100 |
| 3/8" | 60-85 |
| No. 8 | 20-40 |
| No. 30 | 7-22 |
| No. 100 | 1-12 |
| No. 200 | 0-8 |

E. Aggregate-bitumen combination: as in Article 2.04, Hot Mix Binder.

F. Mixture Proportions: as in Article 2.04, Hot Mix Binder.

## 2.06 HOT MIX ASPHALTIC CONCRETE (CRUSHED LIMESTONE)

A. Conform to Articles 2.01 and 2.02.

B. Coarse aggregate (retained on the No. 4 sieve): crushed limestone with a sodium sulphate soundness loss not exceeding 9%, meeting AASHTO M-62 with the above exceptions.

C. Fine aggregate: natural or manufactured sand with material finer than 200 mesh in natural sand not exceeding 5%, meeting ASTM D-1073, except:

1. When used on traffic lanes, use aggregate of not less than 50% crushed limestone and not more than 50% or less than 45% natural sand or sand manufactured from siliceous material.

2. When used for non-traffic lane construction, aggregate may be composed entirely or in part of crushed limestone, but not more than 50% natural sand.

3. When used for curb construction, the material passing the No. 200 sieve shall be 5-10%.

4. Mineral filler, Portland cement, or limestone dust meeting the requirements of AASHTO M-17 shall be added to the mix, if required, to meet gradation requirements and shall be considered a part of the limestone percentage.

5. Not more than 5% of the natural sand shall be retained on the No. 4 sieve.

D. Combined coarse and fine aggregate grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 1/2" | 100 |
| 3/8" | 88-100 |
| No. 4 | 56-80 |
| No. 8 | 40-60 |

| | |
|---|---|
| No. 30 | 18-38 |
| No. 50 | 8-26 |
| No. 100 | 5-15 |
| No. 200 | 2-10 |

E. Proportions, by weight, of the total mixture:

| | |
|---|---|
| Mineral Aggregate | 92.0 to 95.0% |
| Asphalt Cement | 5.0 to 8.0% |

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

A. Conform to Articles 2.01 and 2.02.

B. Treat asphalt cement with a heat-stable, anti-stripping additive blended at the terminal or at the mixing plant.

C. Coarse aggregate (retained on the No. 4 sieve): meeting AASHTO M-62, except:

1. Sodium sulphate soundless loss not exceeding 9%.

2. Use crushed gravel of siliceous particles, processed from washed material; with at least 85% having one or more fractured faces.

3. Use crushed slag with not more than 30% glassy particles.

4. Do not use limestone or other aggregates tending to polish under traffic.

D. Fine aggregate: natural sand, granite, screenings, slag screenings, or a combination of these materials, meeting ASTM D-1073, except:

1. When the combined aggregate includes crushed gravel or natural sand, use agricultural limestone in an amount of not less than 10% nor more than 20% of the aggregate, by weight.

2. Agricultural limestone will also be permitted, as specified, in crushed slag or crushed granite aggregate if required to meet gradation requirements.

E. The combined coarse and fine aggregates, with the required amount of bitumen, will comply with the following Marshall test criteria:

| | |
|---|---|
| Minimum Stability | 1200 Pounds |
| Void Content | 3-7% |
| Flow | 8-15% |

F. Mineral filler may be added, if required, in an amount not to exceed 5% of the aggregate, by weight.

G. Combined coarse and fine aggregate grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 1/2" | 100 |
| 3/8" | 88-100 |
| No. 4 | 56-80 |
| No. 8 | 40-60 |
| No. 30 | 18-38 |
| No. 50 | 8-26 |
| No. 100 | 5-15 |
| No. 200 | 2-10 |

## 2.08 HOT MIX LEVELING COURSE FOR WEARING SURFACE

A. Conform to Articles 2.01 and 2.02.

B. Coarse aggregate: crushed stone, crushed gravel, or crushed slag with:

1. Crushed gravel processed from washed material and consisting of siliceous particles, of which at least 50% of the material retained on the No. 4 sieve shall have one or more fractured faces.

2. No uncrushed particles.

3. The absorption of the gravel retained on the No.4 sieve shall not exceed 5% when tested in accordance with AASHTO T-85.

C. Fine aggregate: natural sand, crushed slab sand, stone screenings, or agricultural limestone with:

1. When the coarse aggregate of the combined aggregate is crushed stone, use not less than 40% nor more than 50%, by weight, natural sand or crushed slag sand.

2. When the crushed aggregate of the combined aggregate is crushed gravel or crushed slag, use not less than 15% nor more than 40% stone screenings or agricultural limestone.

D. The combined coarse and fine aggregates with the required amount of bitumen, shall have a stability of not less than 800 pounds when tested in accordance with ASTM D-1559.

E. Combined coarse and fine aggregates grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3/4" | 100 |
| 3/8" | 71-100 |

| | |
|---|---|
| No. 8 | 40-70 |
| No. 30 | 20-50 |
| No. 100 | 2-12 |
| No. 200 | 0-8 |

F. Proportions, by weight, of the total mixture:

| | |
|---|---|
| Mineral Aggregate | 93.0 to 96.0% |
| Asphalt Cement | 4.0 to 7.0% |

2.09 GENERAL REQUIREMENTS - COLD MIX PAVEMENTS

A. Conform to Article 2.01.

B. Cold mix ingredients: fine and coarse aggregates and emulsified asphalt, mixing grade AE-3.

C. Emulsified asphalt: homogeneous and of such stability that it will remain uniform while being mixed with dry aggregate. The emulsion shall thoroughly coat and adhere firmly to the surface of the mineral aggregate and show no signs of re-emulsifying after being incorporated into the work. The emulsion shall meet the following requirements.

1. Distillation to a temperature of 500 degrees F., not more than 30% distillate, by weight, with oil portion not more than 6% by volume.

2. Viscosity, saybolt-fural, 122 degrees F., sec. shall be 50 plus, and pumpable.

3. Settlement test at 5 days, not more than 5% (settlement shall be waived if the emulsion is manufactured and used in less than five days).

4. Stone coating test, at least 90% coated.

5. Tests on residue from distillation:

   a) Float test at 140 degrees F., not less than 200 sec.

   b) Ductility at 77 degrees F., not less than 40 cm.

   c) Solubility in CC14, not less than 97.5%.

   d) Ash by ignition, not more than 2%.

6. Base asphalt: show a negative result when tested with standard Naphtha Solvent.

7. Test emulsion in accordance with AASHTO T-5a, except as follows:

   a) Spot test, AASHTO T-102.

b) Solubility in CC14, AASHTO T-44.

c) Float test, AASHTO T-50.

d) Stone coating Test, AASHTO T-59, except mix the aggregate and emulsion for five minutes then drench with approximately twice its volume of tap water at room temperature.

D. Cold Mix Mixing Plant: meet the requirements of Article 2.01, except:

1. If the storage tanks for bituminous material are equipped to heat the material, the temperature of the bituminous material shall not exceed 180 degrees F. when combined with the aggregate.

2. Dry the aggregate sufficiently to remove all surface moisture and heat to a temperature that will produce the discharge temperature of the mixture specified in the job-mix formula if the mixer is not heated. The temperature of the mixture shall not be less than 100 degrees F. nor more than 200 degrees F.

3. Mixing time for both batch and continuous mixing plants shall be that required to produce a uniform, homogeneous mixture that is satisfactory to the Engineer.

## 2.10 COLD MIX BASE

A. Conform to Articles 2.01 and 2.09.

B. Aggregate: crushed stone or crushed slag, meeting AASHTO M-62, except:

1. Sodium sulphate soundness loss shall not exceed 9%.

2. Crushed slag: not more than 20%, by weight, of glassy particles.

3. Produce in two fractions, separated on a 1-1/2" screen.

4. Choker aggregate: crushed stone, crushed slag, or crushed gravel of size No. 68.

C. Combined aggregate size grading:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3" | 100 |
| 2 1/2" | 95-100 |

D. Proportions, by weight, of total mixture:

| | |
|---|---|
| Mineral Aggregate | 95.0 to 97.0% |
| Emulsified Asphalt | 3.0 to 5.0% |

## 2.11 COLD MIX SURFACE COURSE

A. Conform to Articles 2.01 and 2.09.

B. The mix may be transported directly to the project site for spreading or may be stockpiled. Stockpiled material shall show no stripping or weather damage.

C. Aggregate: crushed stone or crushed slag meeting AASHTO M-63, except:

1. Sodium sulphate soundness loss shall not exceed 9%.

2. Crushed slag retained on the No. 4 sieve shall not contain more than 20% of glassy particles.

3. Aggregate for this mixture shall be Size No. 68.

4. Choker aggregate: size No. 8 of crushed stone, crushed slag, or crushed gravel.

D. Proportion, by weight, of total mixture:

| | |
|---|---|
| Mineral Aggregate | 93.0 to 95.0% |
| Emulsified Asphalt | 5.0 to 7.0% |

## 2.12 PRIME COAT

A. Bituminous material: emulsified asphalt or cut-back asphalt.

B. Emulsified Asphalt, Grade AE-P:

| | Minimum | Maximum |
|---|---|---|
| Viscosity, Furol at 77 degrees F. | 10 | 50 |
| Settlement at 5 days | | 5% |
| Sieve Test | | 0.10% |
| Distillation to 500 degrees F. | | |
| Distillate, by weight | | 55% |
| Oil Portion of Distillate | | 12% |
| Tests on Residue | | |
| Float Test, 140 degrees F., Sec. | 20 | |
| Soluble in CC14 | 97.5% | |

The settlement test shall be waived if the emulsion is used in less than 5 days. The base asphalt shall show a negative result when tested by the spot test. The emulsion shall be tested in accordance with AASHTO T-59, except:

1. Spot test, AASHTO t-102.

2. Solubility in CC14, AASHTO T-44.

3. Float test, AASHTO T-50.

C. Cut-Back Asphalt: Grade RC-70 or RC-250 meeting the requirements of AASHTO M-81 for the grade specified or selected.

D. Application temperature for the bituminous material:

| | |
|---|---|
| RC - 70 | 80 degrees - 150 degrees F. |
| RC - 250 | 100 degrees - 175 degrees F. |
| AE - P | 60 degrees - 140 degrees F. |

## 2.13 TACK COAT

A. Bituminous Material: emulsified asphalt or cut-back asphalt.

B. Emulsified Asphalt:

1. Grade SS-1, RS-1, and RS-2 meeting the requirements of AASHTO M-140 for the grade specified.

2. Grade AE-3 shall meet the requirements of Article 2.09.

C. Cut-Back Asphalt: Grade RC-70 or RC-250 meeting the requirements of AASHTO M-81 for the grade specified or selected.

D. Application temperature for the bituminous materials:

| | |
|---|---|
| RC - 70 | 80 degrees - 150 degrees F. |
| RC - 250 | 100 degrees - 175 degrees F. |
| SS - 1 | 60 degrees - 140 degrees F. |
| RS - 1 | 60 degrees - 140 degrees F. |
| RS - 2 | 60 degrees - 140 degrees F. |
| AE - 3 | 60 degrees - 140 degrees F. |

## 2.14 DOUBLE BITUMINOUS SURFACE TREATMENT

A. Double Bituminous Surface Treatment: bituminous mat composed of between 50 and 65 pounds per square yard of mineral aggregate bonded with bituminous material.

B. Bituminous Material: emulsified asphalt (AASHTO M-140), grade RS-2; or cut-back asphalt (AASHTO M-81), grade RC 800 or RC 3000.

C. Mineral Aggregate: AASHTO M-43, except:

1. The sodium sulfate soundness loss shall not exceed 9%.

2. Crushed slag aggregate retained on the No. 4 sieve shall not contain more than 20%, by weight, of glassy particles.

3. The amount of material finer than 200 mesh shall not exceed 1%.

4. Testing may be required by the Engineer for bituminous film retention. When required, test in accordance with AASHTO T-182. Retention must be in excess of 95% or use a satisfactory chemical additive.

5. Aggregate in mat: Size No. 6 and the aggregate used in the seal shall be size No. 7.

D. Application temperature ranges:

| | |
|---|---|
| RC - 800 | 175 degrees - 250 degrees F. |
| RC - 3000 | 200 degrees - 275 degrees F. |
| RS - 2 | 60 degrees - 140 degrees F. |

E. Only apply to a surface that is dry and clean, between April first and November first, and when the air temperature is above 60 degrees F. in the shade.

F. Aggregate shall be approved by the Engineer based on test reports and sieve analysis to be furnished by the Contractor. The bituminous material shall be accepted based on laboratory analysis furnished with each shipment of material.

## 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

| Compacted Thickness | Minimum Placement Temperature Air or Surface Whichever is less |
|---|---|
| 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 by preset control string lines.

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 either 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 forty feet.

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 feet 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 prescribed 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 feed wide or more, use four rollers.

4. Increase the number of rollers if the required results are not being obtained.

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, Gradings 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 Gradings 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 and 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. 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 which are 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 PAVEMENT

A. Bituminous pavements and cover materials will be measured for payment by the ton mixed, spread, rolled, and finished including all mix ingredients. Water used to dampen the base prior to applying prime coat will be measured for payment by 1,000 gallon units by means of accurate water meters.

B. Bituminous pavement and cover materials as above stipulated will be paid for by the Contract unit price per ton of the various types shown on the Bid Form. Dampening water as above stipulated will be paid for at the Contract unit price per 1,000 gallons.

# 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 each 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 inch 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 retempering 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 rehandling 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 premoulded 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 ravelling 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 grove 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 screeding 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. Straightedging:

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. Hole 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 straightedging 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 for payment of concrete pavement installed and accepted including base preparation, concrete, formwork, curing, joints, and finishing will be by the square yard.

B. Payment for concrete pavement as stipulated above will be made on the basis of the Contract unit price for the following:

| Pay Item | Pay Unit |
|---|---|
| Portland Cement Concrete Pavement (Plain) 6" | Square Yard |
| Portland Cement Concrete Pavement (Plain) 8" | Square Yard |
| Portland Cement Concrete Pavement (Plain) 9" | Square Yard |
| Portland Cement Concrete Pavement (Plain) 10" | Square Yard |
| Portland Cement Concrete Pavement (Plain) 11" | Square Yard |
| Portland Cement Concrete Pavement (Plain) 12" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 6" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 8" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 9" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 10" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 11" | Square Yard |
| Portland Cement Concrete Pavement (Reinforced) 12" | Square Yard |
| Additional Portland Cement Concrete (Ramp Paving) | Cubic Yard |

# 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 MEASUREMENT AND PAYMENT - CURBS AND GUTTERS

A. Curbs, gutters, and combination curbs and gutters will be measured for payment by the linear foot, complete in place including base, formwork, and finishing.

B. Curbs, gutters, and combination curbs and gutters will be paid for at the Contract unit price per linear foot for the various classifications shown on the Bid Form.

## 3.08 MEASUREMENT AND PAYMENT - SIDEWALKS

A. Sidewalks will be measured for payment by the square foot complete in place including base, formwork, and finishing.

B. Sidewalks will be paid for at the Contract unit price per square foot for the various classifications shown on the Bid Form.

# 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 Subsection 910.05 of the TDOT Standard Specifications for Road and Bridge Construction and all subsequent revisions.

C. Drying time - 3 to 5 minutes when heated to application temperature.

D. Application temperature - 140 to 170 degrees F.

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:

| Sieve Designation | Mass Percent Passing |
|---|---|
| 20 Mesh | 100 |
| 30 Mesh | 75-95 |
| 40 Mesh | — |
| 50 Mesh | 15-35 |
| 80 Mesh | — |
| 100 Mesh | 0-5 |

## 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. Pavement marking will be measured for payment by the linear foot of pavement marked and accepted including surface preparation and paint.

B. Pavement marking as above stipulated will be paid for at the Contract unit price per linear foot for marking of the various types and widths shown on the Bid Form.

# SECTION 02605

# SEPARATION OF PIPE UTILITIES

## PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Location of piped utilities to separate water mains from sewer facilities.

1.02 RELATED WORK

A. Section 02305: Boring and Jacking.

B. Appropriate Piped Utility Sections (02700 Numbers).

## PART 2 - PRODUCTS

(Not Used)

## PART 3 - EXECUTION

3.01 PARALLEL INSTALLATION

A. Separate water mains at least 10 feet horizontally, measured edge to edge, from any sewer facility whenever possible.

B. When local conditions prevent a horizontal separation of 10 feet, closer installations may be made if:

1. The bottom of the water main is at least 18" above the top of the sewer facility; or

2. The sewer is constructed of materials equivalent to water main standards and pressure tested to assure watertightness prior to backfilling.

3.02 CROSSINGS

A. Separate water mains crossing sewer facilities by at least 18" between the bottom of the water main and the top of the sewer facility whenever possible.

B. When local conditions prevent a vertical separation as described above, the following construction shall be used.

1. Sewers passing over or under water mains should be constructed of materials equivalent to water main standards and pressure tested to assure watertightness prior to backfilling.

2. Water mains passing under sewers shall, in addition, be protected by providing:

a. A vertical separation of at least 18" between the bottom of the sewer and the top of the water main.

b. Adequate structural support for the sewer to prevent excessive deflection of joints and settling on and breaking the water mains.

c. That the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

3.03 SEWER FACILITIES

A. Do not install water mains or sewer facilities which pass through or contact each other.

# SECTION 02713

# WATER DISTRIBUTION SYSTEMS

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. Installation, testing, and disinfection of water lines and appurtenances.

### 1.02 RELATED WORK

A. Section 02221: Trenching, Backfilling, and Compaction.

B. Section 02305: Boring and Jacking.

C. Section 02605: Separation of Piped Utilities.

## PART 2 - PRODUCTS

### 2.01 POLYVINYL CHLORIDE PIPE (PVC) AND FITTINGS

A. Provide PVC pipe meeting ASTM D-2241 or AWWA C-900.

B. ASTM D-2241 Pipe:

1. Manufactured from virgin, National Sanitation Foundation (NSF) approved Type 1, Grade 1 impact improved resin suitable for use in transporting potable water.

2. Pipe and fittings pressure rated for 200 psi.

3. Use only where the maximum pressure shall not exceed 2/3 of the pressure rating or 135 psi.

4. Maximum Standard Dimension Ratio (SDR) of 21.

5. Joints sealed with a rubber ring and non-toxic lubricant as provided by the manufacturer meeting or exceeding the requirements of ASTM D-3139 and ASTM F-477.

6. Clearly mark with the manufacturer's name, nominal diameter, SDR, ASTM D-2241, pressure rating, and NSF approved seal.

C. AWWA C-900 Pipe:

1. PVC 1120 pipe manufactured from virgin, National Sanitation Foundation (NSF) approved compounds meeting the requirements of ASTM D-1784.

2. Pressure rated based on Dimension Ratios (DR) and pressure classes (pressure classes are working pressure ratings):

| Dimension Ratio (DR) | Pressure Class (psi) |
|---|---|
| 25 (for force mains only) | 100 |
| 18 | 150 |
| 14 | 200 |

3. Outside diameter equivalent to the same outside diameter of cast iron pipe.

4. The minimum wall thickness of the bell, at any point, shall conform with the DR requirements of the pipe.

5. Furnish in standard laying lengths of twenty (20) feet.

6. Clearly mark with the manufacturer's name, nominal diameter, DR, PVC 1120, pressure class, AWWA C-900, and NSF approval seal.

## 2.02 DUCTILE IRON PIPE AND FITTINGS

A. Pipe:

1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).

2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).

3. A minimum of 1 mil thick bituminous coating on the outside surface.

4. Clearly mark with manufacturer's name, DI or Ductile, weight, class or nominal thickness, and casting period.

5. Unless otherwise specified or shown on the plans, ductile iron pipe shall be Class 50 for 200 psi working pressure.

B. Fittings:

1. Fittings 4" - 24": Pressure rated at 350 psi.

2. Fittings 30" - 36": Pressure rated at 250 psi.

3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111).

## 2.03 SERVICE PIPE

A. Polyethylene Pipe:

1. Class 160, SDR 9, polyethylene classified PE 3406C suitable for a working pressure of 150 psi.

2. 100% non-toxic polyethylene resin compound or ultra-high molecular weight in accordance with ASTM D-1248.

3. 3/4 inch nominal diameter unless otherwise specified or shown on the plans.

4. Service pipe shall be used to connect the corporation stop with the meter yoke. Use the minimum length required to make a straight line connection including a gooseneck.

B. Copper Pipe:

1. Seamless copper tubing meeting the requirements of ASTM B-88, Type K.

2. Contain not less than 99.90% copper and not more than 0.04% phosphorous.

3. Suitable for use with a working water pressure of 160 psi.

4. 3/4 inch nominal diameter unless otherwise specified or shown on the plans.

5. Service pipe shall be used to connect the corporation stop with the meter yoke. Use the minimum length required to make a straight line connection including a gooseneck.

2.04 WATER SERVICE ASSEMBLIES

A. Water Meters:

1. AWWA C-700.

2. 5/8" x 3/4" unless otherwise specified or shown on the plans.

3. Frost-proof with a cast bronze casing and a hinged cover.

4. Direct reading register, in gallons, unless otherwise specified.

5. Disc or piston operated with magnetic drive.

6. A suitable non-corrosive strainer located over the inlet to the measuring chamber.

7. The name of the manufacturer cast in the lid of the register box and the meter serial number imprinted thereon.

B. Water Main Connections:

1. Tap water mains in the upper half of the pipe at a 45 degree angle or provide brass tapped couplings with AWWA threads.

2. Do not exceed the pipe manufacturer's recommended maximum tap size.

3. Use service clamps on all taps for PVC pipe.

C. Corporation Stops:

1. AWWA C-800.

2. Cast of certified waterworks red brass, composed of 85% copper and 5% each of tin, lead, and zinc.

3. Watertight and individually tested for leaks.

4. Waterway diameter approximately equal to the nominal size of the stop.

5. Coat or cap all threads for protection prior to installation.

D. Meter Yokes:

1. Copper tubing with an integral brace and meter stop.

2. Minimum rise of 14".

3. Provide with outlets designed for the use of polyethylene or copper service pipe.

E. Service Clamps: Bronze with neoprene gasket and double straps.

F. Meter Boxes:

1. Rectangular pre-cast concrete, cast iron, or plastic.

2. Pre-cast concrete and cast iron meter boxes shall have a cast iron lid.

3. Depth of the meter box not less than 18 inches.

4. Of sufficient size to facilitate easy installation and removal of the water meter.

5. Where service assemblies include a pressure reducing valve, sufficiently sized for installation of the pressure reducing valve in the meter box.

G. Pressure Reducing Valves for Service Assemblies:

1. Where the static pressure is greater than 80 psi, or as shown on the Plans, service assemblies shall include a pressure reducing valve and all necessary fittings and appurtenances.

2. Cast bronze body provided with a strainer on the inlet end.

3. 3/4 inch nominal size with factory pre-set delivery pressure of 45 psi and field adjustable without the use of special tools or without removing the valve from the line.

4. Locate in the meter box on the downstream side of the meter.

2.05 VALVES AND VALVE BOXES

A. Gate Valves:

1. AWWA C-500 or AWWA C-509 (resilient seat).

2. Valves shall be iron body, bronze mounted, non-rising stem type.

3. Stuffing boxes: O-ring seal type with two (2) rings in the stem located above the thrust collar.

4. 2" square wrench nut for operation of the valve.

5. Minimum design working water pressure of 200 psi for valves with diameters 2"-12" and 150 psi for valves with diameters of 14"-54", unless otherwise specified or shown on the Plans.

6. Joints: ANSI A-21.11 (AWWA C-111).

7. Bonnet or body markings: Manufacturer's name, year of casting, size, pressure rating, and OPEN with direction.

8. Open by counter-clockwise operation, unless otherwise specified.

B. Butterfly Valves:

1. AWWA C-504.

2. Cast iron body, rubber seated tight-closing type.

3. Cast markings: valve size, manufacturer's name, class, direction of opening, and the year of casting.

4. Class 150, suitable for working water pressure of 150 psi unless otherwise specified or shown on the Plans.

5. Open by counter-clockwise operation, unless otherwise specified.

C. Main Line Pressure Reducing Valves:

1. Cast iron globe body, full bronze mounted, external pilot operated, single, resilient seated type.

2. Packed with leather (or other soft material) to insure tight closure and to prevent metal to metal friction and seating.

3. Open when the downstream pressure is less than the valve setting and close tightly when the downstream pressure exceeds the valve setting.

4. Valve opening: proportional to the delivery requirements and not influenced by changes in inlet pressure.

5. Pilot valve: arranged to allow for its removal from the main valve while under pressure and easily accessible without removal of springs, weights, or the use of special tools.

6. Suitable to operation at 200 psi working water pressure and adjustable.

D. Valve Boxes:

1. Cast iron, 2 or 3 piece, screw type with shaft diameter of not less than 5".

2. Heavy roadway type equipped with a cover containing the word "WATER" in raised letters on the top.

3. Base of such size as to permit its installation without allowing it to come in contact with either the valve or the pipe.

2.06 AIR RELEASE ASSEMBLIES

A. Furnish in 1" nominal diameter for 8" mains and smaller and in 2" nominal diameter for 10" mains and larger, unless otherwise specified or shown on the Plans.

B. Air release assemblies shall consist of:

1. Double strap, bronze service clamp with neoprene gasket (for PVC lines).

2. Galvanized steel pipe of the nominal diameter required by the main size.

3. Red brass corporation stop.

4. Galvanized steel elbow.

5. Gate valve.

6. Air release valve.

C. Combination air release valves consisting of:

1. An air and vacuum valve coupled with an air release valve.

2. Cast iron body, stainless steel float, bronze linkage, bronze trim, suitable for use in mains having a working pressure of 200 psi.

D. Install in a pre-cast concrete manhole, 48" in diameter and 48" deep, with 24" nominal diameter cast iron frame and cover.

E. Place crushed stone from the top of the main to 12" below the bottom of the main.

## 2.07 FIRE HYDRANTS AND BLOW-OFF HYDRANTS

A. Fire Hydrants:

1. AWWA C-502.

2. Cast iron bodies, fully bronze mounted, designed for operation at a working water pressure of 150 psi.

3. Furnish with two 2 1/2" threaded brass hose nozzles and one threaded brass pumper nozzle.

4. Compression type main valve 5 1/4" or 4 1/2" in diameter faced with a suitable yielding material such as rubber, leather, or balata.

5. So designed that, when it is installed, no excavation is required to remove the main valve or the movable parts of the drain valve.

6. Inside diameter of barrel: at least 120 percent of the hydrant valve size.

7. Inlet connection: minimum of 6" mechanical joint on all lines, unless otherwise specified or shown on the plans.

8. Equipped with safety flange located not more than 2" above ground and a two piece shaft break-away assembly.

9. Open on counter-clockwise operation, unless otherwise specified.

10. Shop paint and mark in accordance with AWWA C-502.

11. Cast markings: manufacturer's name, size of the main valve, year of manufacture, and direction of opening.

12. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color and type as that used during shop painting.

B. Blow-Off Hydrants:

1. Post type having cast iron bodies, fully bronze mounted and designed for operation at a working water pressure of 150 psi.

2. Furnish with either two 1 1/2" or one 2 1/2" threaded brass hose nozzle.

3. Compression type main valve 2 1/8" minimum diameter faced with a suitable yielding material such as rubber, leather, or balata.

4. So designed that, when it is installed, no excavation is required to remove the main valve or the movable parts of the drain valve.

5. Inside diameter of barrel: at least 3".

6. Inlet connection: 2" mechanical joint, unless otherwise specified or shown on the Plans.

7. Equipped with a safety flange located not more than 2" above the ground.

8. Open on counter-clockwise operation, unless otherwise specified.

9. Cast markings: manufacturer's name, size of the main valve, year of manufacture, and direction of opening.

10. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color and type as that used during shop painting.

## 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 WATERLINES

A. Lay all pipe in a straight line on a uniform grade.

B. After applying gasket lubricant, take extreme care to keep the spigot end from contacting the ground.

C. Hone the pipe with suitable tools or equipment.

D. Closely follow the manufacturer's instruction in laying and joining pipe.

E. Cut pipe for inserting valves, fittings, etc. in a neat and workmanlike manner without damaging the pipe so as to leave a smooth end at right angles to the axis of the pipe.

F. Locate waterlines in relation to other piped utilities in accordance with Section 02605.

## 3.03 INSTALLING APPURTENANCES

A. Securely plug open ends of pipe at the close of each work day and during temporary discontinuance of pipe laying.

B. Set all valves, fittings, hydrants, and other specials in a neat workmanlike manner.

C. Use thrust blocks, as shown on the Plans, pipe anchors, or other approved means to prevent displacement or other fittings.

D. Erect hydrants to stand plumb with the pumper nozzle facing the road.

E. Effect drainage of hydrants by using 6 cubic feet of gravel.

F. Close dead ends with cast iron plugs or caps and equip with blow-off assemblies, where shown on the drawings.

## 3.04 HIGHWAY AND RAILROAD CROSSINGS

A. Perform highway crossings by the open cut method, unless otherwise shown on the drawings or required by the appropriate authorities.

B. Boring and jacking of crossings, if necessary, will be performed and paid for in accordance with Section 02305.

## 3.05 WATERLINE PRESSURE TESTS

A. After the pipe has been laid, subject all newly laid pipe or any valved section thereof to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.

B. Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section.

2. Not exceed the pipe and thrust restraint design pressures.

3. Be of at least 2-hour duration.

4. Not vary by more than $\pm 5$ psi.

5. Not exceed twice the rated pressure of closed valves or hydrants included in the test section.

6. Not exceed the rated pressure of resilient-seated butterfly valves.

C. Pressurization:

1. Slowly fill each valved section of pipe with water.

2. Apply the specified test pressure, based on the elevation of the lowest point of the line or section under test and correct to the elevation of the test gauge by means of a pump connected to the pipe in a manner satisfactory to the Owner.

D. Air Removal:

1. Before applying the specified test pressure, expel air completely from the pipe, valves, and hydrants.

2. If permanent air vents are not located at all high points, install corporation cocks at such points to expel air as the line is filled with water.

3. After all the air has been expelled, close the corporation cocks and apply the test pressure.

4. At the conclusion of the pressure test, remove the corporation cocks and plug or leave in place at the discretion of the Owner.

E. Examination:

1. Carefully examine all exposed pipe, fittings, valves, hydrants, and joints.

2. Repair or replace any damaged or defective pipe, fittings, valve, or hydrants, that are discovered with sound material and repeat the test until it is satisfactory to the Owner.

## 3.06 WATERLINE LEAKAGE TESTS

A. Concurrently conduct a leakage test with the pressure test.

B. Leakage Defined: the quantity of water that must be supplied into the newly laid pipe to maintain the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

C. Allowable Leakage:

1. Determine allowable leakage by: $L = \frac{ND\sqrt{P}}{7400}$

Where L is the allowable leakage, in gallons per hour; N is the number of joints in the tested pipeline; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in psig.

2. Allowable leakage at various pressures:

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE*
(Gallons Per Hour)

| Avg. Test Pressure PSI | NOMINAL PIPE DIAMETER - INCHES | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 36 | 42 | 48 | 54 |
| 450 | 0.32 | 0.48 | 0.64 | 0.95 | 1.27 | 1.59 | 1.91 | 2.23 | 2.55 | 2.87 | 3.18 | 3.82 | 4.78 | 5.73 | 6.69 | 7.64 | 8.60 |
| 400 | 0.30 | 0.45 | 0.60 | 0.90 | 1.20 | 1.50 | 1.80 | 2.10 | 2.40 | 2.70 | 3.00 | 3.60 | 4.50 | 5.41 | 6.31 | 7.21 | 8.11 |
| 350 | 0.28 | 0.42 | 0.56 | 0.84 | 1.12 | 1.40 | 1.69 | 1.97 | 2.25 | 2.53 | 2.81 | 3.37 | 4.21 | 5.06 | 5.90 | 6.74 | 7.58 |
| 300 | 0.26 | 0.39 | 0.52 | 0.78 | 1.04 | 1.30 | 1.56 | 1.82 | 2.08 | 2.34 | 2.60 | 3.12 | 3.90 | 4.68 | 5.46 | 6.24 | 7.02 |
| 275 | 0.25 | 0.37 | 0.50 | 0.75 | 1.00 | 1.24 | 1.49 | 1.74 | 1.99 | 2.24 | 2.49 | 2.99 | 3.73 | 4.48 | 5.23 | 5.98 | 6.72 |
| 250 | 0.24 | 0.36 | 0.47 | 0.71 | 0.95 | 1.19 | 1.42 | 1.66 | 1.90 | 2.14 | 2.37 | 2.85 | 3.56 | 4.27 | 4.99 | 5.70 | 6.41 |
| 225 | 0.23 | 0.34 | 0.45 | 0.68 | 0.90 | 1.13 | 1.35 | 1.58 | 1.80 | 2.03 | 2.25 | 2.70 | 3.38 | 4.05 | 4.73 | 5.41 | 6.03 |
| 200 | 0.21 | 0.32 | 0.43 | 0.64 | 0.85 | 1.06 | 1.28 | 1.48 | 1.70 | 1.91 | 2.12 | 2.55 | 3.19 | 3.82 | 4.46 | 5.09 | 5.73 |
| 175 | 0.20 | 0.30 | 0.40 | 0.59 | 0.80 | 0.99 | 1.19 | 1.39 | 1.59 | 1.79 | 1.98 | 2.38 | 2.98 | 3.58 | 4.17 | 4.77 | 5.36 |
| 150 | 0.19 | 0.28 | 0.37 | 0.55 | 0.74 | 0.92 | 1.10 | 1.29 | 1.47 | 1.66 | 1.84 | 2.21 | 2.76 | 3.31 | 3.86 | 4.41 | 4.97 |
| 125 | 0.17 | 0.25 | 0.34 | 0.50 | 0.67 | 0.84 | 1.01 | 1.18 | 1.34 | 1.51 | 1.68 | 2.01 | 2.52 | 3.02 | 3.53 | 4.03 | 4.53 |
| 100 | 0.15 | 0.23 | 0.30 | 0.45 | 0.60 | 0.75 | 0.90 | 1.05 | 1.20 | 1.35 | 1.50 | 1.80 | 2.25 | 2.70 | 3.15 | 3.60 | 4.05 |

*For Mechanical or push-on joint pipe with 18' nominal lengths. To obtain the recommended allowable leakage for pipe with 20' nominal lengths, multiply the leakage calculated from the above table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.078 gal/hr/in. of nominal valve size shall be allowed.

4. When hydrants are in the test section, test against the closed hydrant.

3.07 ACCEPTANCE OF INSTALLATION

A. If any test of pipe laid discloses leakage greater than that specified above, locate and repair the defective material until the leakage is within the specified allowance.

B. Repair all visible leaks regardless of the amount of leakage.

3.08 CLEANING AND DISINFECTION OF WATERLINES

A. Flush waterlines clean prior to disinfection.

B. Thoroughly disinfect waterlines prior to placing in service.

1. Use chlorine disinfecting agent applied to produce a 25 ppm dosage.

2. Allow water to escape from the ends of all lines to cause dispersion of the chlorine solution into all parts of the system.

3. Operate all valves and hydrants during the time disinfection is occurring.

4. Retain the chlorine solution in the lines for a period of 24 hours.

5. At the end of the 24 hour period, the residual chlorine must be a minimum of 10 ppm. Otherwise, repeat the disinfection procedure again.

6. Upon refilling the lines, collect a sample for bacteriological analysis. If the same is acceptable, the lines may be connected to the system. Otherwise repeat the disinfection procedure until acceptable samples are obtained.

3.09 MEASUREMENT AND PAYMENT - WATER PIPE

A. Water pipe will be measured by the linear foot of pipe installed, tested, disinfected, and accepted including trenching, bedding, backfill, fittings (unless otherwise specified), thrust blocking and metallic tape, when required. Water pipe installed in connection with boring and jacking of crossings will be measured for payment in Section 02305 and not here.

B. Water pipe as above stipulated will be paid for at the Contract unit price per linear foot for the various sizes and classifications shown on the Bid Form.

3.10 MEASUREMENT AND PAYMENT - VALVES, HYDRANTS, AND SERVICE ASSEMBLIES

A. Valves, hydrants, and service assemblies will be measured by the number installed, tested, disinfected, and accepted including trenching, backfill, fittings (unless otherwise specified), and thrust blocking.

B. Valves, hydrants, and service assemblies, as above stipulated, will be paid for at the Contract unit price per each for the various sizes and classifications shown on the Bid Form.

## 3.11 MEASUREMENT AND PAYMENT - FITTINGS (SPECIALLY CALLED FOR ON BID FORM)

A. Waterline fittings will be measured for payment only when specially called for on the Bid Form and will be measured by the pound of fittings installed, tested, and accepted.

B. Fittings, as above stipulated, will be paid for at the Contract unit price per pound.

# 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 my 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 |

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:

| Sieve Size | Total Percent Passing By Weight |
|---|---|
| 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 Section 02722 for complete specifications.

## 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 upgrade.

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 dewater.

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 relaid 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 catchbasins, 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 which 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 catchbasins, 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 AND CATCHBASINS

A. Manholes and catchbasins shall be measured for payment by the number installed and accepted including excavation, steel reinforcing, brick masonry, concrete, casting, and fittings.

B. Manholes and catchbasins as above stipulated shall be paid for at the Contract unit price per each for the various type and depth classifications shown on the Bid Form.

3.08 MEASUREMENT AND PAYMENT - STORM SEWERS

A. Pipe for storm sewers, of the various kinds, types, and sizes, will be measured by the linear foot of pipe installed and accepted. Wyes or tees required in the line will be measured separately based upon the kind, type, and size.

B. Accepted quantities of sanitary sewers, measured as provided for above, will be paid for at the contract unit price per linear foot of pipe of each kind and size, including incidental appurtenances, complete in place.

# SECTION 02722

# SANITARY SEWERAGE SYSTEMS

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. Installation of sanitary sewerage 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 AND FITTINGS

A. Reinforced Concrete Sewer Pipe (RCP): conform to the permeability and hydrostatic requirements of ASTM C-497 with flexible gasket joints conforming to ASTM C-443.

B. Non-reinforced Concrete Sewer Pipe: ASTM C-14, except that the minimum content of cement shall be 940 pounds (10 bags) per cubic yard with flexible gasket joints conforming to ASTM C-443.

### 2.02 VITRIFIED CLAY PIPE AND FITTINGS

A. ASTM C-700, extra strength pipe with joints conforming to ASTM C-425.

B. All VCP shall be clearly marked with the manufacturer's name, plant location, diameter, and "Extra Strength."

### 2.03 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.

B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a Standard Dimension Ratio (SDR) of 35.

C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.

D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM D-3034, and NSF approved seal.

## 2.04 DUCTILE IRON PIPE AND FITTINGS

A. Pipe:

1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).

2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).

3. A minimum of 1 mil thick bituminous coating on the outside surface.

4. Clearly mark with manufacturer's name, DI or Ductile, weight, class or nominal thickness, and casting period.

5. Unless otherwise specified or shown on the Plans, ductile iron pipe shall be Class 50 for 200 psi working pressure.

B. Fittings:

1. Fittings 4" - 24": Pressure rated at 350 psi.

2. Fittings 30" - 36": Pressure rated at 250 psi.

3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111).

## 2.05 CONCRETE MATERIALS

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

## 2.06 CASTINGS FOR FRAME AND COVERS

A. Gray iron, Class 30, unless otherwise specified, meeting AASHTO M-108.

B. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.

C. Rings and covers for use on watertight manholes shall be machined to a smooth uniform bearing that will provide a watertight seal.

## 2.07 PRE-CAST CONCRETE MANHOLES

A. AASHTO M-199 SR or ASTM C-478.

B. Flexible boots shall be cast in the manhole to provide for the required number and size pipes and shall be marked to insure installation at proper locations.

C. Use premolded rubber or approved bitumastic gaskets at all joints between sections in sanitary sewer manholes.

2.08 PRE-CAST POLYETHYLENE MANHOLE

A. Polyethylene Manholes shall be produced using polyethylene compounds conforming to the requirement of Type III, Category "3", Class B., as defined and described in ASTM D-1248.

B. Polyethylene Manholes shall be produced in the rotational molding process.

C. Manholes should be supplied with factory molded steps.

D. The manhole shall be designed to accept concrete filled polyethylene manhole lids weighing not less than 190 pounds and must be compatible with standard cast iron frames and cast iron lids or grates.

E. Manhole segment joints shall be designed to function as a full tongue and groove with the groove portion no less than 2.75 inches in depth with the capability to accommodate optional gaskets and/or sealing compounds recommended by the manufacturer.

F. Polyethylene Manholes shall have a nominal cylinder internal diameter of 48 inches. The manway reducer nominal inside diameter shall be 27.75 inches.

G. Wall thickness of all components shall be determined in accordance with ASTM D-2122 and shall be a minimum of .330 inches.

H. Polyethylene Manholes shall have compressive strength which shall be determined in accordance with ASTM D-2412 modified pipe stiffness test. Pipe stiffness values shall be 12 psi min. at 5% deflection, including joints. Axial compressive strength shall exceed 10,000 pounds at deflection less than 3%.

2.09 MANHOLE STEPS

A. ASTM C-478.

B. Cast Iron Steps: ASTM A-48, Class 30.

C. Aluminum Steps: fabricated from aluminum alloy 6061, T6.

D. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections which may be a safety hazard and shall be of sufficient strength to be a live load of 300 pounds imposed at any point.

E. The minimum width of cleat shall be 10 inches.

F. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4" from the wall when the step is securely imbedded in the manhole wall.

G. The top surface of the cleats shall be designed to prevent foot slippage.

2.10 PIPE ENTRANCE COUPLINGS FOR MANHOLES

Two types of flexible connections will be acceptable:

A. Compression type rubber with stainless steel internal korband and external pipe clamp, conforming to ASTM C923: Kor-N-Seal or approved equal.

B. Integrally cast into pipe opening with external stainless steel pipe clamps conforming to ASTM C923: Z-Lok or approved equal.

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 GRAVITY SANITARY SEWERS

A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.

1. Where laser equipment is used, provide offset hubs at every manhole location for purposes of checking grade between sections.

2. Where batter boards are used, furnish stakes at intervals of 50 feet along the route of the pipeline.

3. Set stakes at such distance from centerline of excavations as is suitable for the excavating method and machinery used.

4. Provide and use accurately set batter boards at each 50 foot interval in establishing the bottom invert of each pipe laid.

B. Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.

C. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any defective pipe of fitting from the job site.

D. Lay pipe progressively upgrade, with bell upstream, in such a manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.

E. Bed each pipe section in accordance with Section 02221.

F. Unless otherwise specified, provide all gravity sewer lines with a minimum of 4 feet of cover in roadways and 2 1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.

G. Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.

H. Keep the interior of the pipe free of all unneeded material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.

I. When laying pipe ceases, close the open ends of the pipe with a suitable plug for preventing the entrance of foreign materials.

J. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, shall meet the requirements of ASTM C-594.

K. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic, and metallic materials that will not be attacked by municipal wastewaters or aggressive elements in the soil and conform to ASTM C-425, Section 5.

## 3.03 INITIAL PROOF TESTING OF SANITARY SEWERS

A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.

B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.

C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.

D. The basis for grade, alignment, and cleanliness testing will be visual inspection. Leakage testing will be by means of low pressure air as specified hereinafter.

E. Proof test flexible pipeline installation for deflection by pulling a "go-no go" test mandrell through the line after the initial backfill is complete to avoid unnecessary digups.

## 3.04 FINAL TESTING

A. Before the job is accepted, a final testing procedure is to be followed.

B. Perform a visual inspection when ground water levels are above the pipeline if possible. All visible leaks shall be repaired.

C. If there is evidence of infiltration, make measurement with suitable pipe weirs:

1. If the flow through the lower most manhole of a continuous section of sewer does not exceed 50 gallons day/inch/mile of pipeline and the groundwater level is representative of the highest annual level, the entire continuous section shall be approved for leakage.

2. The leakage test will be conducted with all lines connected (including service lines).

3. If the apparent infiltration rate exceeds 50 gallon/day/inch/mile, then take additional weir measurements to isolate those sections leaking.

4. Any single reach of pipeline which exhibits an apparent infiltration rate in excess 50 gallon/day/inch/mile will not be accepted and all leaks will be located and corrected.

D. If it is not practical to wait for groundwater levels that are representative of the highest annual level, the Contractor may request approval on the basis of a low pressure air exfiltration test.

1. Such test, if approved by the Engineer, will be conducted in accordance with ASTM C-828.

2. When an exfiltration test is used as a substitute for infiltration testing, correct all conditions that are potential sources of infiltration.

E. If flexible pipe is used, pull an approved go-no go deflection mandrell of 95/100 pipe diameter through all reaches of gravity sewer main. No sections will be accepted that exhibit a deflection of more than 5%.

## 3.05 LOW PRESSURE AIR EXFILTRATION TEST

A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 3 1/2 to 2 1/2 psig.

B. Times for mixed pipe sizes of varying lengths should be calculated as described in ASTM, C-828-76T using formula $t = k\,d/q$ ($q = .0020$).

C. The following times are for one pipe size only:

| Pipe Size (inches) | Time, T (sec/100 ft) | Allowable Air Loss, Q (ft3/min) |
|---|---|---|
| 6 | 42 | 2.0 |
| 8 | 72 | 2.0 |
| 10 | 90 | 2.5 |
| 12 | 108 | 3.0 |
| 15 | 126 | 4.0 |
| 18 | 144 | 5.0 |
| 21 | 180 | 5.5 |
| 24 | 216 | 6.0 |
| 27 | 252 | 6.5 |
| 30 | 288 | 7.0 |

## 3.06 SEWER MANHOLES - GENERAL

A. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet.

B. The clear opening in the manhole shall not be less than 2.0 feet.

C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the base of the ring.

D. Apply an application of bituminous material to the outside of each manhole section prior to backfilling and preferably when making the vacuum test.

E. Backfill manholes with the same material used for pipelines.

## 3.07 STANDARD PRE-CAST CONCRETE MANHOLES

A. ASTM C-478.

B. The base of the manhole shall be a pre-cast section with openings or flexible connections sized to accept the sewer pipe.

C. Shape manhole inverts from Class B concrete to be smooth, accurately shaped, and in accordance with the Plans.

D. Inlets and outlets from each manhole shall be finished smooth and flush with the sides of the manhole walls so as not to obstruct the flow of liquid through the manhole.

E. Provide a subbase with a minimum of 12" of Class I, granular material, well compacted with mechanical tamping equipment.

F. When completed, the manhole shall be free from channel obstructions and leakage.

G. Seal joints between sections with a rubber O-ring or "RAM-NEK" gasket as shown on the Plans.

3.08 PRE-CAST POLYETHYLENE MANHOLE

A. Pre-cast Polyethylene Manholes shall be installed in strict accordance with manufacturer specifications and requirements.

3.09 "CAST-IN-PLACE" CONCRETE MANHOLES

A. Manholes shall conform to the dimensions outlined on the Plans.

B. The vertical forms, wall spacers, steps, and placing cone must be carefully positioned and firmly clamped in place before any placement is made.

C. The wall spacers must be located 90 degrees from each other.

D. Use Class "A" concrete with a maximum slump of 4" per Section 03001.

E. First place approximately 1/2 yard of concrete evenly around the walls and vibrate until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole.

F. When this is complete and before additional concrete is added, vibrate the concrete on each side of each pipe.

G. Deposit additional concrete in evenly distributed layers of about 18" with each layer vibrated to bond it to the preceding layer.

H. Raise the wall spacers as the placement are made, with the area from which the spacer is withdrawn being carefully vibrated.

I. Excessive vibration is to be avoided.

J. A maximum of 2% Calcium Chloride may be added to the concrete, at the Contractor's option, to speed the set.

K. Remove the forms as soon as the concrete has sufficiently set, but not within 6 hours of pouring and not without approval.

L. Excessive honeycombs will be cause for rejection of the manhole. Honeycombs and other imperfections shall be mortared as soon as possible after form removal so that a proper bond will take place.

M. Form marks and offsets of up to ½" will be permitted on the outside surface of the manhole.

N. Form marks and offsets up to ¼" will be permitted inside of the manhole.

O. All offsets on the inside surface of the manhole will be smoothed and plastered so there is no projection of irregularity capable of scratching a worker or catching and holding water or solid materials.

P. Honeycomb will be plastered with mortar, consisting of three parts of masonry sand to one part Portland cement, immediately upon removal of the forms.

## 3.10 MANHOLE STEPS

A. Set manhole steps at intervals of 15 inches along the wall of the manhole.

B. The treads of the steps shall be free from mortar or other material when the manhole is completed.

C. In pre-cast manholes, the holes left to receive the steps shall be mortared smooth following placement of the steps.

## 3.11 MANHOLE RINGS AND COVERS

A. Grout manhole rings and covers in place with cement mortar. Bricks may be used for adjustment of ring to match grade.

B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.

C. All castings shall be of the types, dimensions, and weights as shown on the Plans and shall be free of faults, cracks, blow-holes, or other defects.

## 3.12 DROP MANHOLE ASSEMBLIES

A. Drop manhole assemblies shall be constructed as outlined on the Plans.

B. The material used in the drop pipe construction shall be ductile iron and Class "B" concrete.

## 3.13 MANHOLE VACUUM TEST

A. All manholes shall be subjected to and shall pass a vacuum test of at least 10" Hg. prior to acceptance. The Contractor shall be responsible for providing the equipment required for the testing including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel. The equipment shall be top quality, and in good condition and approved by the Engineer for use.

B. Each manhole shall be tested immediately after assembly and prior to backfilling. The lifting holes shall be plugged with an approved non-shrink grout. The pipes entering the manhole shall be plugged, taking care to securely brace the plugs to prevent them from being drawn into the manhole.

C. With the vacuum tester set in place on top of the cone section of the manhole:

1. Inflate the compression band seal in accordance with the manufacturer's recommendations.

2. Connect the vacuum pump to the outlet port with the valve open and draw a vacuum of 10 inches of mercury (Hg).

3. Close the valve and shut off vacuum pump.

4. Measure the time elapsed for the vacuum to drop to 9 inches Hg.

5. The manhole shall pass if the time is greater than 60 seconds for 48" diameter, 75 seconds for 60" diameter and 90 seconds for 72" diameter manholes.

D. If the manhole fails the vacuum test, necessary repairs shall be made with an approved non-shrink grout while the vacuum is being drawn. Retesting as outlined above shall proceed until a satisfactory test is obtained.

## 3.14 SEWER SERVICE ASSEMBLIES

A. Where shown on the plans or located in the field, install fittings for individual service assemblies.

1. The standard collector tap shall consist of a wye or tee connected with a service branch.

2. Use vertical risers when the depth of the collector line is greater than 8 feet or when their use will facilitate connection of individual services.

3. Plug the ends of tee branches not to be used immediately with stoppers of the same material and joints used on the collector lines.

B. Where shown on the plans or located in the field, install collector saddles by attaching to the sewer main by stainless steel bands secured by 2 bronze or stainless steel bolts, with a minimum diameter of 3/8".

C. Service pipe shall be 4" or 6" in diameter and shall be installed as shown in the Plans.

1. Plug the ends of service pipe and cover the same as for collectors and interceptors (where possible).

2. The minimum grade on service pipes shall be 2% or ¼inch per foot for 4" and 1% or 1/8 inch per foot for 6".

3.15 MEASUREMENT AND PAYMENT - GRAVITY SEWER PIPE

A. Sewer pipe shall be measured by the linear foot of pipe installed, tested, and accepted without deduction for the trench, granular bed, and backfill, removal, and disposal of existing materials, inspection, internal testing, internal sealing or replacement of defective joints, fittings, and appurtenances.

B. Sewer pipe as above stipulated shall be paid for at the Contract unit price per linear foot for sewer pipe of the various sizes and material classifications.

3.16 MEASUREMENT AND PAYMENT - SEWER MANHOLES

A. Manholes shall be measured by the number installed, tested, and accepted including concrete base, granular sub-base, poured concrete invert, all brick work or pre-cast concrete sections, steps, and castings as shown on the Plans. Measurement of the depth to determine depth classification shall be the vertical distance from the lowest invert in the manhole to the base of the ring. (This item shall not include drop assemblies.)

B. Manholes as above stipulated shall be paid for at the Contract unit price per each for the various depth classifications.

3.17 MEASUREMENT - MANHOLE CASTINGS

A. Manhole castings, except the watertight and traffic type, shall not be measured for payment, but shall be included in the unit price per manhole.

B. As above stipulated, manhole castings shall not be measured for payment, but shall be included in the unit price per manhole.

3.18 MEASUREMENT AND PAYMENT - WATERTIGHT AND TRAFFIC MANHOLE CASTINGS

A. Watertight manhole castings shall be measured by the number installed and accepted.

B. Watertight manhole castings as above stipulated shall be paid for at the Contract unit price per each installed and accepted.

3.19 MEASUREMENT AND PAYMENT - MANHOLE DROP ASSEMBLIES

A. Drop assemblies shall be measured by the number installed, tested, and accepted, including drop pipes, fittings, Class "B" concrete and brickwork. Measurement of the depth to determine depth classification shall be the vertical distance from the lowest invert in the manhole to the invert of the Drop "Tee". (This item shall not include manhole construction.)

B. Drop assemblies as above stipulated shall be paid for at the Contract unit price per each for the various depth classifications.

## 3.20 MEASUREMENT AND PAYMENT - SEWER SERVICE ASSEMBLIES

A. Service assemblies shall be measured by the number installed, tested, and accepted including tee branch collection line fittings and plugs. Service pipe shall be measured by the linear foot of pipe installed, tested, and accepted from the centerline of the collection line to the stopping point without deductions for fittings.

B. Service assemblies as above stipulated shall be paid for at the Contract unit price each. Service pipe as above stipulated shall be paid for at the Contract unit price per linear foot for service pipe.

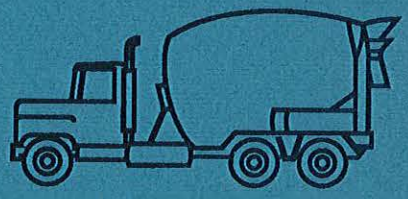
## 3.21 CONCRETE ENCASEMENT

A. Concrete for encasement of pipe shall be measured by the cubic yard actually specified or shown on the Plans, regardless of any excess placed by the Contractor.

B. Concrete as above stipulated shall be paid for at the Contract unit price per cubic yard, which payment shall be compensation in full for furnishing and placing concrete and for all equipment and incidentals necessary for performance of the work as herein specified or shown on the plans.

# CONSTRUCTION STANDARDS AND SPECIFICATIONS

## Division 3: Concrete



# 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 or other inert materials with similar characteristics conforming to AASHTO M-6 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 which has been 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 from coarse to fine and, when tested by means of laboratory sieves, conforming to:

| Sieve Size | Total Percent Passing By Weight |
|---|---|
| 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 for AASHTO M-43, except as specified otherwise.

1. Graded to standard sizes between the limits specified conforming 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 | 3/4 | ½ | 3/8 | 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 3/4 | | | 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 3/4 | | | | | 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 3/8 | | | | | | 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 | 3/4 to 3/8 | | | | | | | 100 | 90-100 | 20-55 | 0-15 | 0-5 | | | | |
| 67 | 3/4 to No. 4 | | | | | | | 100 | 90-100 | | 20-55 | 0-10 | 0-5 | | | |
| 68 | 3/4 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 | 3/8 to No. 8 | | | | | | | | | 100 | 85-100 | 10-30 | 0-10 | 0-5 | | |
| 89 | 3/8 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 | No. 4 to 0 (2) | | | | | | | | | | 100 | 85-100 | | | | 10-30 |

**(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. Furnish coarse aggregate for concrete base and pavement in two sizes: No. 4 and No. 67. The two sizes shall be manufactured to produce Size No. 467, when 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:

| | |
|---|---|
| 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 |
| Coal or lignite | 1.0 |
| Clay lumps | 0.25 |
| Material passing the No. 200 sieve | 0.75 |
| Thin or elongated pieces (length greater than five (5) times average thickness) | 10.00 |
| 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 |
| Tensil 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 |
| Tensil 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 3% or minus 2%.

D. Submit a mix design to Engineer for approval prior to commencing work.

E. Collect compression test specimens using ASTM C-31 or AASHTO T-23.

F. Test compression strength specimens using ASTM C-39 or AASHTO T-22.

G. Test slump using ASTM C-143 or AASHTO T-119.

H. Structural Concrete Proportioning Table:

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 | Natural | 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 | Natural | 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 | Natural | 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 | Natural | 280 | 187 | 4.09 | 6.0 | 6.6 |
| Specific Gravity of Gravel Based on 2.52 | | | | | | |
| Specific Gravity of Natural Sand Based on 2.60 | | | | | | |
| Specific Gravity of Limestone Based on 2.70 | | | | | | |
| 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 | | | | | | |

## 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. 67.

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, subfoundations, 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.

3. Minimum Cement Content: 5.0 bags (470 lbs) per cubic yard.

4. Minimum Compressive Strength: 28 day, 2500 psi, average of any 3 cylinders.

5. Slump: 5 to 8 inches for pipe encasements and 2 to 4 inches in subfoundations 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. Give Engineer free access to the 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 a 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" Dia. Bar | 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:

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 premolded 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. Concrete will be measured for payment by the cubic yard of concrete placed, finished, cured, and accepted. Concrete used and paid for in other items of work will not be measured for payment here.

B. Concrete as above stipulated will be paid for at the Contract unit price per cubic yard for the various classifications shown on the Bid Form.

# CONSTRUCTION STANDARDS AND SPECIFICATIONS

# Division 16: Electrical

# SECTION 16550

# HIGHWAY LIGHTING

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. Installing lighting systems including standards, conductor cable, conduit, luminaries, service poles, and all accessories needed for the lighting system.

## PART 2 - PRODUCTS

### 2.01 GENERAL REQUIREMENTS

A. Lighting materials shall consist of new materials, which meet applicable TDOT, AASHTO, and ASTM Standards.

B. Furnish the Engineer a list of materials proposed for use, prior to construction.

C. Upon request, furnish samples of materials and/or notarized certificate by the manufacturer that the materials meet the requirements of these specifications and referenced standards.

### 2.02 SPUN ALUMINUM LIGHTING STANDARDS

A. An aluminum shaft having a base welded to the lower end, complete with anchor bolts.

B. Castings:

1. All structural castings - Aluminum Association Alloy 356-T6.

2. Non-structural castings - Alloy No. 43.

3. Sand castings - ASTM B-26. Permanent mold castings - ASTM B-108.

C. Shaft: spun from one piece of seamless tubing Alloy 6063, conforming to ASTM B-221, with a post-fabrication strength of T6 temper.

D. Anchor Base: one-piece cast aluminum, welded to the lower end of the shaft by the Metallic-Arc-Consumable-Electrode-Inert-Gas-Shielded Process.

E. When transformer bases are specified, cast of Aluminum Association Alloy 356-T6, conforming to ASTM B-26 or B-108.

F. When bracket arms are specified, fabricate from aluminum alloy pipe or tapered tubes.

1. Pipe: Schedule 40 pipe of Aluminum Alloy 60603-T6, ASTM B-241.

2. Tapered tubes: Aluminum Alloy 60603-T6, ASTM B-221.

3. Cast aluminum clamps: Cast of Alloy No. 43.

G. Anchor bolts: High strength structural bolts conforming to ASTM A-325 and zinc coated in conformance with ASTM A-153.

H. Hardware (bolts, nuts, and washers): Aluminum or stainless steel.

2.03 STEEL LIGHTING STANDARDS

A. A steel shaft having a base welded to the lower end complete with anchor bolts.

1. Gray iron castings: ASTM A-125, Class A, A-448, or Class 20.

2. Steel castings: ASTM A-27, Grade 65-35.

B. Anchor Bases: one-piece cast construction, secured to the lower end of the shaft by two continuous electric arc welds.

C. The shaft may have only one longitudinal electrically welded joint and shall not have any intermediate horizontal joints or welds. The shaft shall be fabricated from not less than No. 11 gauge corrosion resistant steel conforming to ASTM A-242 or ASTM A-375. Cold roll after fabrication to flatten the weld. The shaft shall have a minimum guaranteed yield strength of 48,000 psi.

D. When bracket arms are specified, fabricate from nominal two inch diameter, or larger, Schedule 40 pipe conforming to ASTM A-120 and galvanized in accordance with ASTM A-386 and A-385.

E. Anchor bolts: as specified for spun aluminum standard.

F. Hardware (bolts, nuts, and washers): stainless steel.

G. Steel light standards shall be galvanized in accordance with ASTM A-123. Galvanizing of hardware and anchor bolts shall meet the requirements of ASTM A-153.

2.04 CONDUCTOR CABLE

A. The size and type of conductor cable shall be as shown on the Plans and shall be in compliance with the National Electrical Safety Code, and local codes.

B. The conductor cable shall conform to applicable ASTM Specifications as follows:

| | Material | Designation |
|---|---|---|
| 1. | Tinned Soft or Annealed Copper Wire for Electrical Purposes | ASTM B-33 |
| 2. | Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft | ASTM B-8 |
| 3. | Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes | ASTM D-189 |
| 4. | Polyethyl Insulated Wire and Cable | ASTM D-1351 |
| 5. | Ozone-Resisting Butyl Rubber Insulation for Wire and Cable | ASTM D-574 |
| 6. | Synthetic Rubber Performance, Moisture-Resisting Insulation for Wire and Cable | ASTM D-1521 |
| 7. | Synthetic Rubber Insulation for Wire and Cable, 90 degree C. Operation | ASTM D-1523 |
| 8. | Synthetic Rubber Heat and Moisture Resisting Insulation for Wire and Cable, 75 Degree C. | ASTM D-1679 |
| 9. | Heavy-Duty Black Neoprene Sheath for Wire and Cable | ASTM D-752 |
| 10. | General Purpose Neoprene Sheath for Wire and Cable | ASTM D-753 |

C. Sample and test the cable by the procedures outlined in ASTM D-470.

2.05 PREASSEMBLED CABLE AND DUCT

A. Two rubber insulated neoprene sheathed conductors meeting the requirements of Article 2.04, laid parallel and preassembled in a polyethylene duct.

B. Polyethylene duct: manufactured from medium density polyethylene and flexible enough to allow easy coiling and uncoiling at 10 degrees Centigrade. Meeting the following requirements:

| Property | Requirement | Test Method |
|---|---|---|
| Tensile Strength | 2500 psi Minimum | ASTM D-638 |
| Elongation | 40 Percent Minimum | ASTM D-638 |
| Melt Index | 0.5 Maximum | ASTM D-1238 |
| Carbon Black Content | 1.0 to 3.0 Percent | ASTM D-1603 |
| Density of Base Resin | 0.926-0.940 | ASTM D-1505 |
| Brittle Temperature - 80% Non-Failure | -75 degrees C. | ASTM D-746 |
| Environmental Stress Crack Resistance Maximum Failure per 10 Specimens after 48 hours | 2 | ASTM D-1693 |
| Impact Resistance | 0.9 ft. lbs/in. of notch | ASTM D-256, |

2.06 METALLIC CONDUIT

A. Rigid Steel Conduit: conform to FSS WW-C-581 or ASA C-80.1 and either hot dip galvanized, metallized galvanized, electro-galvanized, or sherardized.

B. Flexible Metal Conduit: FSS WW-C-566, galvanized.

C. Aluminum Conduit: FSS WW-C-540.

D. Welded Steel Pipe: hot dipped galvanized inside and out conforming to ASTM A-120.

2.07 NON-METALLIC RIGID CONDUIT

A. Conform to Federal Specifications for conduit and fittings:

1. Bituminized homogeneous fiber, FSS W-C-581.

2. Bituminized fiber laminated wall, FSS W-C-575.

3. Asbestos cement or fire clay cement, FSS W-C-571.

4. Plastic, FSS L-C-740.

2.08 METALLIC CONDUIT FITTINGS

A. Galvanized steel conforming to WW-C-581, or ASA C-80.4.

2.09 LUMINARIES AND LAMPS

A. Luminaries shall be complete including ballast, lamps, insulating transformer, when required, and incidental hardware and wiring.

B. The luminaries shall include either mercury vapor florescent, incandescent, or sodium light sources as indicated on the Plans.

2.10 FITTINGS, PULL BOXES, AND BENDS

A. Conform to requirements of the National Electrical Code, and be compatible with adjacent conduit and materials.

2.11 RELAYS, SWITCHES, CONTROL CABINETS

A. Conform to requirements of the National Electrical Code with details shown on the Plans.

2.12 WOOD SERVICE POLES AND CROSSARMS

A. Treated Southern Pine, of the dimensions shown on the Plans, conforming to ASA 05.1.

B. The poles shall be treated with either creosote oil conforming to ASTM D-390 or pentachloro-phenol in petroleum solvent in accordance with ASTM D-1272.

C. Sampling and testing of preservative: FSS TT-W-571.

2.13 GUYING HARDWARE

A. Zinc-coated wire strand, zinc-coated anchor rod, four-way expanding anchor and accessories.

B. Wire strand: ASTM A-475.

C. The anchor rod, anchor, and accessories shall be hot dipped galvanized.

2.14 GROUNDING MATERIALS

A. As shown on the Plans.

2.15 SPLICING MATERIALS

A. As shown on the Plans.

2.16 DRAG WIRE

A. 9-gauge galvanized iron wire, unless otherwise specified.

2.17 PHOTOELECTRIC RELAYS

A. As shown on the Plans.

## PART 3 - EXECUTION

3.01 Install roadway lighting systems at the locations shown on the drawings.

3.02 Furnish all material and perform all work in strict accordance with the latest revision of the National Electrical Code, the National Electrical Safety Code, and the codes, regulations, and rules prevailing in the area in which the work is being performed, insofar as they apply.

3.03 All equipment necessary for the satisfactory performance of the work shall be on the project and approved before construction will be permitted to begin.

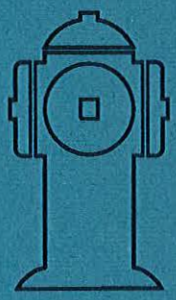
3.04 MEASUREMENT AND PAYMENT

A. Lighting system shall not be measured for payment.

B. Lighting system as above stipulated shall be paid for at the Contract lump sum price.

# DESIGN CRITERIA

# Water Distribution Systems



# DESIGN CRITERIA
# WATER DISTRIBUTION SYSTEMS

## SCOPE

The design criteria for water distribution systems presented hereafter offer basic standards for use in the design process. All of the information contained herein, as well as additional information, may be obtained from the publication *Design Criteria For Community Public Water Systems*, as published by the Division of Water Supply-Tennessee Department of Environment and Conservation.

## ENGINEER'S REPORT

An Engineer's report shall be submitted to the Tennessee Department of Environment and Conservation - Division of Water Supply (TDE&C-DWS) when it is required. The Engineer's report shall be submitted for review prior to the preparation of final plans. The Engineer's report shall be submitted at least 30 days prior to the date on which action by the TDE&C-DWS is desired. The Engineer's report shall address all applicable points as set forth by the TDE&C-DWS.

## DESIGN FACTORS

### SOURCE OF WATER SUPPLY

The source of water supply for the distribution system under design shall be thoroughly investigated to ascertain that it can supply the average and peak daily demands imposed upon it by the proposed system without loss or burden to the existing customers supplied by it.

### WATER CONSUMPTION

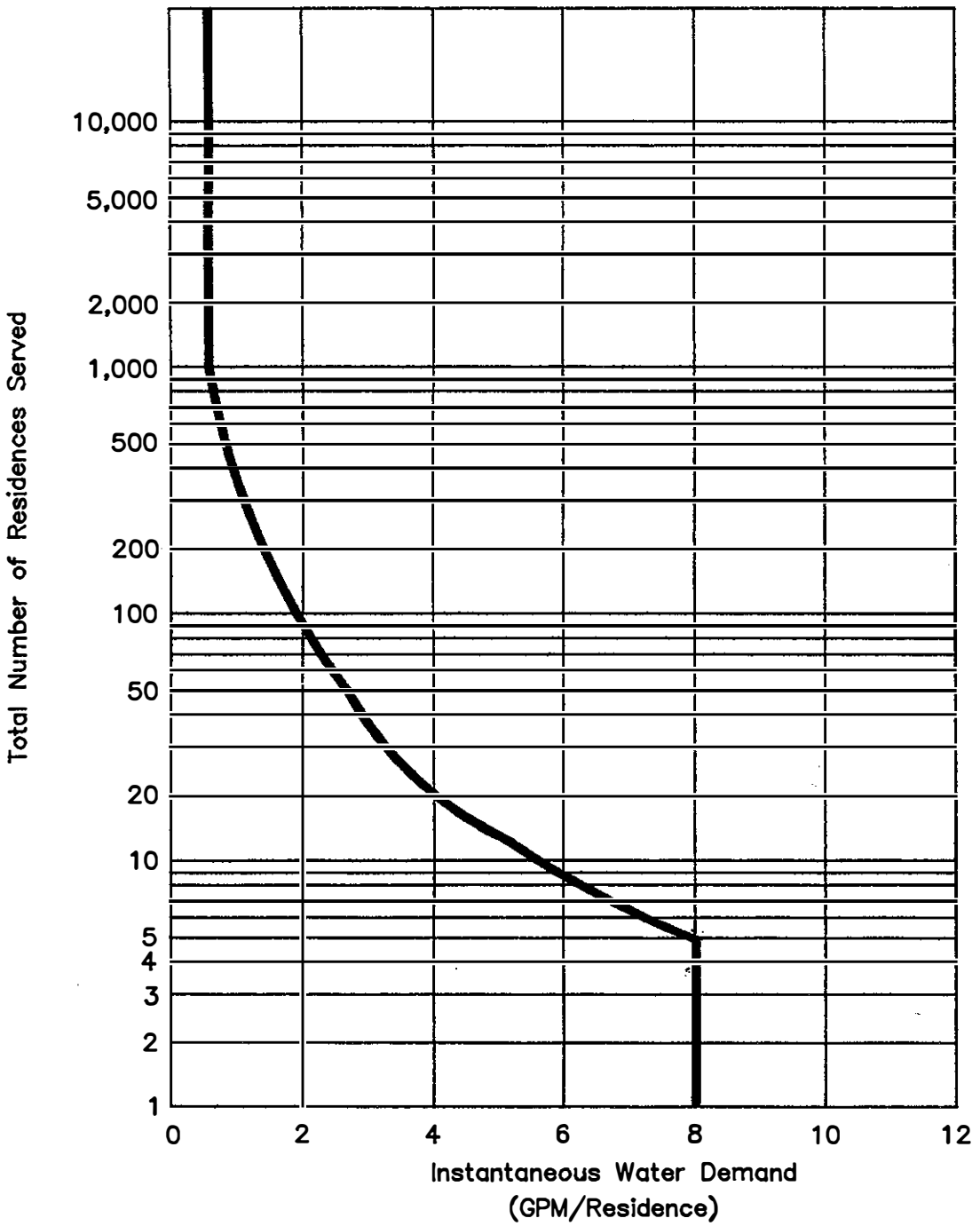
In addition to fire flow requirements, water mains and distribution systems shall be sized for normal consumption demands of 2 gallons per minute per domestic customer or as per Illustration I.

### FIRE FLOW REQUIREMENTS

A minimum fire flow of 500 gallons per minute and 20 pounds per square inch residual pressure must be available in all distribution systems containing fire hydrants. The requirements of the Insurance Services Office and related agencies shall be investigated and complied with if more stringent than the minimum flow set forth above.

ILLUSTRATION 1

DESIGN CRITERIA



## MINIMUM SIZE

The minimum size of water distribution mains shall be that which is required to provide the instantaneous peak demand plus fire flow while maintaining adequate residual pressure. The minimum size of pipe allowable by the TDE&C-DWS, where fire flow is a consideration, is 6" diameter.

## SIZING WATER MAINS

Water mains shall be sized to provide the instantaneous peak demand plus anticipated fire flow plus any foreseeable future demand while maintaining a minimum of 20 pounds per square inch residual pressure at all points in the system. The pressure losses due to friction must be calculated with storage facilities half full or pumping facilities using typical system flows as well as the flows required by the distribution mains being added. From this information, a hydraulic profile is plotted for submittal to the TDE&C-DWS. The plotting shall show the water system hydraulic gradient in relationship to the ground line at all points for the planned extensions and any pertinent points in the existing system. If advantageous, loop analysis may be performed to reduce the losses. If loop analysis is used, a Hardy-Cross or other loop analysis program shall be used. Single path friction loss is readily available from many published tables and nomographs or it may be calculated from the Hazen-Williams equation:

$$h_f = 0.002083\, L \left(\frac{100}{C}\right)^{1.85} \times \frac{gpm^{1.85}}{d^{4.8655}}$$

This equation is based on water at 60 degrees F. and the symbols used are as follows:

| | | |
|---|---|---|
| $h_f$ | = | head loss due to friction, feet of water |
| L | = | length of pipe including equivalent length for losses through fittings, feet |
| C | = | roughness coefficient |
| gpm | = | flow of water, gallons per minute |
| d | = | inside diameter of circular pipe, inches |

The C value varies widely depending on type and age of pipe. For new pipe, the maximum value allowed by TDE&C-DWS is 130.

All calculations and the hydraulic profile shall be submitted to the TDE&C-DWS for consideration during its review of the plans and specifications.

## SELECTION OF PRESSURE CLASS FOR WATER MAINS

### DETERMINATION OF MAXIMUM AND MINIMUM PRESSURES WITHIN THE SYSTEM

In the determination of the proper pressure class of pipe materials for use in the system, consideration must be given to the maximum and minimum pressures that will be encountered. The following factors must be considered when determining pressure within a system:

a. Highest and lowest elevation of pipelines.
b. High and low levels in the water storage reservoirs.
c. Booster pumping stations - suction and discharge pressures.
d. Fire flow requirements.

e. Special control valves, ie., pressure reducing valves in the system.
f. Surge allowance and water hammer.
g. Customer water usage (present and future).

Care must be exercised in evaluating all the parameters involved in the project to insure the customer adequate pressures even under very demanding flow situations.

### DUCTILE IRON PIPE

Ductile iron pipe is manufactured in seven (7) standard thickness classes, Class 50 through Class 56. The recommendations for thickness found in AWWA C-151 shall be followed.

### POLYVINYL CHLORIDE PIPE

#### General

Polyvinyl chloride (PVC) pipe for installation in water distribution systems is manufactured under one of two standards: ASTM D-2241 or AWWA C-900.

#### ASTM D-2241 Pipe

PVC pipe manufactured under ASTM D-2241 is pressure rated for each Standard Dimension Ratio (SDR). The TDE&C-DWS guidelines state that SDR 21 class 200 pressure rated pipe may be used where the working pressure will not exceed 135 psi.

#### AWWA C-900 Pipe

AWWA C-900 PVC pipe is pressure rated for each Dimension Ratio (DR). Due to its design, the full pressure rating can be utilized as working pressure. DR 14 is suitable for working pressures to 200 psi and DR 18 is suitable for working pressures to 150 psi.

### OTHER WATER PIPE MATERIALS

Water pipe materials other than those described herein which are acceptable to the TDE&C-DWS are concrete, and fiberglass composite pipe. Any of these types of pipe being considered for installation in water distribution systems shall be thoroughly investigated as to pressure rating, allowable working pressure, surge allowance, and depth of bury to determine the required pressure class.

## LOCATION OF APPURTENANCES

### CONTROL VALVES

Control valves (gate valves) shall be placed at all intersections of water mains but at no time greater than 4000 feet apart. Good practice is to limit spacing to 2500 feet.

### SAFETY VALVES

Safety valves (air release, pressure reducing, etc.) shall be installed at such locations as deemed necessary for the safe, reliable operation of the distribution system.

### FIRE HYDRANTS AND BLOW-OFFS

Fire hydrants shall be spaced as recommended by local codes, subdivision regulations, Insurance Services Office, or related agencies. Fire hydrants shall be strategically located for ease of access during fires to both the hydrant and the area served. A fire hydrant shall be located at the end of each extension for both fire protection and line flushing. In systems where fire protection is not offered, blow-off hydrants shall be installed at the end of each line and at each location required to provide adequate flushing of the mains.

## THRUST BLOCKING

Thrust forces are created in a pipeline at changes in direction, tees, dead ends, or reducers where changes in pipe size occur. Acceptable restraint methods include concrete thrust blocks, restrained joints and tie rods. The details and dimensional data for concrete thrust blocks given in Standard Drawing TBD 1 and 2 are for 100 pounds per square inch working water pressure and soil bearing load of approximately 1000 pounds per square foot. For greater pressure or less soil bearing, the quantities required will have to be recalculated, but for pressure less than 100 psi and soil bearing greater than 1000 psf, the thrust blocks shown shall be adequate.

## INSTALLATION AND ACCEPTANCE TESTING

As a minimum, the specifications shall require acceptance testing to include pressure and leakage testing. All pressure and leakage testing shall be performed in accordance with current AWWA Standard C600. Pressure tests shall be performed at a pressure of 1.5 times the working pressure at the test point and shall be maintained for two (2) hours. The leakage test shall be conducted concurrently with the pressure test to check for excessive leakage.

Allowable leakage shall be no greater than as calculated in $L = ND\sqrt{P}/7400$ where L is allowable leakage in gallons/hour, N is number of joints in test section, D is the pipe diameter in inches and P is the test pressure in psi.

All water pipe shall be flushed and disinfected in accordance with current AWWA Standard C651.

## PREPARATION OF PLANS - WATER DISTRIBUTION SYSTEMS

### GENERAL

Plans for water distribution mains must be submitted to the TDE&C-DWS for review and approval. The plans must be prepared on 24" x 36" plan sheets and the three (3) sets submitted must be of quality suitable for reproduction. Each sheet of a set of plans must bear a signed and dated imprint of a professional Engineer's seal.

### TITLE SHEET

The title sheet for a set of plans generally contains the following: name of project, name of municipality, area to be served, municipal official's names, index of drawings, date, address and names of the design Engineer (in addition to seal), and signature of approval by the appropriate utility official.

### GENERAL LAYOUT SHEET

The general layout sheet shall include a large-scale map of the entire distribution system showing the corporate or utility district boundaries. Existing and planned utilities shall be shown with line sizes noted and easily distinguishable between existing and planned. The layout sheet shall incorporate both a north arrow and scale and if the area to be served is obscure, a location plan shall be provided showing the municipality or utility district in relation to surrounding towns, streams, and noted landmarks.

### PLAN SHEETS

The plan sheets shall be drawn at a scale not greater than 1 inch equals 200 feet and be complete with north arrow, scale, street and road names, existing utilities, planned utilities, and installation notes with locations shown for all valves, hydrants, and other appurtenances. The plan sheets shall also provide adequate descriptions of any features not otherwise covered by the specifications. The planned water distribution mains shall have adequate notes and stationing system to aid in the location of the water lines and appurtenances.

## DETAIL SHEETS

Any feature of construction which requires additional clarification to that shown on the plan sheets shall be drawn in detail on the detail sheets. Each detail shall cover thoroughly the dimensions, equipment, materials, method of construction, and any clarifying notes to aid in construction of the item.

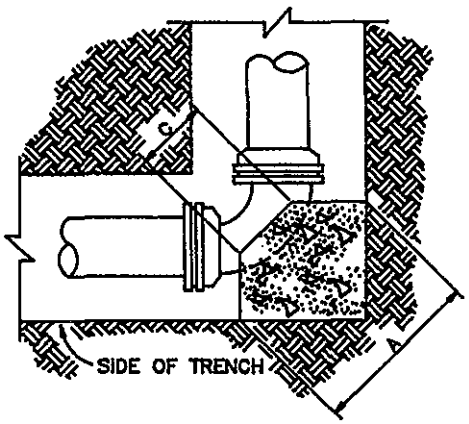
## AS-CONSTRUCTED DRAWINGS

Following the end of construction of the water distribution mains, the tracings shall be revised to reflect any deviations from the plans and provide the precise field location of the water mains, valves, hydrants, services, and other appurtenances. Permanent reproducible copies of the As-Constructed drawings shall be submitted to the TDE&C-DWS, City or Utility Officials, while the Engineer shall keep the tracings available for future reference.

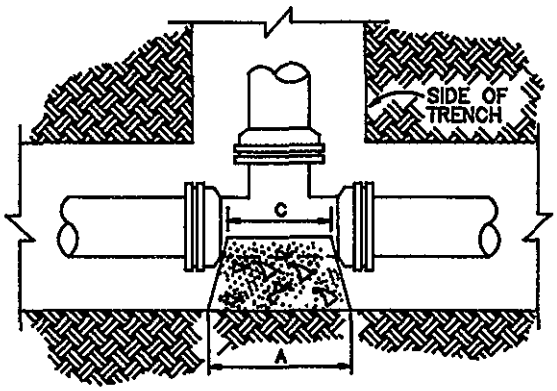
## WATER DISTRIBUTION SYSTEM

## STANDARD DRAWINGS

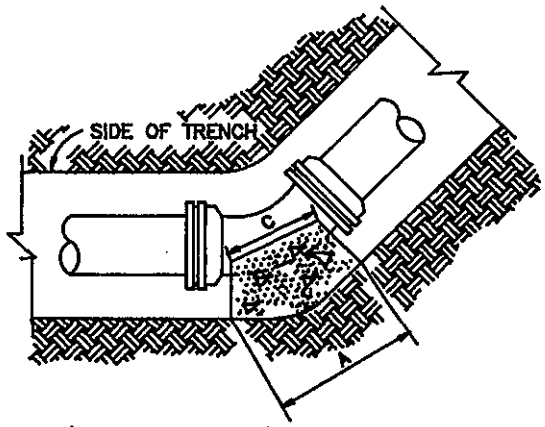
The following drawings supplement the design criteria. Some are referenced in the criteria, while others need no discussion.




90° BEND

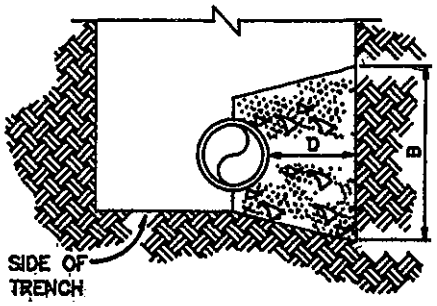



TEE

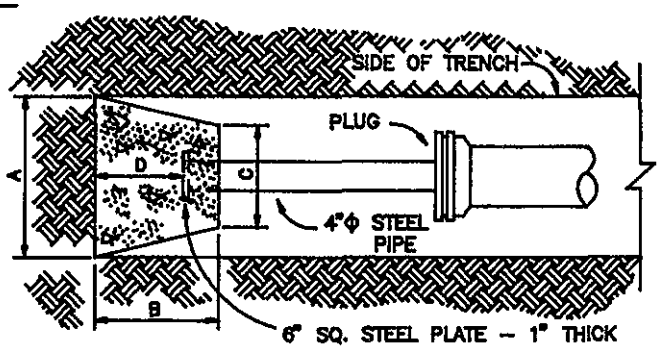



45°– 22 1/2°– 11 1/4° BENDS

NOTE: THRUST BLOCK TO BE POURED AGAINST UNDISTURBED EARTH.
SEE TBD2 FOR SIZE




TYPICAL SECTION




PLUG

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | THRUST BLOCKING DETAILS | DRAWING NO. TBD 1 |
|---|---|---|---|

TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS

REVISED:

THRUST BLOCKING DIMENSIONS

DRAWING NO. TBD2

# THRUST BLOCKING DIMENSIONS

| 90° BEND | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | 2" | 4" | 6" | 8" | 10" | 12" | 18" |
| A | 16" | 16" | 26" | 33" | 40" | 50" | 70" |
| B | 16" | 16" | 24" | 33" | 40" | 50" | 70" |
| C | 9" | 9" | 12" | 12" | 15" | 16" | 22" |
| D | 8" | 8" | 12" | 16" | 20" | 25" | 24" |

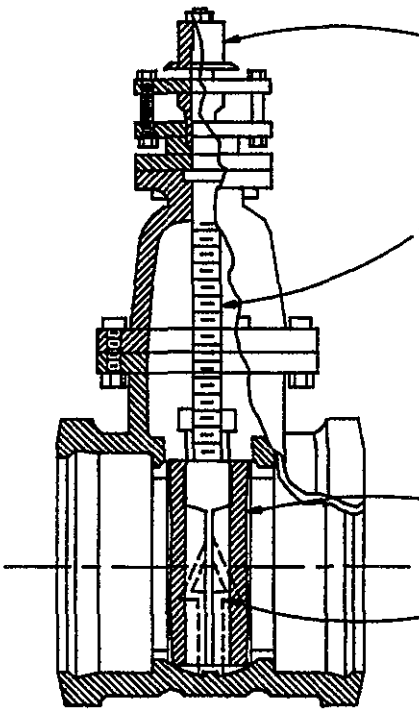
| 11-1/4° BEND | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | 2" | 4" | 6" | 8" | 10" | 12" | 18" |
| A | 9" | 9" | 11" | 13" | 16" | 18" | 30" |
| B | 9" | 9" | 11" | 13" | 16" | 18" | 30" |
| C | 8" | 8" | 10" | 12" | 14" | 16" | 15" |
| D | 4" | 4" | 5" | 6" | 8" | 9" | 16" |

| 45° BEND | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | 2" | 4" | 6" | 8" | 10" | 12" | 18" |
| A | 12" | 12" | 18" | 24" | 31" | 37" | 52" |
| B | 12" | 12" | 18" | 24" | 31" | 37" | 52" |
| C | 8" | 8" | 10" | 12" | 14" | 16" | 14" |
| D | 6" | 6" | 9" | 12" | 15" | 18" | 18" |

| 22-1/2° BEND | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | 2" | 4" | 6" | 8" | 10" | 12" | 18" |
| A | 9" | 9" | 13" | 18" | 23" | 26" | 40" |
| B | 9" | 9" | 13" | 18" | 23" | 26" | 40" |
| C | 8" | 8" | 10" | 12" | 14" | 16" | 15" |
| D | 4" | 4" | 6" | 9" | 11" | 13" | 16" |

| | TEE | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | | | | | | | |
| Main | 2"-6" | 8"-12" | 8"-10" | 12" | 12" | 12" | 18" |
| Branch | 2"-6" | 2"-6" | 8"-10" | 2"-6" | 8"-10" | 12" | 16"-18" |
| A | 26" | 26" | 43" | 26" | 43" | 52" | 70" |
| B | 26" | 26" | 43" | 26" | 43" | 52" | 70" |
| C | 12" | 12" | 12" | 12" | 12" | 12" | 30" |
| D | 13" | 13" | 21" | 13" | 21" | 26" | 24" |

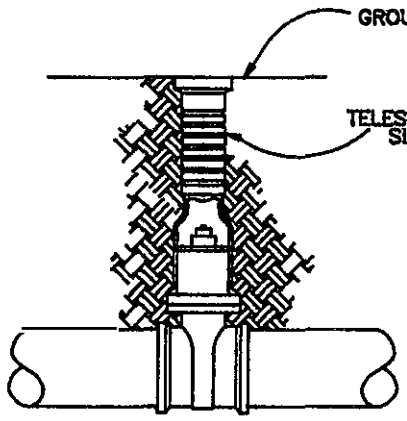
| PLUG | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | 2" | 4" | 6" | 8" | 10" | 12" | 18" |
| A | 26" | 26" | 26" | 34" | 43" | 52" | 70" |
| B | 26" | 26" | 26" | 34" | 43" | 52" | 70" |
| C | 12" | 12" | 12" | 12" | 12" | 12" | 30" |
| D | 11" | 11" | 11" | 15" | 22" | 32" | 32" |




NOTE: THIS MODEL USES DOUBLE DISCS. THE SOILD WEDGE TYPE HAS THE ADVANTAGES OF LOW COST AND LOW HEAD LOSS PLUS BEING MORE DURABLE.

GATE VALVE SECTION

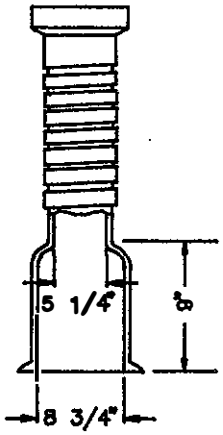
(CLOSED)




VALVE & BOX INSTALLED

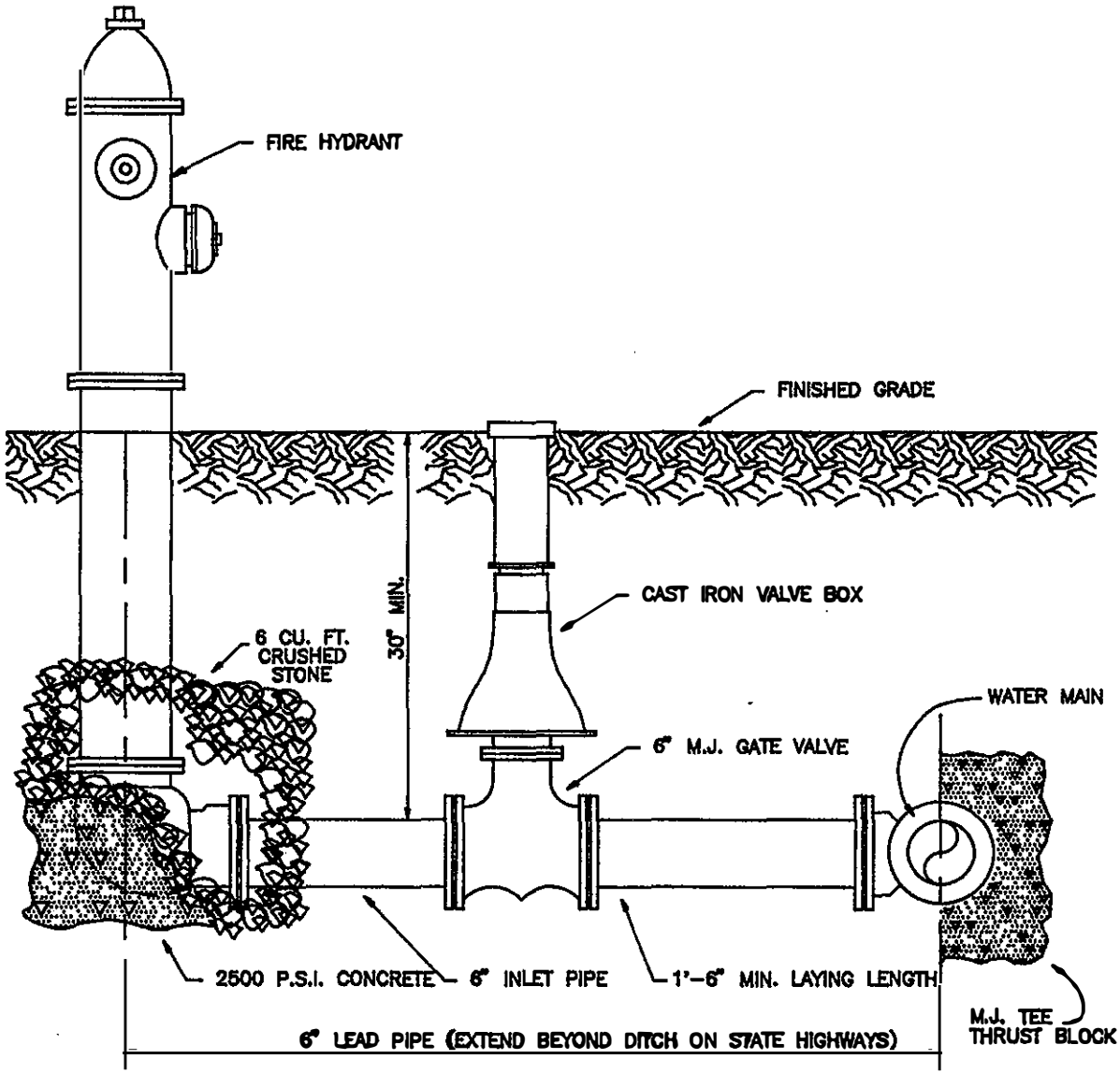

VALVE BOX LID

CAST IRON, TWO PIECE, SCREW TYPE



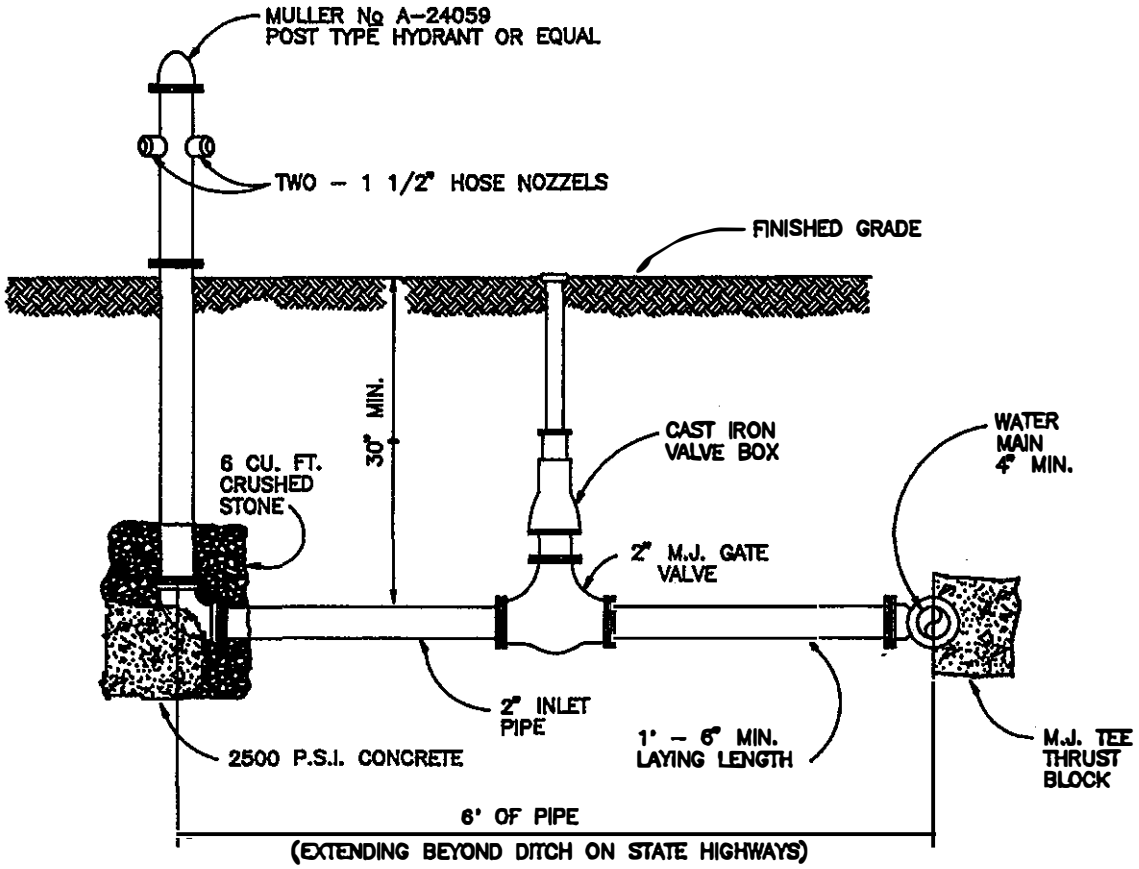

SCREW TYPE VALVE BOX

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | GATE VALVE & VALVE BOX | DRAWING NO. GV–VB 1 |
|---|---|---|---|




FIRE HYDRANT INSTALLATION

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | FIRE HYDRANT ASSEMBLY | DRAWING NO. FHA 1 |
|---|---|---|---|




BLOWOFF ASSEMBLY

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | BLOWOFF HYDRANT ASSEMBLY | DRAWING NO. BHA 1 |
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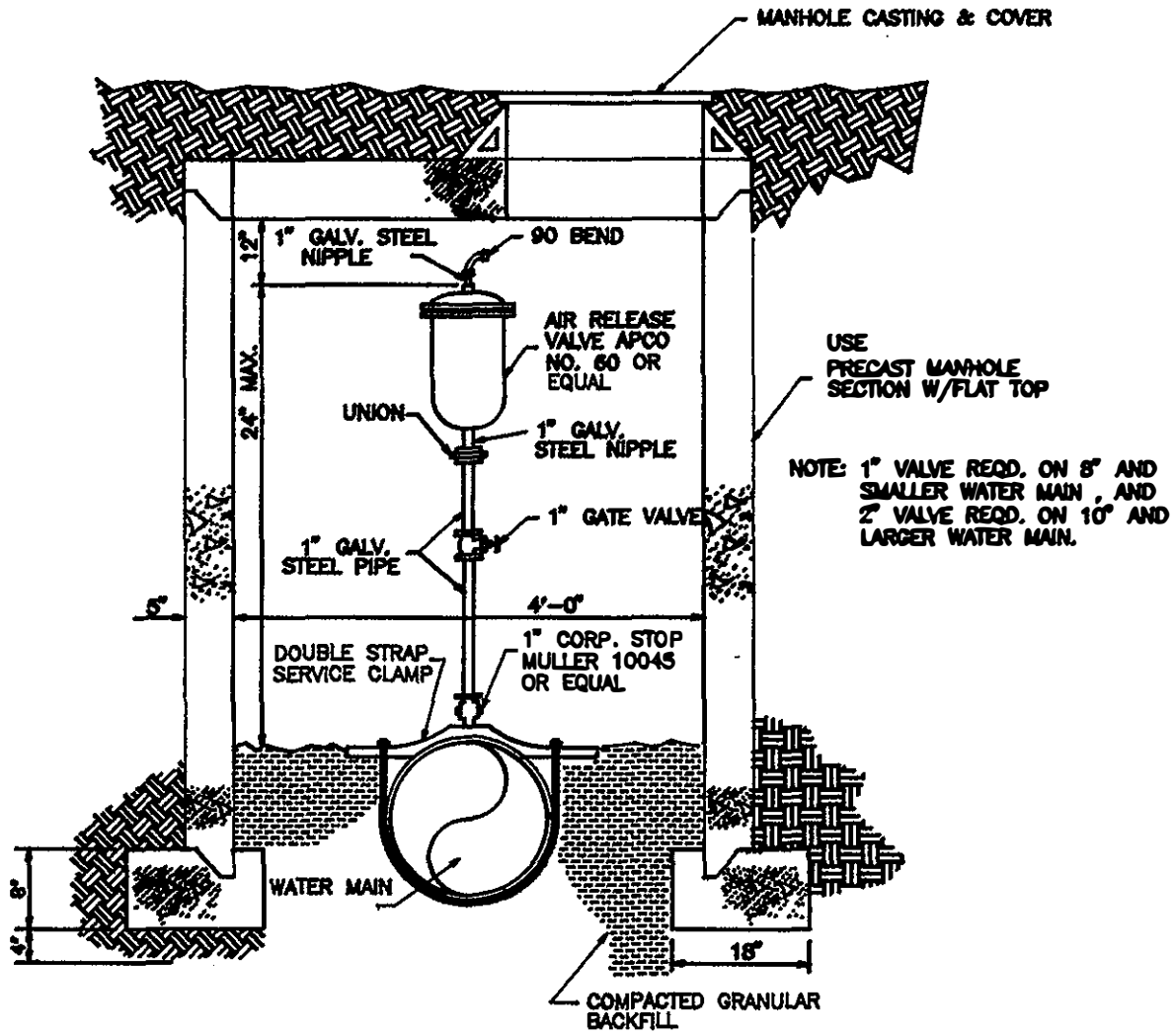
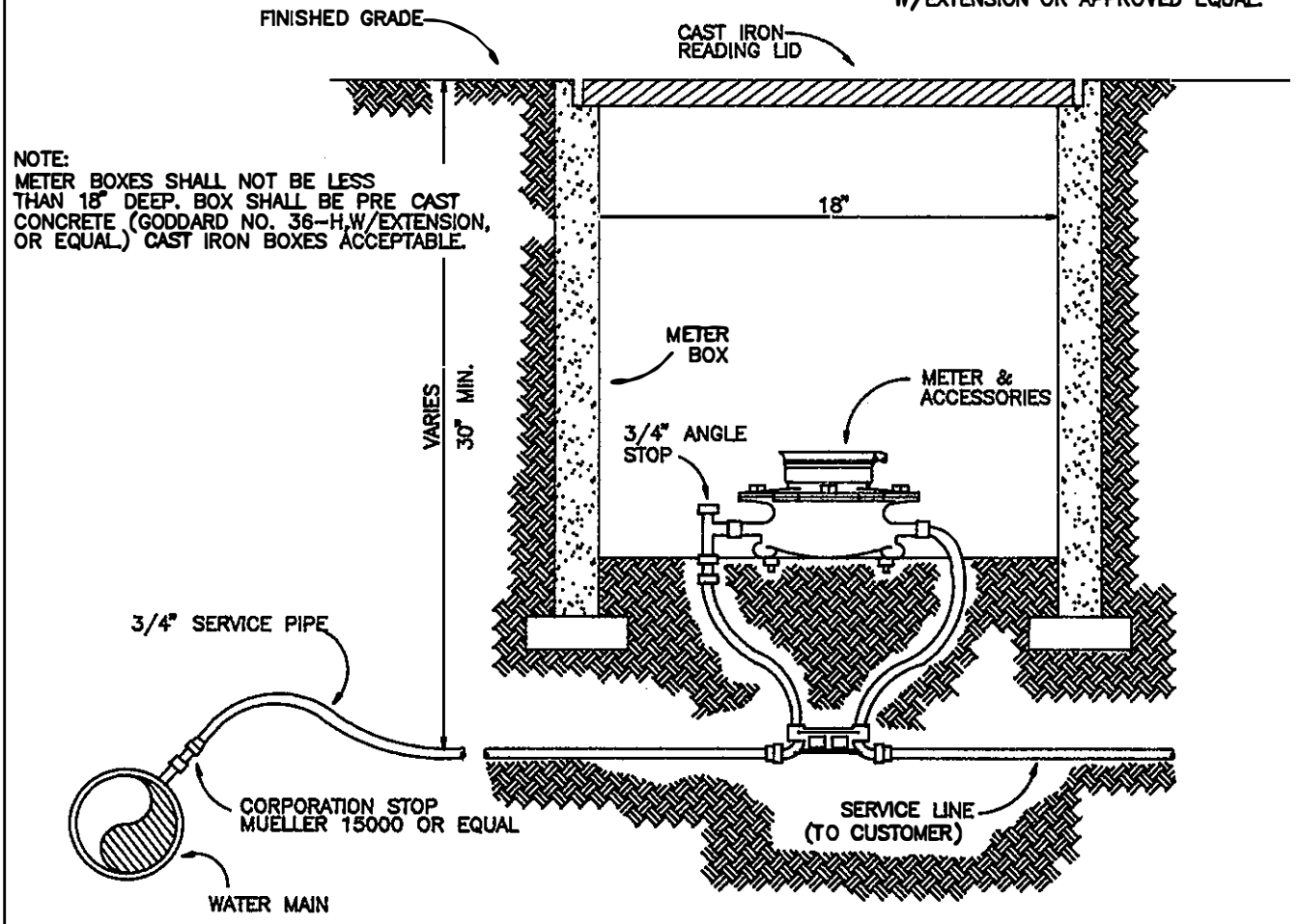



AIR RELEASE VALVE ASSEMBLY

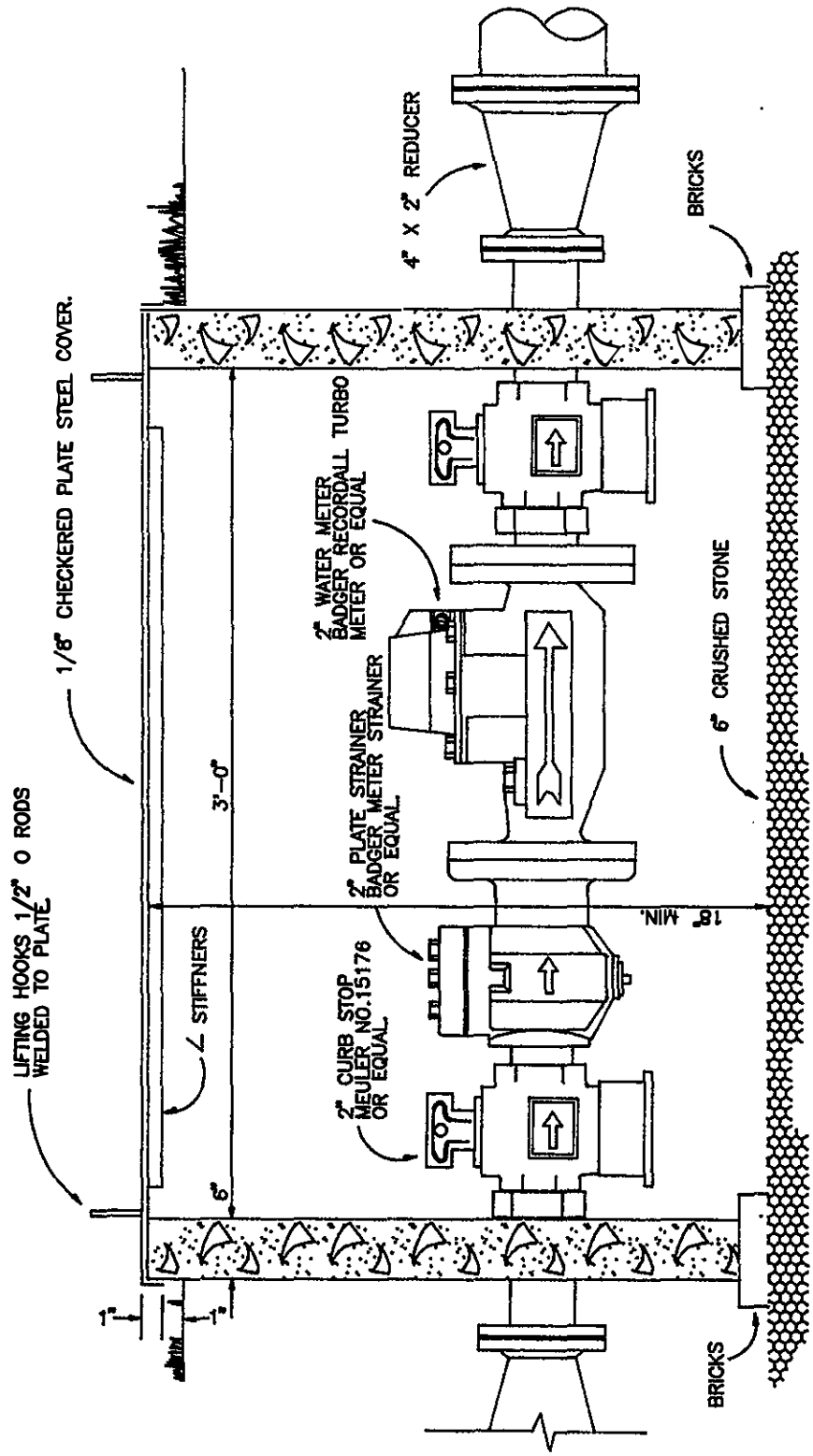
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | AIR RELEASE VALVE ASSEMBLY | DRAWING NO. AR–VA 1 |
|---|---|---|---|

METERS FURNISHED WITH PRESSURE REDUCING VALVES SHALL BE INSTALLED IN GODDARD NO. 37H METER BOXES W/EXTENSION OR APPROVED EQUAL.




WATER METER INSTALLATION

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | WATER SERVICE ASSEMBLY 5/8" x 3/4" METER | DRAWING NO. WSA 1 |
|---|---|---|---|

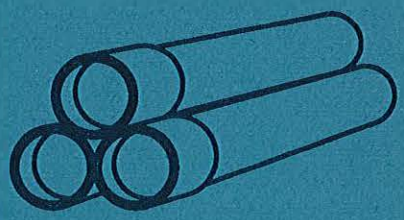



WATER METER VAULT ASSEMBLY

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | WATER SERVICE ASSEMBLY 2" METER | DRAWING NO. WSA 2 |
|---|---|---|---|

# DESIGN CRITERIA

# Wastewater Systems



# DESIGN CRITERIA

# WASTEWATER SYSTEMS

## SCOPE

This section pertains to the requirements for submitting plans and specifications to the Tennessee Department of Environment and Conservation in order to obtain approval to construct sanitary sewers.

Much of the design criteria presented has been taken from Chapter 2, State of Tennessee, Design Criteria for Sewage Works.

## ENGINEER'S REPORT

An Engineer's report shall be submitted to the Tennessee Department of Environment and Conservation - Division of Water Pollution Control (TDE&C-WPC) when it is required by the funding agency and when a sewage collection system is being created or expanded. The engineer's report shall be submitted for review prior to the preparation of final plans. The Engineer's report shall be submitted at least 30 days prior to the date on which action by the TDE&C-WPC is desired. The Engineer's report shall address all appropriate points as set forth by the TDE&C-WPC.

## PLANNING FACTORS

### GENERAL

In general, and except for special reasons, Tennessee Department of Environment and Conservation (TDE&C) will approve plans for new systems or extensions for existing systems. Design criteria and hydraulic calculations must be submitted on all projects. Rainwater from roofs, streets, and other areas, and ground water from foundation drains shall be excluded from the wastewater collection system.

### DESIGN PERIOD

In general, sewer systems shall be designed for the estimated ultimate tributary population except when considering parts of the system that can be readily increased in capacity. Similarly, consideration shall be given to the maximum anticipated capacity of institutions.

### DESIGN FACTORS

In determining the required capacity of sanitary sewers, the following factors shall be considered:

Maximum hourly quantity of wastewater.
Additional maximum wastewater from industrial plants.
Ground water infiltration.

### DESIGN BASIS

Per capita flow: New sewer systems shall be designed on the basis of an average daily per capita flow of wastewater of not less than 100 gallons per day when no water use information is available. This figure is assumed to cover normal infiltration, but an additional allowance shall be made where conditions are unfavorable. Generally, the sewers shall be designed to carry, when running full, not less than the following daily per capita contributions of wastewater, exclusive of wastewater from industrial plants:

Laterals and sub-main sewers: 400 gallons
Main, trunk, and outfall sewers: 250 gallons

Alternate method: When the need for deviations from the foregoing per capita rates is demonstrated, a brief description of the procedure used for sewer design shall be submitted to the Tennessee Department of Environment and Conservation.

## DETAILS OF DESIGN AND CONSTRUCTION - GRAVITY MAINS

### GENERAL

This section pertains to the considerations to be made in designing gravity sewer mains.

### MINIMUM SIZE

No public sewer shall be less than eight inches in diameter. Sewer service pipe shall be either 4" or 6" in diameter.

### DEPTH

In general, sewers shall be deep enough to drain basement wastewater only and to prevent freezing.

### SLOPE

All sewers shall be so designed and constructed to give mean velocities, when flowing half full, of not less than 2.0 feet per second, based on using an "n" of 0.013 for full flow in Mannings formula. The required minimum slopes are as follows:

| Sewer Size | Required Minimum Slopes (feet/100 feet) |
|---|---|
| 8 | 0.40 |
| 10 | 0.28 |
| 12 | 0.22 |
| 14 | 0.17 |
| 15 | 0.15 |
| 16 | 0.14 |
| 18 | 0.12 |
| 21 | 0.10 |
| 24 | 0.08 |
| 27 | 0.07 |
| 30 | 0.06 |
| 36 | 0.05 |

### ALIGNMENT

Sewers 24 inches or less shall be laid with straight alignment between manholes.

INCREASING SIZE

When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

PIPE MATERIALS SELECTION

Where velocities greater than 15 feet per second or a slope greater than 18.86% (for 8") are attained, special provisions shall be made to protect against displacement by erosion and shock. Ductile iron pipe or similar material shall be used with mechanical joints and concrete anchors.

Any generally accepted material for sewers should be given consideration, but the material selected shall be adapted to local conditions, such as character of industrial wastes, possibility of septicity, discharge of force mains, soil characteristics, abrasion, and similar problems. Careful consideration should be given to pipes and compressive joint materials which are not chemically inert when they will be required to carry corrosive or solvent wastes. Such pipe material shall be evaluated for vulnerability to chemical attack, chemical/stress failure, and stability in the presence of common household chemicals such as cooking oils, detergents, and drain cleaners.

Rigid Pipe shall include, but not be limited to, vitrified clay, concrete, and cast iron pipe. Any rigid pipe shall have a minimum crushing strength of 2000 pounds per lineal foot. All pipe should meet the appropriate ASTM and/or ANSI specifications.

Semi-rigid Pipe shall include, but not be limited to, ductile iron. All pipe should meet the appropriate ASTM and/or ANSI specifications.

Flexible Pipe shall include, but not be limited to, ABS solid wall pipe, polyvinyl chloride pipe (PVC), polyethylene pipe (PE), fiberglass composite pipe, reinforced plastic mortar pipe (RPM) and reinforced thermosetting resin pipe (RTR). PVC pipe should have a maximum Standard Dimension Ratio (SDR) of 35. All other flexible pipe that is not classified by the SDR system should have the same calculated maximum deflection under identical conditions as the SDR 35 PVC pipe.

Flexible pipe deflection under earth loading may be calculated using the formula presented in the ASCE/WPCF publication, Design and Construction of Sanitary and Storm Sewers.

All pipe should meet appropriate ASTM and/or ANSI specifications. It should be noted that ASTM D-3033 and D-3034 PVC pipes differ in wall thickness and have non-interchangeable fittings.

PIPE JOINTS

The method of making joints and the materials used should be included in the specifications. Sewer joints shall be designed to eliminate infiltration and to prevent the entrance of roots.

Elastomeric gaskets and other types of premolded (factory made) joints are required. Cement mortar joints and field solvent welds for pipe and fittings are not acceptable.

PIPELINE BEDDING

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made because of the width and depth of the trench. Backfill material up to 3 feet above the pipe shall not exceed 6 inches in diameter at its greatest dimension. As a general rule, in roadways where cover is less than 4 feet, or in open areas where cover is less than 2 1/2 feet, ductile iron pipe or concrete encasement shall be used. For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer is less than 18 inches below the bottom of the culvert or conduit.

All pipe shall be bedded and completely encapsulated at minimum of 6 inches below the pipe to 6 inches above the top of the pipe with crushed stone or other approved Class I material.

## MANHOLES

### LOCATION

Manholes shall be installed at the upper end of each line, at all changes in grade, size, or alignment, at all intersections, and at distances not greater than 350 feet. Greater spacing may be permitted in larger sewers and in those carrying a plant effluent. Systems equipped with proper tools and equipment may be allowed a greater distance between manholes when conditions warrant the need.

### DROP MANHOLES

A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent deposition of solids.

### SIZE

The minimum diameter of manholes shall be 4 feet. It is recommended that 4 feet be used for 8-15 inch pipe, 5 feet be used for 18-24 inch pipe, and 6 feet for larger. The minimum clear opening in the manhole frame shall be at least 24 inches in diameter.

### FLOW CHANNELS

Flow channels in manholes shall be of such shape and slope to provide smooth transition between inlet and outlet sewers and to minimize turbulence. Channeling height shall be to the crowns of the sewers. benches shall be sloped from the manhole wall toward the channel to prevent accumulation of solids.

### BASE CONSTRUCTION

Except for poured-in-place manholes, all bases shall be precast sections with preformed openings for rubber boots or cast-in-place rubber boots.

All manholes shall be placed on a sub-base foundation constructed from crushed stone or gravel. A poured concrete sub-base foundation should be used in extremely bad conditions.

## INSTALLATION AND ACCEPTANCE TESTING

As a minimum, the specifications shall require acceptance testing to include visual, leakage, and where flexible pipe is selected, deflection testing. Detailed specifications for acceptance testing are stipulated in the technical specifications.

Before acceptance, each reach shall be visually inspected from manhole to manhole for grade, alignment, and defective materials or workmanship.

Low pressure air testing for all pipe shall be performed as specified in ASTM C-828.

All manholes shall be subjected to a vacuum test as specified in the detail specifications.

Non-rigid pipe shall be tested for proper backfill support by pulling a go/no-go mandrel or similar device through the pipeline.

## PROTECTION OF WATER SUPPLIES

### WATER SUPPLY INTERCONNECTIONS

There shall be no physical connection between a public or private potable water supply system and a sewer or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply.

### RELATION TO WATERWORKS STRUCTURES

Sewers shall be kept remote from public water supply wells or other water supply sources and structures.

Relations to Water Mains

Horizontal Separation: Whenever possible, sewers shall be laid at least 10 feet horizontally, from any existing or proposed water main. The distance should be measured edge to edge. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if it is laid in a separate trench and if the elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.

Vertical Separation: Whenever sewers must cross under water mains, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide this separation or reconstructed with mechanical joint pipe to provide a distance of 10 feet to the joint on either side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer shall be constructed of water main pipe and shall be pressure-tested to assure watertightness.

### RELATION TO STREAMS

Location of Sewers in Streams

The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, the following cover requirements must be met:

a. One (1) foot of cover (concrete) is required where the sewer is located in rock.

b. Three (3) feet of cover is required in stabilized stream channels.

c. Seven (7) feet of cover or more is required in shifting stream channels.

Sewers located along streams shall be located outside of the stream bed and sufficiently removed therefrom to minimize disturbance or root damage to streamside trees and vegetation.

Sewer outfalls, headwalls, manholes, gateboxes or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.

Sewers crossing streams shall be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade.

Construction

Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints, concrete encased, or shall be so otherwise constructed that they will remain watertight and free from changes in alignment or grade. Sewer systems shall be designed to minimize the number of stream crossings. The construction methods that will minimize siltation shall be employed. Upon completion of construction, the stream shall be returned as nearly as possible to its original condition. The stream banks shall be seeded, planted or other erosion prevention methods employed to prevent erosion. Stream banks shall be sodded, if necessary, to prevent erosion. Where tree canopy has been removed, replacement trees shall be planted of natural species.

During construction, the contractor shall be prohibited from unnecessarily disturbing or uprooting trees and vegetation along the stream bank and in the vicinity of the stream, dumping of soil and debris into streams and/or on banks of streams, changing course of the stream without encroachment permit, leaving cofferdams in streams, leaving temporary stream crossings for equipment, operating equipment in the stream, or pumping silt-laden water into the stream.

Provisions shall be made to retard the rate of run-off from the construction site and control disposal of run-off, including liberal use of silt fencing to trap sediment resulting from construction in temporary or permanent silt-holding basins, including pump discharges resulting from dewatering operations; to deposit out of the flood plain area all material and debris removed from the stream bed.

Cleanup, grading, seeding, planting, or restoration of work area shall be carried out as early as practical as the construction proceeds.

Uncased borings are not permitted.

Special Construction Requirement

Special design requirements shall be employed to prevent stream drainage from sinking at the crossing and following along the sewer pipe bedding. This can be accomplished with an in-trench impounding structure of compacted clay.

Aerial Crossings

Sewers laid on piers across ravines or streams shall be allowed when no other practical alternative exists or when other methods will not be as reliable.

Support shall be provided for all joints. All supports shall be designed to prevent frost heave, overturning or settlement. Precautions against freezing, such as insulation or increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. The impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50) year flood stage.

Permits

It is the owner's responsibility to obtain all necessary permits along streams or rivers; i.e., Corps of Engineers, TVA, or the Natural Resources Section of the Division of Water Pollution Control.

## APPURTENANCE

Service connections may have been accommodated by providing well-marked and recorded tees and/or wyes in the mains as they were constructed. Where tees or wyes exist, they shall be used for connecting new services.

When tapping an existing line (where a tee or wye does not exist), a special machine for tapping sewers shall be used. A tapping saddle shall be used to make a watertight connection.

## PREPARATION OF PLANS - SANITARY SEWER FACILITIES

### GENERAL

Each plan sheet shall bear an appropriate title block showing the name of the project, location, owner, engineer, date, scale in feet, true north (or plant north with true reference) where applicable, sheet number and revision data.

Each sheet shall contain a blank area at least 3" x 4" near the title block for imprinting the official "Approved for Construction" stamp of TDE&C. Plans shall be clear and legible and shall conform to the requirements of the Regulations. Plans shall be printed, on sheets approximately 24 inches by 36 inches, with all sheets the same size. All sheets shall bear the stamp and signature of a professional Engineer licensed to practice sanitary engineering by the State of Tennessee.

### GENERAL PLAN

A plot plan of the existing and proposed sewers shall be submitted for projects involving new sewer systems or substantial additions to existing systems. This plan shall show the following:

Geographical Features

Topography and elevations - existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals shall be included.

Streams - the direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown.

Boundaries - the boundary lines of the Owner's property, municipality, sewer district, or area to be sewered shall be shown.

Sewers

The plans shall show the location, size, and direction of flow of all existing and proposed sewers draining to the treatment works concerned. Hydraulic calculations are required for all lines in the project. All lines receiving discharge from the project shall be shown to be adequate. A vicinity map must accompany all sewer line extensions showing the flow route to the treatment facilities. Hydraulic calculations of pumping stations and sewer lines must be furnished, taking into consideration existing loading plus projected loading from developments under construction as well as the projected loading from the proposed extension.

### DETAIL PLANS

Detail plans shall be submitted. Plans and profiles are required for all wastewater lines. Profiles shall have a horizontal scale of not more than 100 feet to the inch. The plan view shall be drawn to a corresponding horizontal scale. Plans and profiles shall be drawn on the same sheet and will show:

a. Location of streets and sewers.
b. Line of ground surface, size, material, and type of pipe, length between manholes, inverts, and surface elevation at each manhole, and grade of sewer between each two adjacent manholes. All manholes shall be numbered on the plans and correspondingly numbered on the profiles. Where there is any question of the sewer being sufficiently deep to serve any residence or other source, the elevation and location of the basement floor or other low point source shall be plotted on the profile of the sewer which is to serve the house or source in

question. The engineer shall state that all sewers are sufficiently deep to serve adjacent basements or sources except where otherwise noted on the plans.

c. Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, etc.

d. All known existing structures both above and below ground which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, etc.

e. Special detail drawings, made to a scale to clearly show the nature of the design, shall be furnished to show the following particulars:

   1) All stream crossing and sewer outlets, with elevations of the stream bed and of normal and extreme high and low water levels to include the 100 year flood plain.
   2) Details of all special sewer joints and cross sections.
   3) Details of all sewer appurtenance such as manholes, inspection chambers, flush valves, inverted siphons, regulators, tide gates, and elevated sewers.

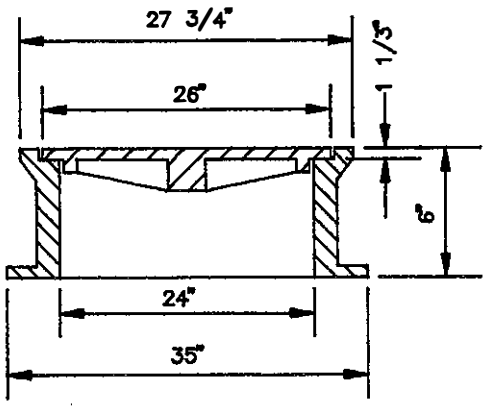
AS-CONSTRUCTED DRAWINGS

Following the end of construction of the wastewater facilities, the tracings shall be revised to reflect any deviations from the plans and provide the precise field location of the water mains, valves, hydrants, services, and other appurtenances. Permanent reproducible copies of the As-Constructed drawings shall be submitted to the TDE&C-WPC and City or Utility Officials, while the Engineer shall keep the tracings available for future reference and additional prints if required.

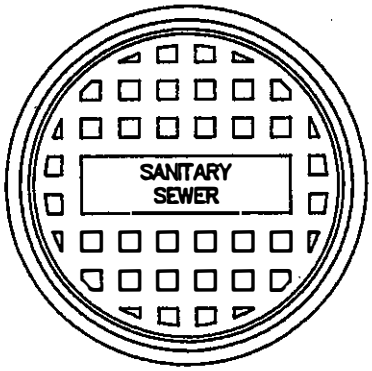
## WASTEWATER SYSTEM

## STANDARD DRAWINGS

The following drawings supplement the design criteria. Some are referenced in the criteria, while others need no discussion.



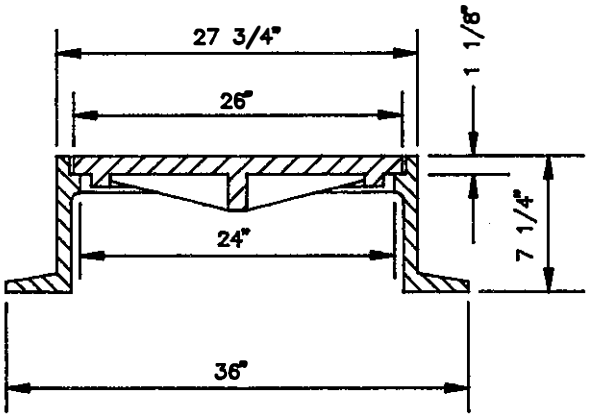

SECTION



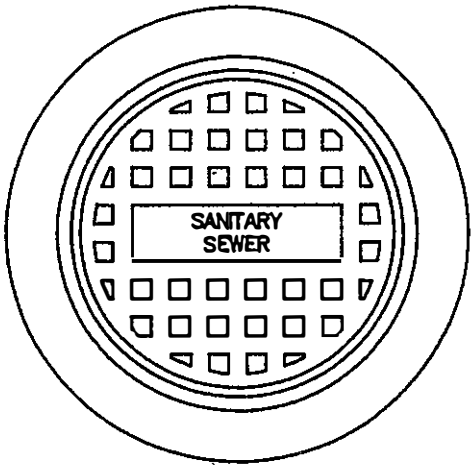

TOP VIEW

NON–TRAFFIC

RING 160 lbs.
COVER 180 lbs.
TOTAL 340 lbs.




SECTION



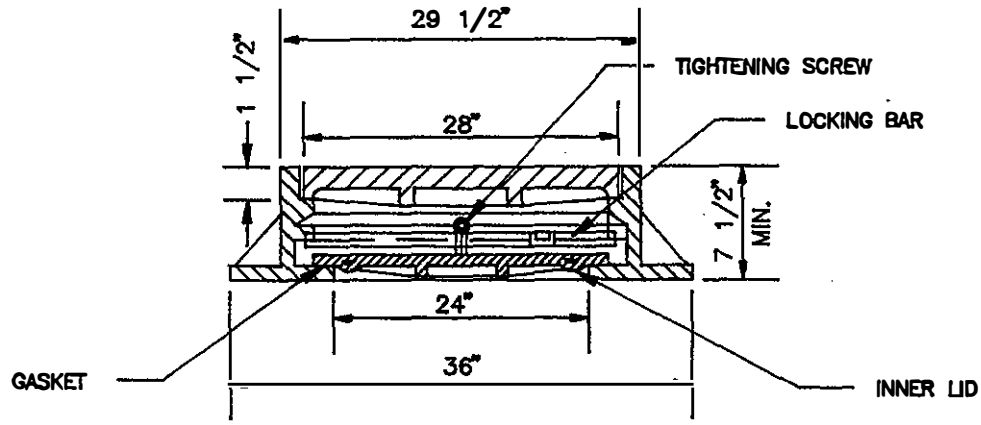

TOP VIEW

TRAFFIC

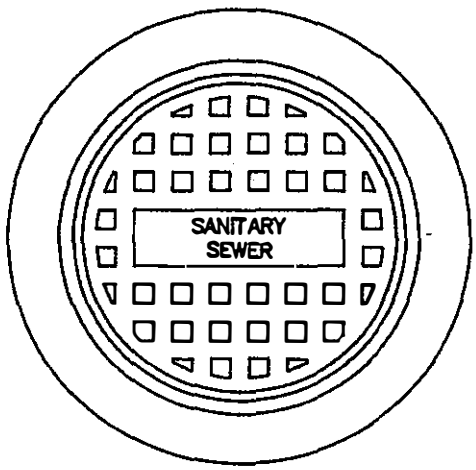
RING 253 lbs.
COVER 180 lbs.

TOTAL 415 lbs.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | TRAFFIC & NON–TRAFFIC MANHOLE FRAME & COVER | DRAWING NO. MH–FC 1 |
|---|---|---|---|




SECTION




TOP VIEW

WATERTIGHT MANHOLE

TOTAL WEIGHT 500 lbs.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | WATERTIGHT MANHOLE FRAME & COVER | DRAWING NO. MH–FC 2 |
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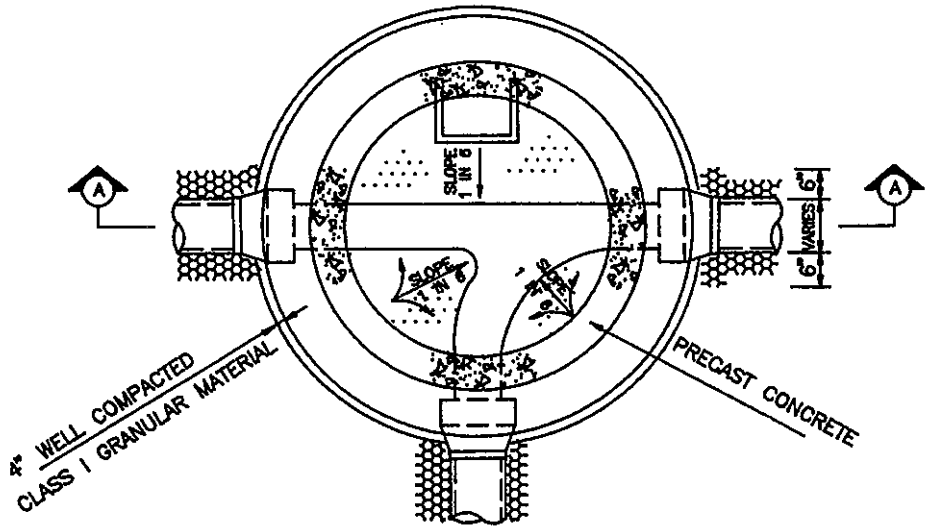
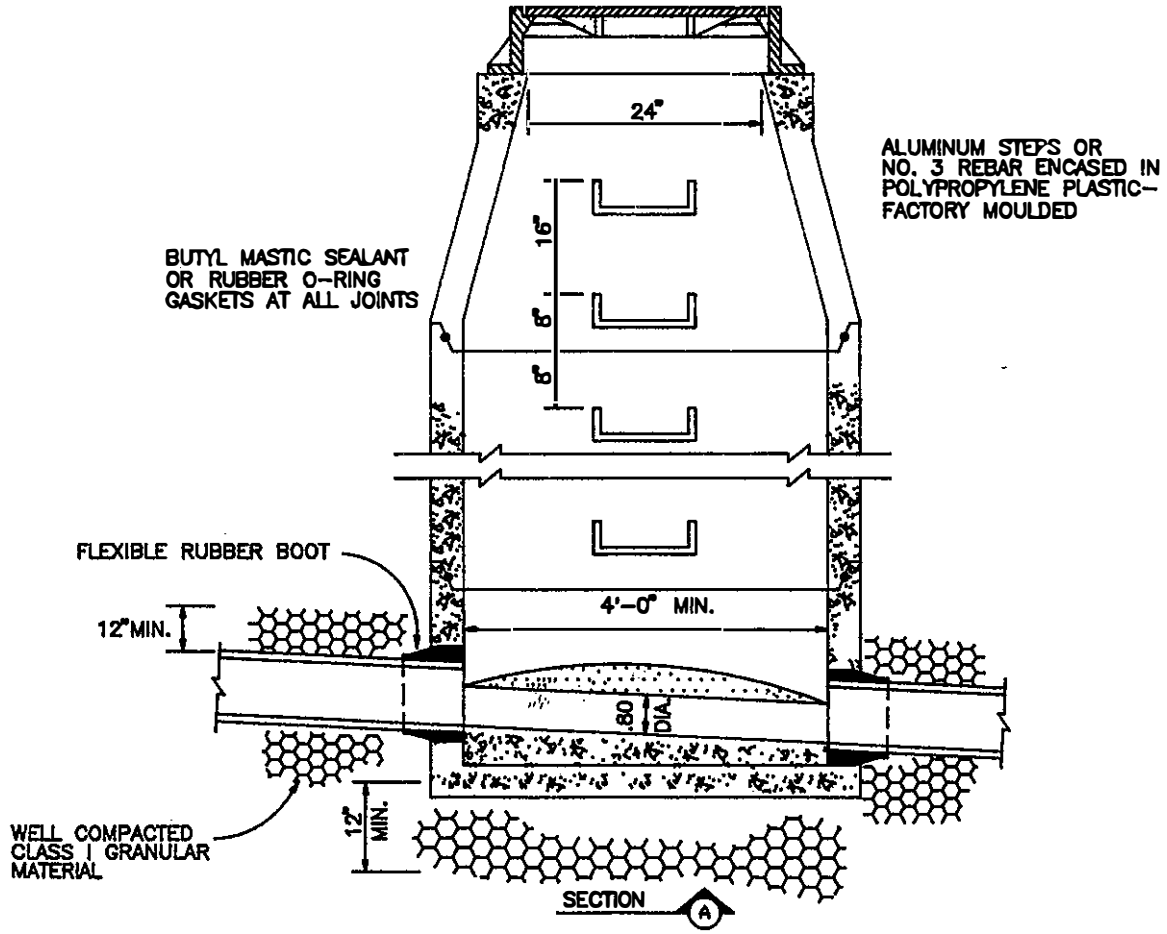
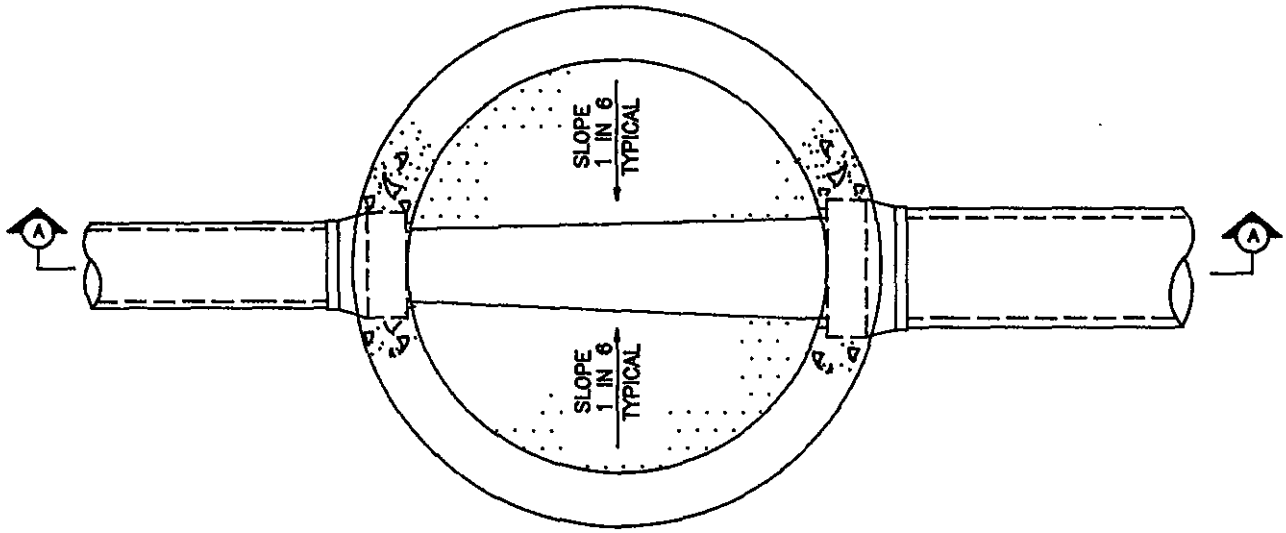


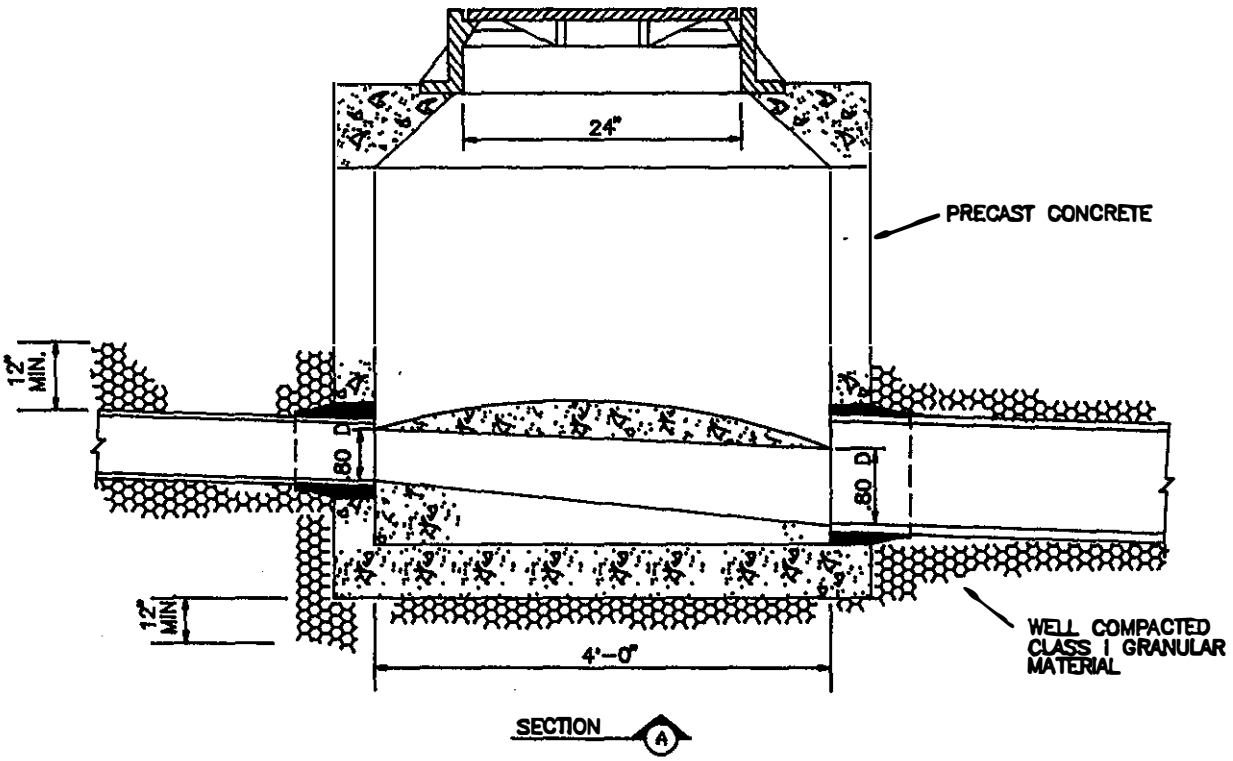

PLAN



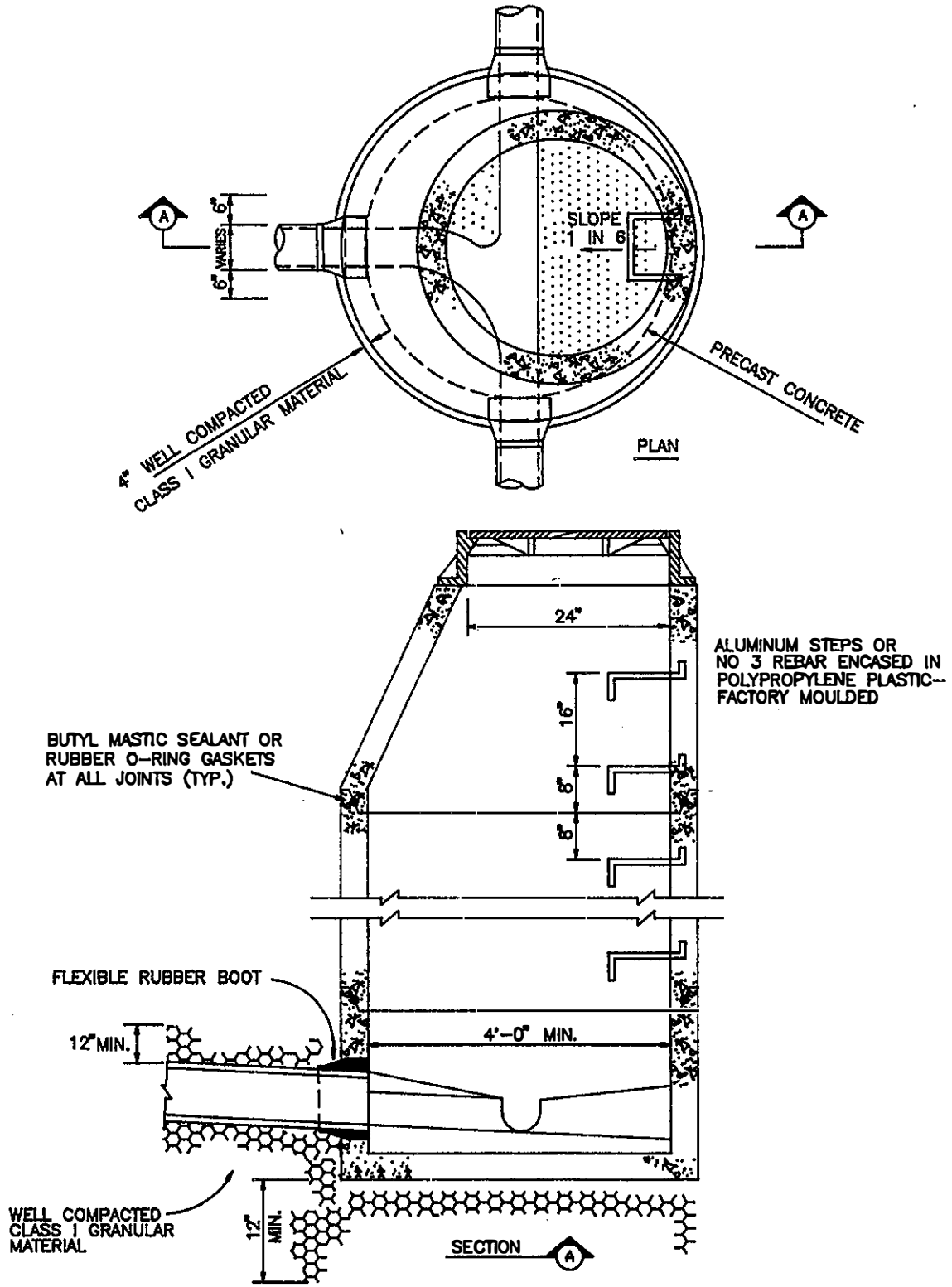

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | STANDARD PRECAST CONCRETE MANHOLE | DRAWING NO. MH–PC 1 |
|---|---|---|---|



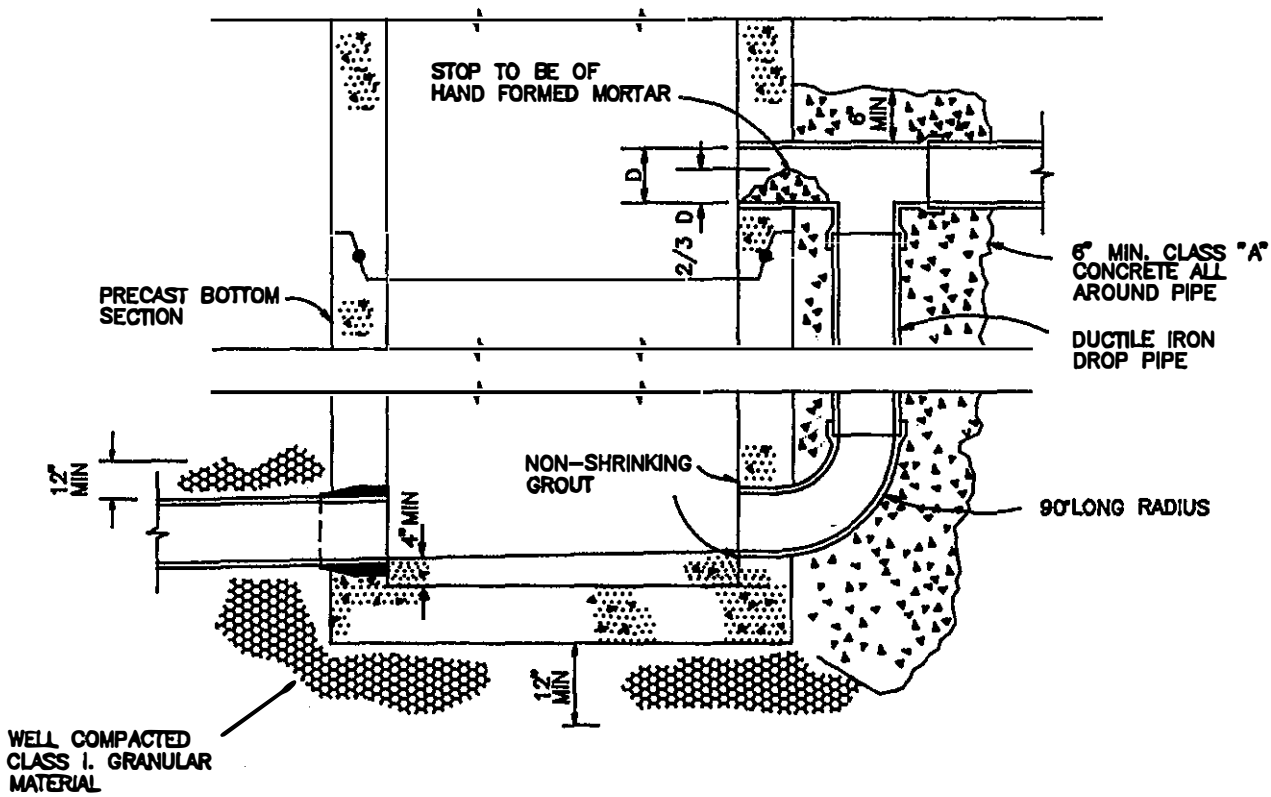

PLAN




| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SHALLOW PRECAST CONCRETE MANHOLE | DRAWING NO. MH–PC 2 |
|---|---|---|---|

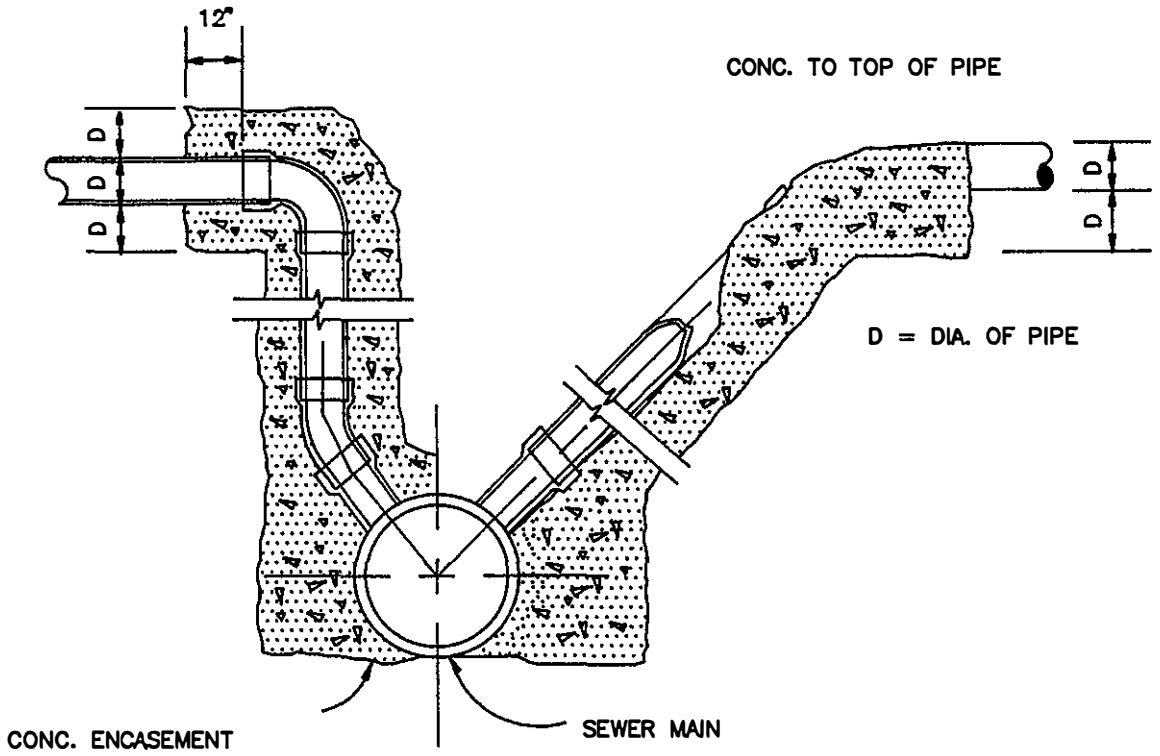



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | OFFSET PRECAST CONCRETE MANHOLE | DRAWING NO. MH-PC 3 |
|---|---|---|---|

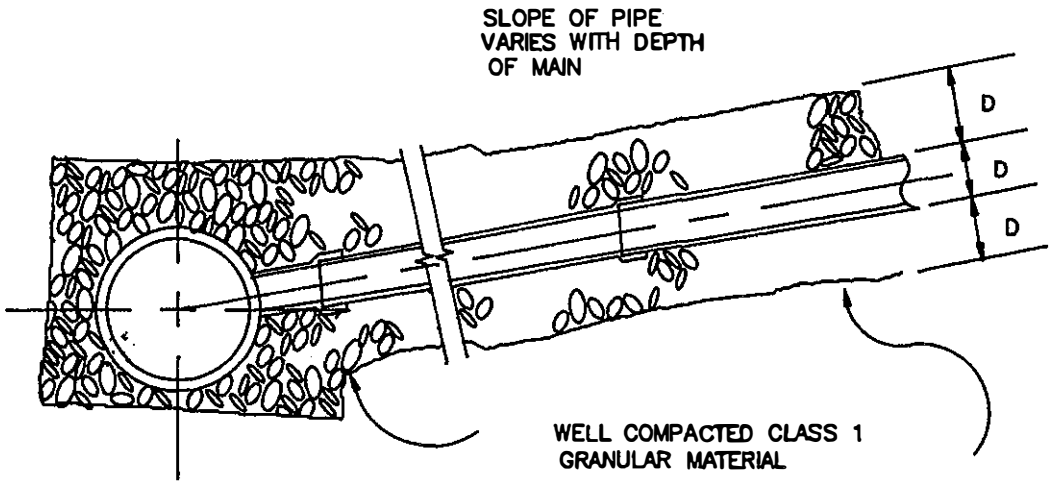



DROP MANHOLE

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | DROP MANHOLE | DRAWING NO. MH-D 1 |
|---|---|---|---|




DEEP MAIN

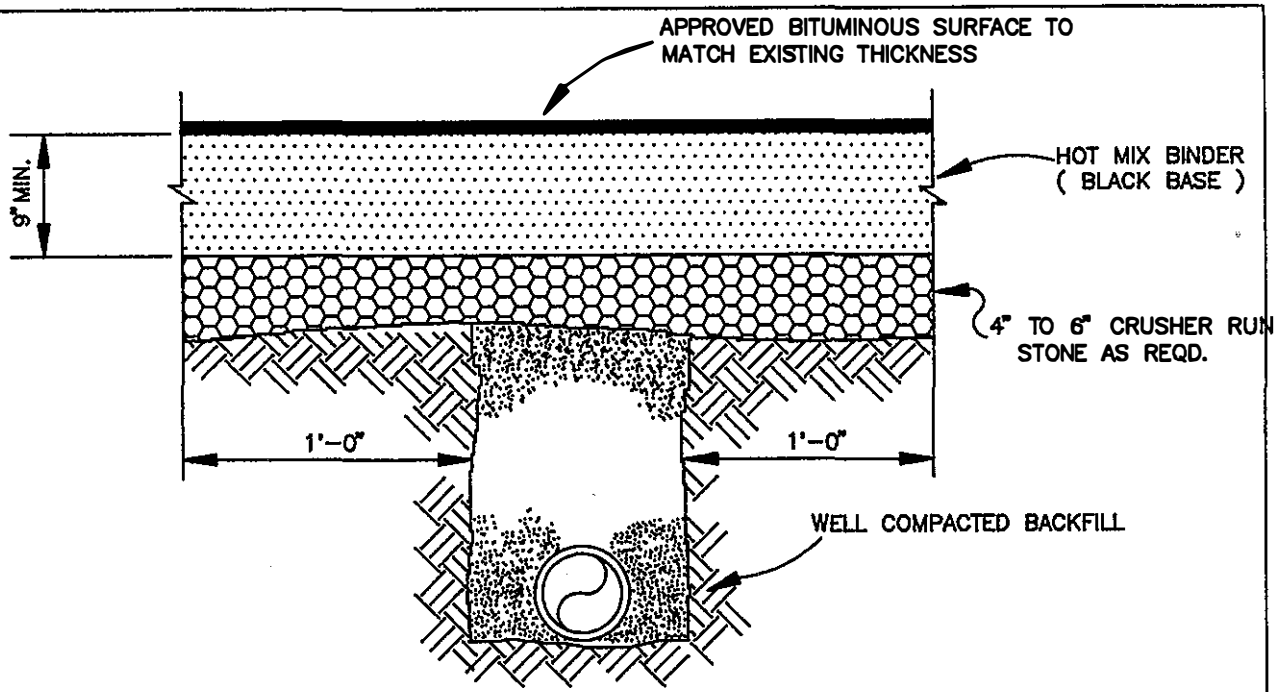



SHALLOW MAIN

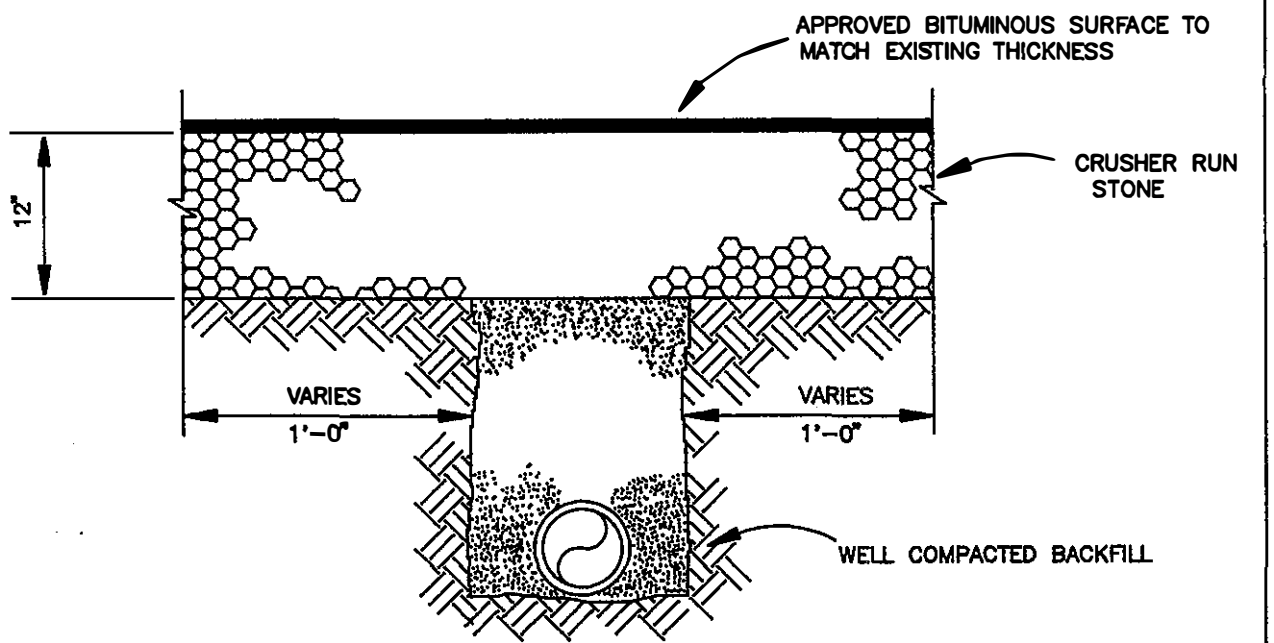
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SEWER SERVICE CONNECTION | DRAWING NO. SSC 1 |
|---|---|---|---|

CLEANOUT DETAILS

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SEWER CLEANOUT | DRAWING NO. SC 1 |
|---|---|---|---|

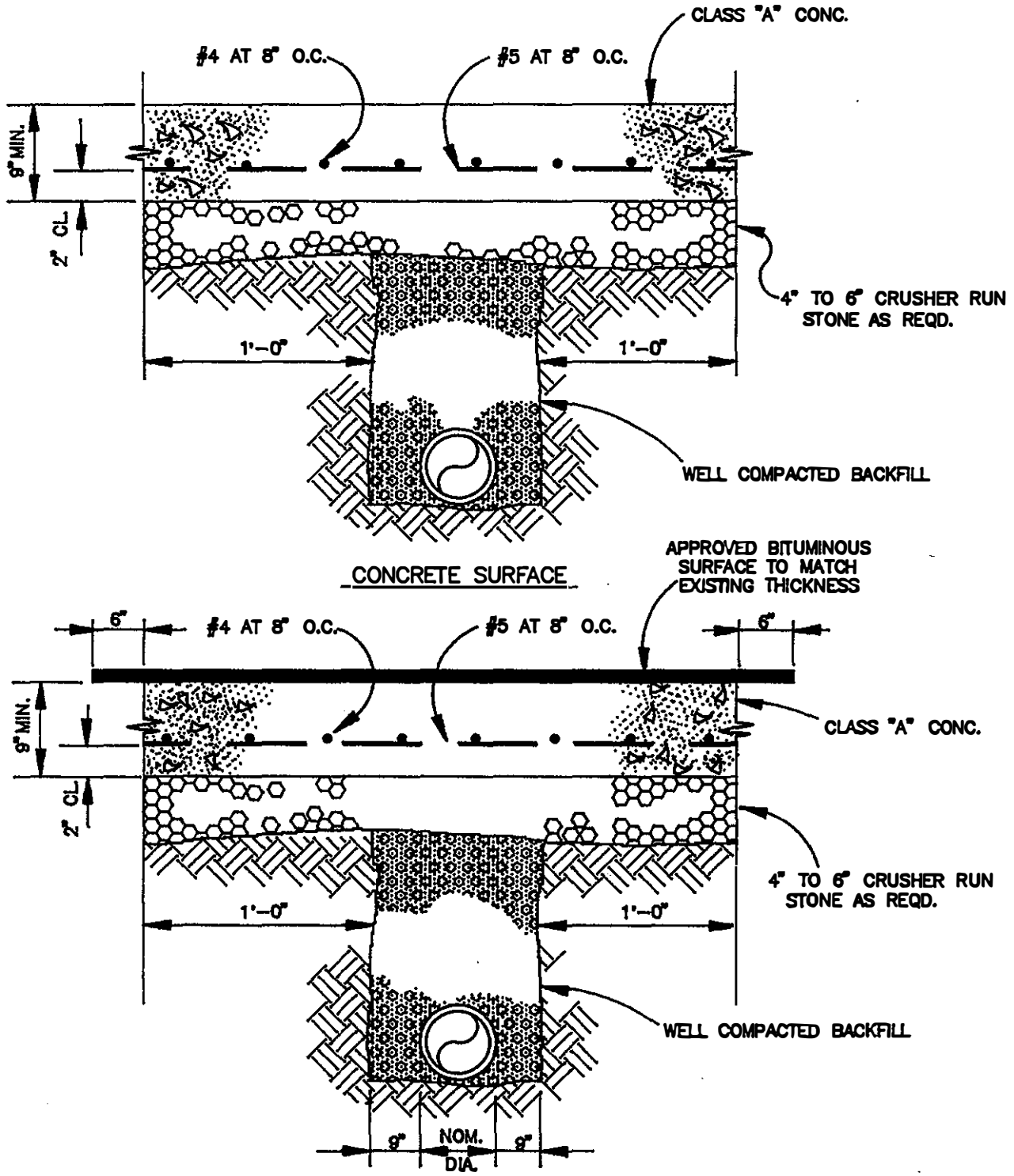



BITUMINOUS SURFACE
STATE HIGHWAY




BITUMINOUS SURFACE
CITY STREET OR COUNTRY ROAD

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | PAVEMENT REPLACEMENT BACKFILL | DRAWING NO. PR-B 1 |
|---|---|---|---|

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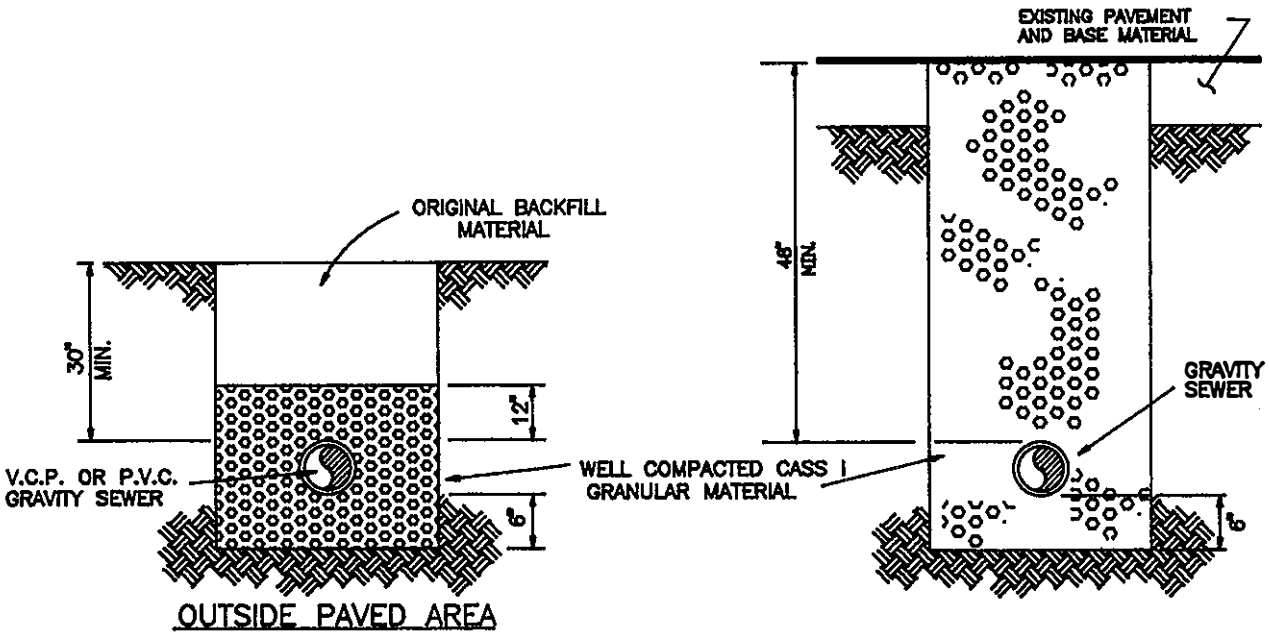
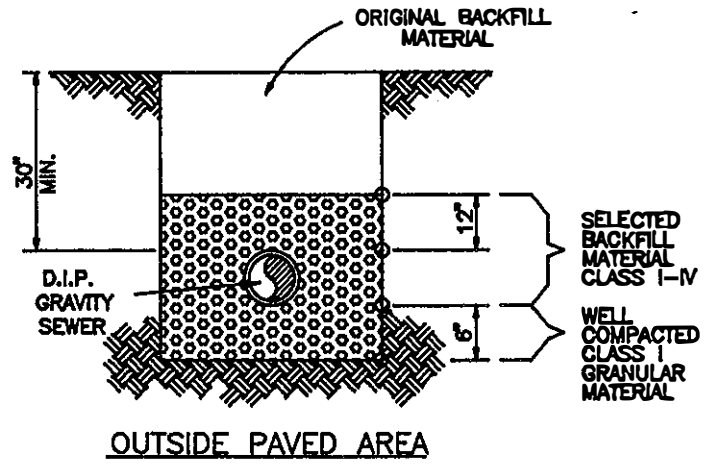



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | BACKFILL | DRAWING NO. |
|---|---|---|---|
| | | | B 1 |

# DESIGN CRITERIA

# Drainage Systems

# DESIGN CRITERIA
# DRAINAGE SYSTEMS

## SCOPE

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. It covers the reference information needed, design procedures, and standard details. This is not expected to cover extra-ordinary situations.

## GENERAL

### STORM WATER

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.

### PROTECTION

Storm sewer systems shall be designed to prevent flooding of improvements by storms having the return period as designed by the controlling authority. Return periods are discussed under "Runoff Calculations and Criteria". Design of the system shall provide a minimum of 1.0 feet of freeboard.

### STORM SEWER SYSTEMS

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:

a. Enclosed storm sewers and appurtenance
b. Open channels
c. Swales on property lines and/or back lot lines

Enclosed sewers shall be used to collect and convey drainage on, across, and through public street right-of-way. Outfall drains shall extend at least 60 feet to the rear of the front building line or 20 feet past the back line of the structure, whichever is greater, and on the inlet to 1 foot from the center of the side ditch.

Open channels are acceptable only to carry storm water runoff from tributary areas exceeding 100 acres, or from smaller tributary areas otherwise requiring an enclosed storm sewer pipe 48" in diameter or larger, except drainage structures shall be provided where open channels cross public right-of-way.

Side 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.

### VELOCITY

Discharge velocity shall be controlled to prevent both erosion and siltation at and immediately downstream from the point of discharge. Energy dissipating structures shall be used if required.

## DESIGN PROCEDURES

### MAPS

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

### SURVEYS

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

### UTILITIES

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

### EXISTING INFORMATION

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.

### PRELIMINARY LAYOUT

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

### ULTIMATE DEVELOPMENT

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

### FIELD CHECK

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.

### RUNOFF

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

### CURB CAPACITY

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

### INLETS

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. 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.

INLET AND PIPE CAPACITY

Calculate capacities for inlets and size pipe laterals. A 15 inch pipe is the minimum sizing for all laterals.

MAXIMUM DEPTH

Drainage water must not exceed the depth of the curb at any intersection. This maximum drainage water depth is further limited in duration as stipulated in Subsection 308.3.

HYDRAULICS

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

## RUN-OFF CALCULATIONS AND CRITERIA

The rational method of calculating storm water quantities, Q = AIR, shall be used with the following definitions of terms and arbitrary values:

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.

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.

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%.

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.

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.

## PIPE SIZING

### MANNING FORMULA

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

$$V = \frac{1.5}{N} r^{2/3} s^{1/2}$$

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.

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 |

### MINIMUM PIPE SIZE

The minimum size storm sewer shall be 15 inches in diameter.

### VELOCITY

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.

### VELOCITY HEAD

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 ($V^2/2g$).

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.

### SLOPE

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 <u>percent</u>.

| 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.)

## LOCATION

Storm drainage lines shall generally be located in the parkway area and shall be placed as shown on the approved submitted plans.

## DEPTH OF COVER

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.

## DRAINAGE INLETS

### LOCATION

Provide inlets to maintain a reasonable level of vehicular and pedestrian traffic service as follows:

### GENERAL

Contain all flow within street curbs during the design storm.

### ARTERIAL & COLLECTION STREETS

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.

Good design does not allow flow across intersections. Where economic and other factors control, the following would 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 |

RESIDENTIAL STREETS

Limit gutter flow width to prevent encroachment on the center 14 feet of street during run-off occurring 50 percent of peak design rates of the design storm.

Limit gutter flow across intersections with arterial or collector class streets as provided for arterial street intersections.

PEDESTRIAN CROSSWALK

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.

## OPEN CHANNELS

GENERAL

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.

CONNECTIONS

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

VELOCITY

Channel design shall include lining or treatment of the invert and sides as required to minimize erosion. Minimum treatment shall include seeding. Channel inverts and sides shall be lined to a height 1.0 foot above the hydraulic grade line produced by a flow rate of 60 percent of the peak design rate of the design storm in accordance with the following table:

| Mean Flow Velocity | Type of Lining |
|---|---|
| 3 F.P.S. & Less | Seeded |
| 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 in lieu thereof.

CAPACITY

Open channels shall be sized to carry design flow rates with 1.0 foot of freeboard.

SECTIONS

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. Channels lined with sod, grass, or other vegetative ground cover and having slopes steeper than 3 horizontal to 1 vertical are not readily susceptible to mowing. Friction factors used in design shall be considered in selecting type of lining.

## CHECK DAMS

Check dams may be used 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.

## NATURAL CHANNELS

Natural channels of adequate capacity and having stable banks and invert may be used without modification.

## DESIGN DETAILS

### PLAN

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 relating to the storm drainage system. 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. Easement shall be a minimum of 14 feet for enclosed structures and 20 feet for open paved channels where they cross private property or as designated by the City Engineer.

### PROFILE

The profile of all storm sewers shall show the necessary slope, existing and proposed street grades, locations of angles and appurtenances, and proper elevations for existing outfall ditches. The profile shall indicate the size of line and the capacity of each line as determined by the design engineer. 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.

## EASEMENTS

Permanent drainage easements shall be obtained for all storm sewers, and open drains, that are not within a public dedication, with the right of entry for inspection and maintenance.

Permanent easements shall be obtained for a retention dam site with spillway and release facilities, and floodage rights for temporary detention and conveyance of storm drainage. Easements and floodage rights shall include all necessary provisions and sufficient land for entry to inspect and maintain facilities. Deeds and easements shall be properly recorded.

## SUGGESTED STORM SEWER DESIGN CHECK LIST

| | | |
|---|---|---|
| ( ) | 1. Control--Scale: | Horizontal 1" = 100', Vertical 1" = 10' |
| ( ) | | Large scale for details |
| ( ) | | Drawing number and date |
| ( ) | | North Arrow |
| ( ) | | Signature Blocks |
| ( ) | 2. Boundary Lines: | Counties, Cities, Sewer Districts, 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 Date - 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

## TEMPORARY DETENTION

### GENERAL

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, may be included in storm sewer systems development upon specific approval of the City Engineer.

### PERFORMANCE CRITERIA

The design storm shall be a storm of 24-hour duration and having the return periods set forth in "Run-off Calculations and Criteria" for enclosed structures.

Detention storage areas shall have adequate capacity to contain maximum required volume of tributary storm drainage run-off with 1.0 foot of freeboard. Adequate provisions and allowances shall be made for the accumulation and removal of silt.

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.

a. Outlet works shall not include any mechanical components or devices and shall function without requiring attendance or control during operation.
b. Size and hydraulic characteristics shall 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.

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.

Emergency spillways shall be provided to permit safe passage of water from storms producing run-off in excess of the design storm.

## DESIGN DATA SUBMITTAL

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

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.

Area: Capacity curve for proposed detention facility plotted in units of datum elevation as ordinates, and cumulative volume of storage as abscissas.

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.

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.

a. Curves shall be so arranged that the vertical distance between the accumulated storage and accumulated discharge will indicate the net volume in storage at any point in time.
b. Curves shall be extended to the time required for complete discharge of all run-off stored in the detention facility.

## LAND REQUIREMENTS

Permanent easements for the temporary impoundment of storm water run-off shall be dedicated to the City. The permanent easement shall include all lands, structures, and facilities to be used for temporary detention and conveyance of storm drainage. Easements shall include all necessary provision and land necessary for the City's right-of-entry for purposes of inspection and/or maintenance. All instruments and easements shall be subject to the approval of the City.

## MAINTENANCE

Provisions acceptable to the city for perpetual maintenance of temporary detention facilities, outlet works, and appurtenances, shall be made.

## PERMITS

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.

# METHODS TO REDUCE QUANTITY OF RUN-OFF AND MINIMIZE POLLUTION

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. Storm water shall be directed into the soil preferably to the same extend 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.

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.

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 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 | | | | | | | | |
| - 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
Ins - Institutional
Com - Commercial
Ind - Industrial
Hwy - Highways

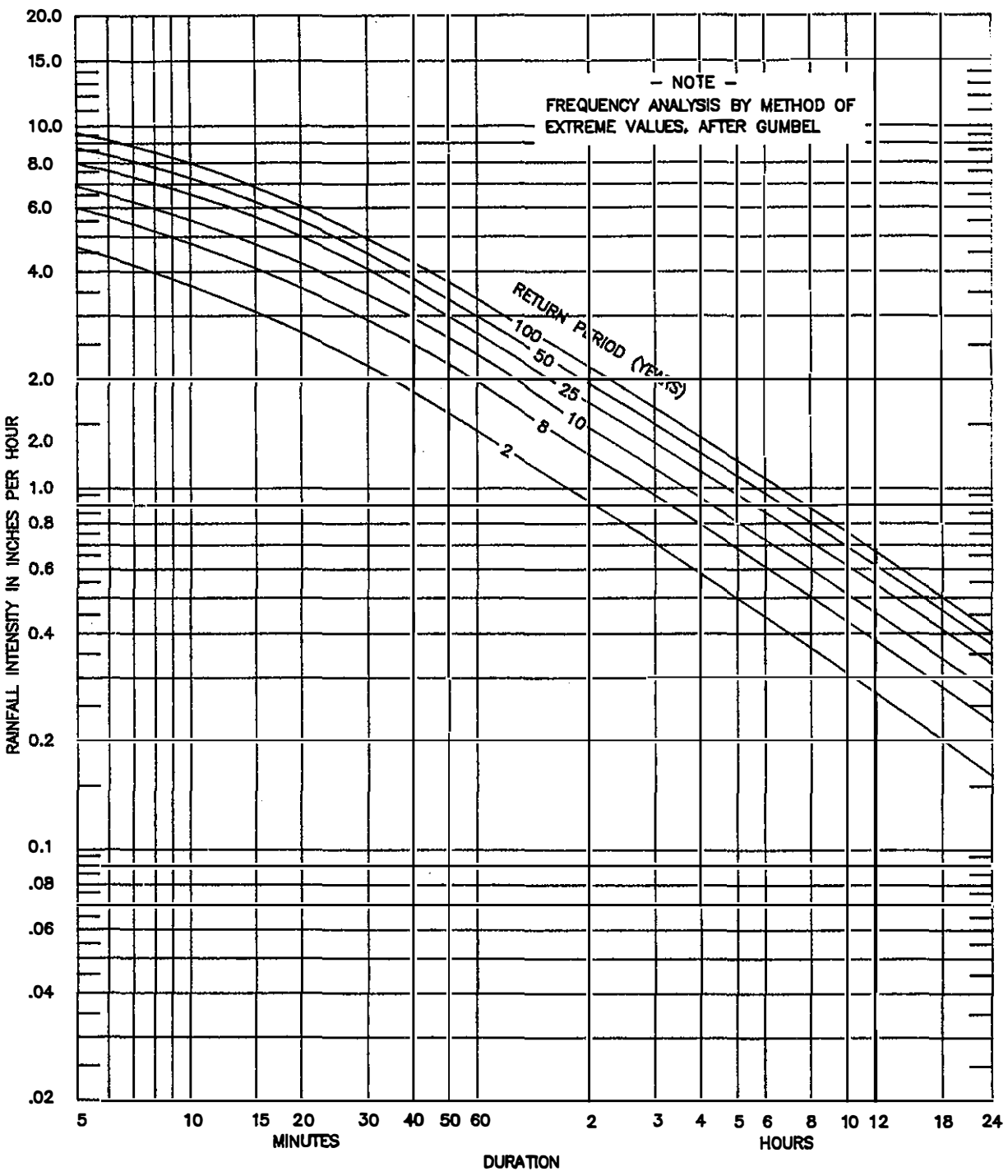
All of these measures for reducing quantity of run-off and minimizing pollution are not applicable to every city, but many are, and the run-off can be reduced by using those that are suited to the varying conditions.

## DRAINAGE SYSTEM

## STANDARD DRAWINGS AND DESIGN CHARTS

The following drawings supplement the criteria. Some are referenced in the criteria, while others need no discussion.

MEMPHIS, TENNESSEE
1903 – 1951




| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | RAINFALL INTENSITY FREQUENCY – DURATION CURVES | DRAWING NO. RIFDC–1 |
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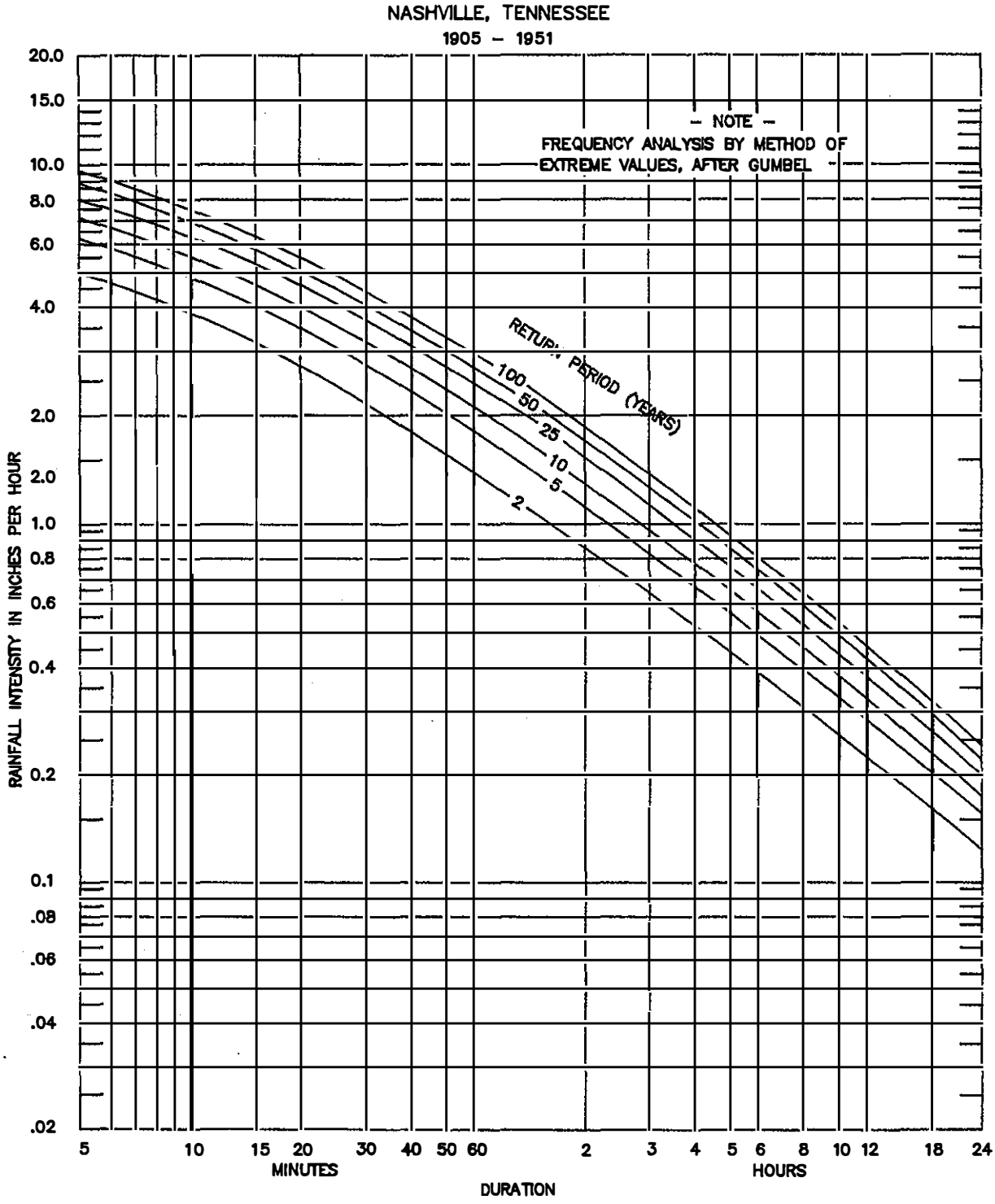


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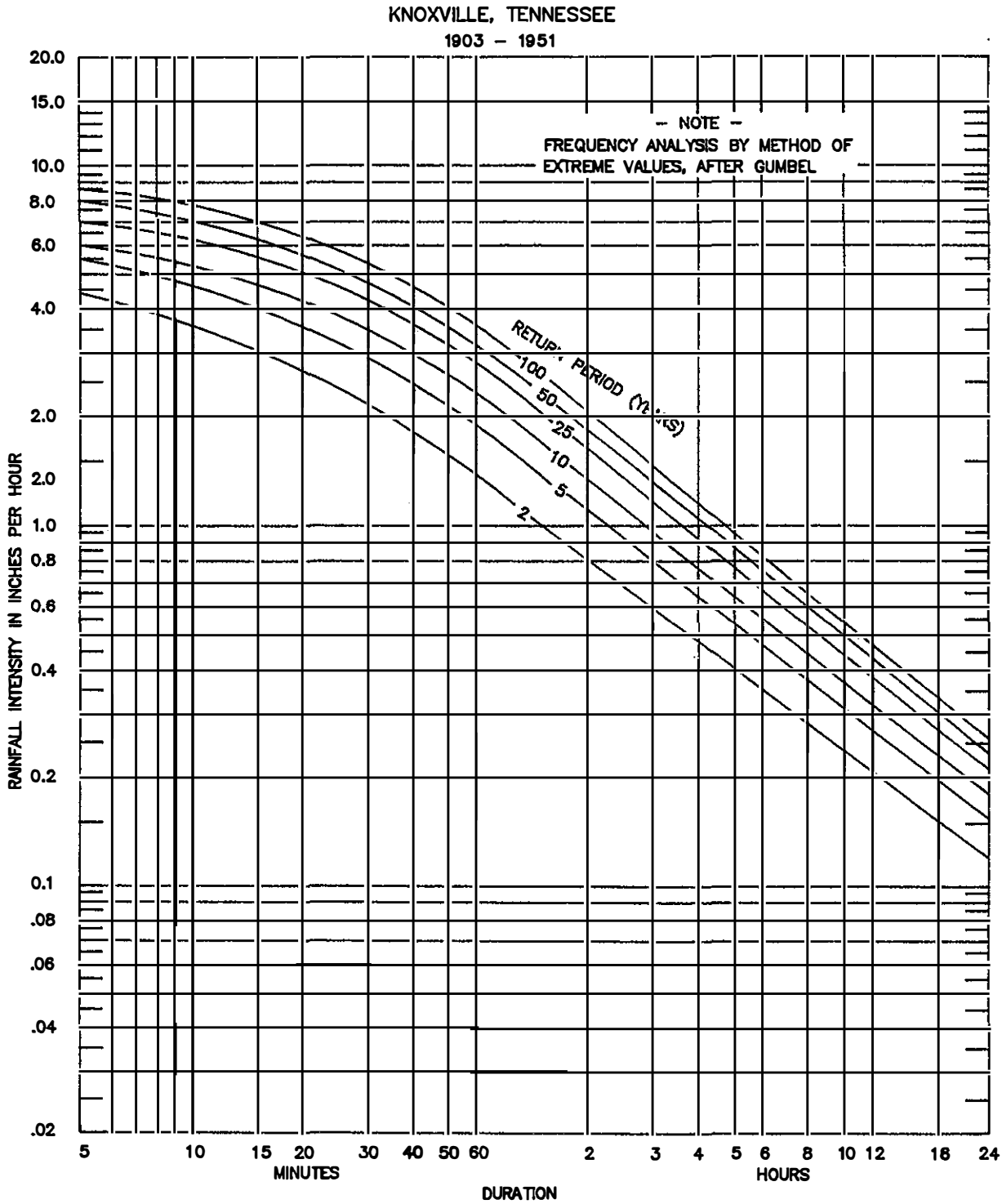
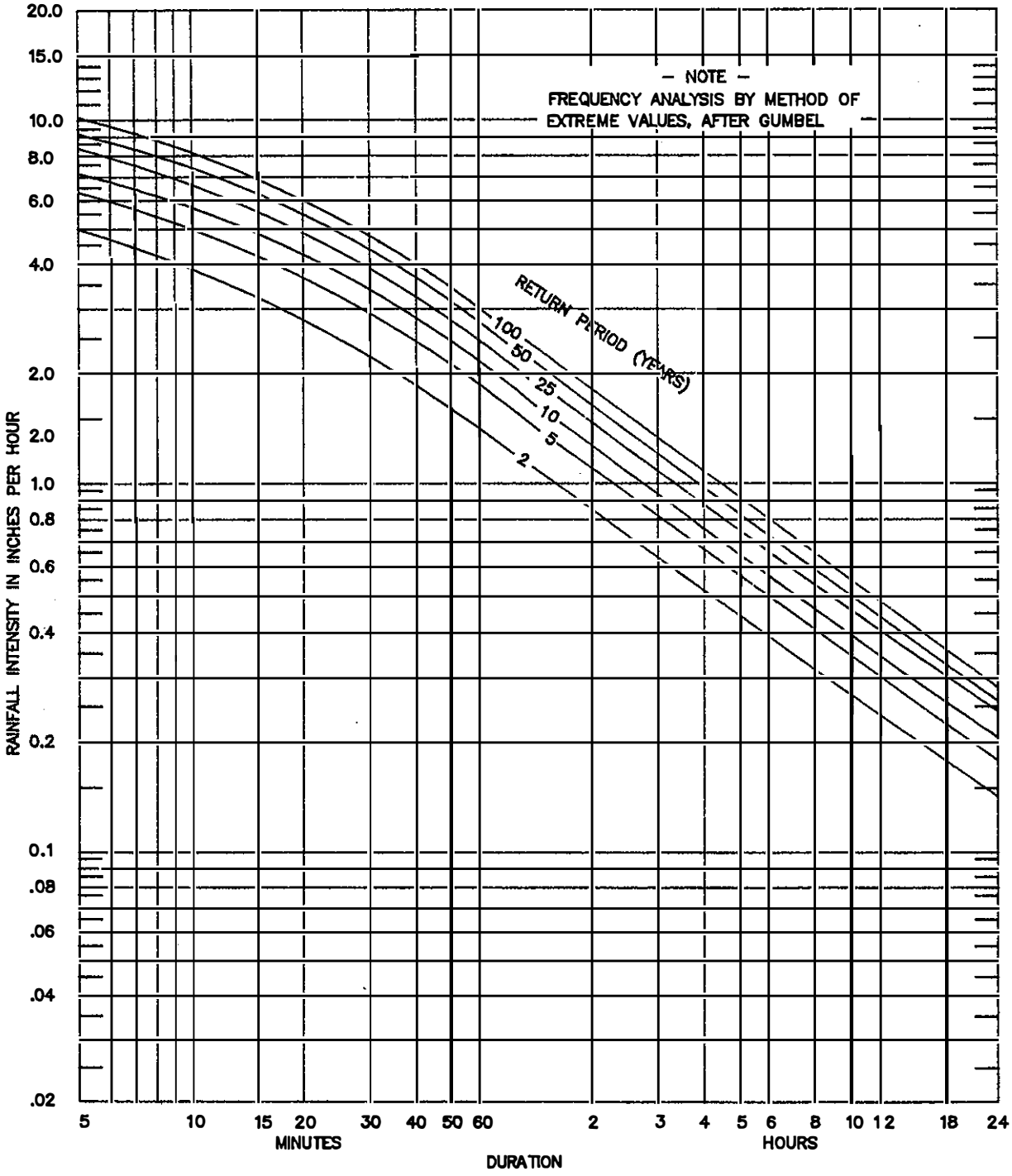



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | RAINFALL INTENSITY FREQUENCY – DURATION CURVES | DRAWING NO. RIFDC–3 |
|---|---|---|---|

CHATTANOOGA, TENNESSEE
1903 – 1948




| | | | |
|---|---|---|---|
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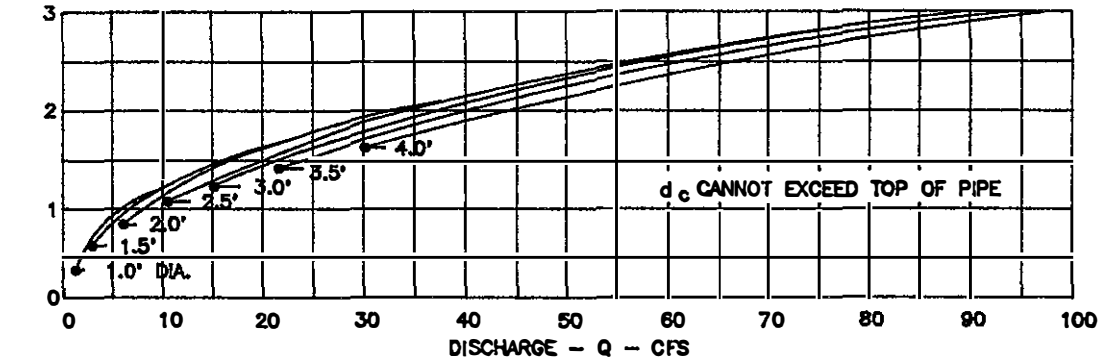
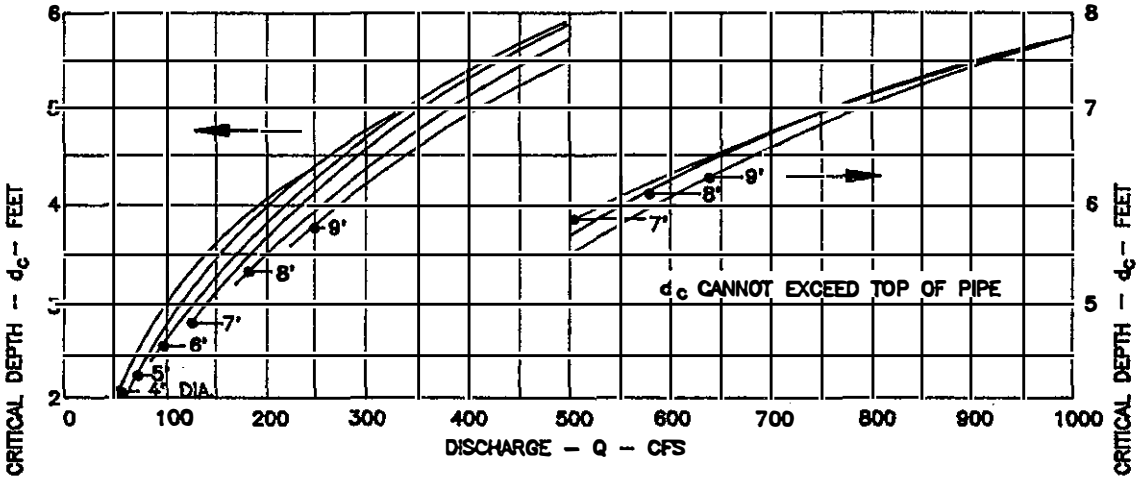
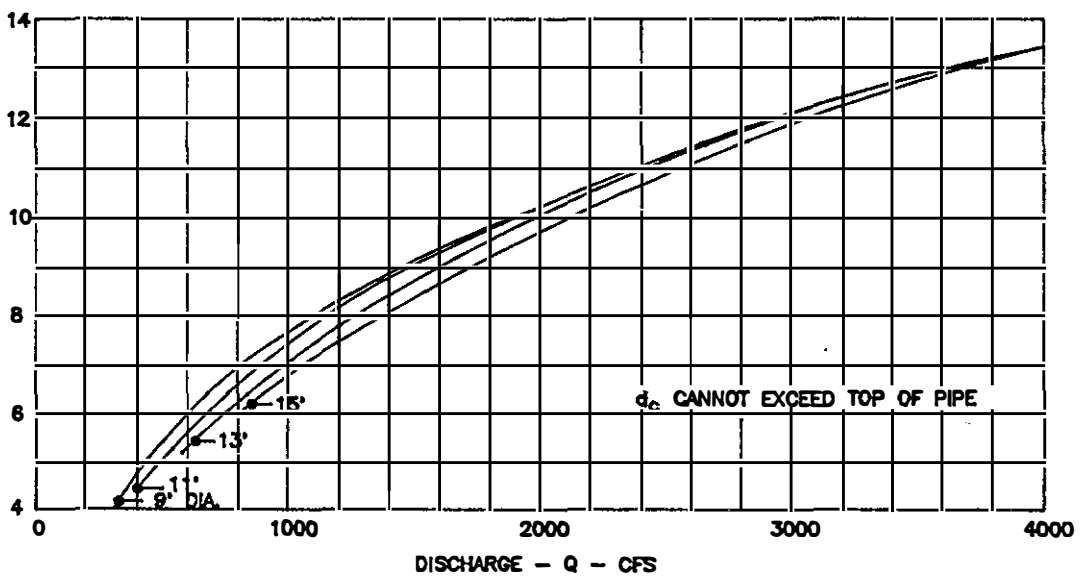
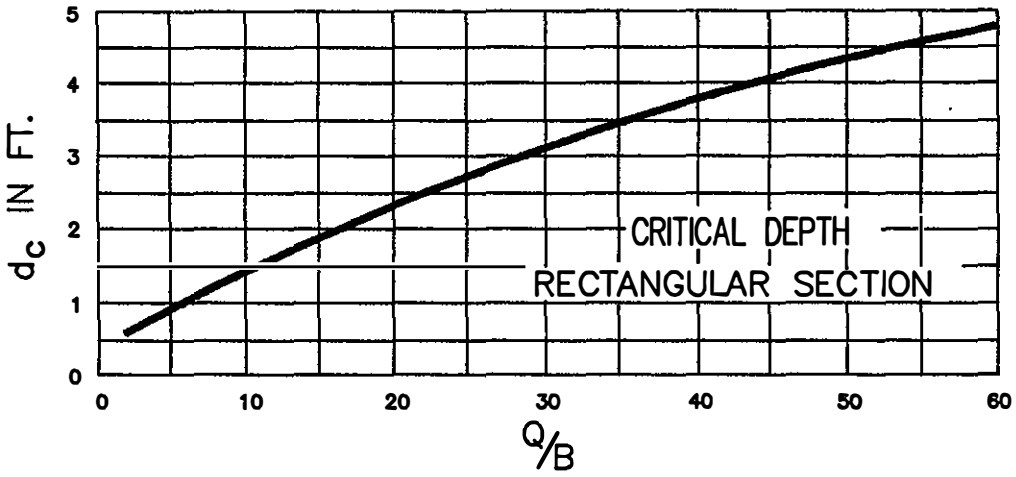
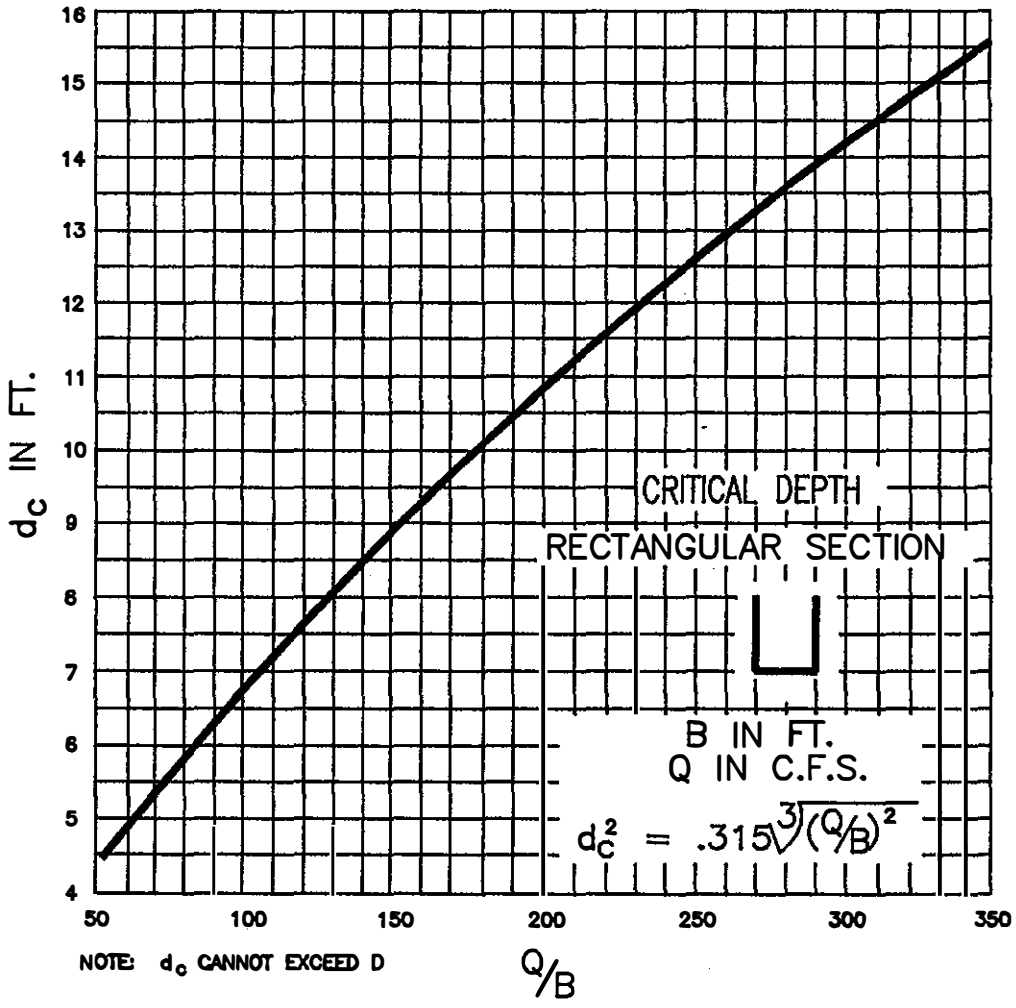


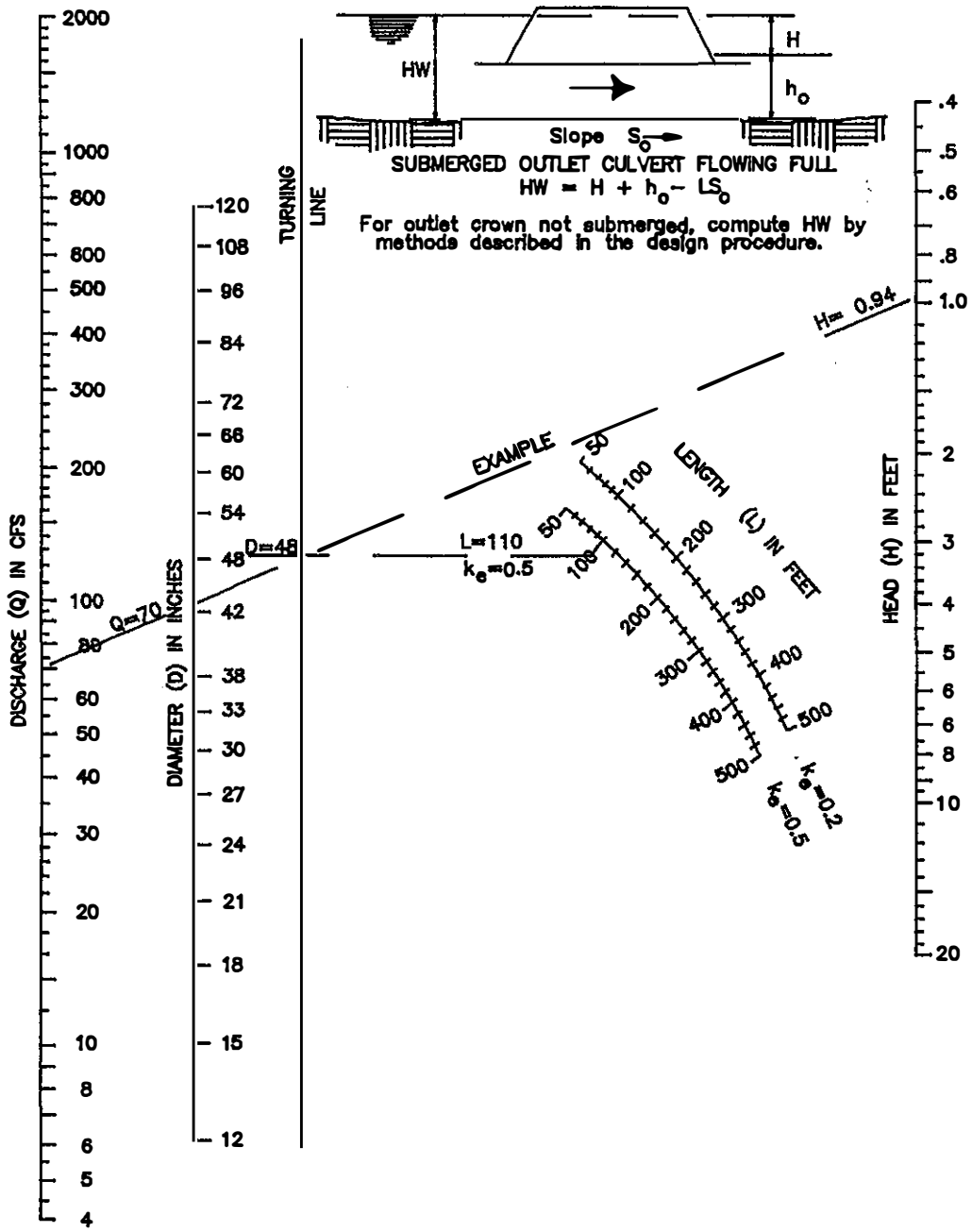




| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CRITICAL DEPTH CIRCULAR PIPE | DRAWING NO. CDCP–1 |
|---|---|---|---|

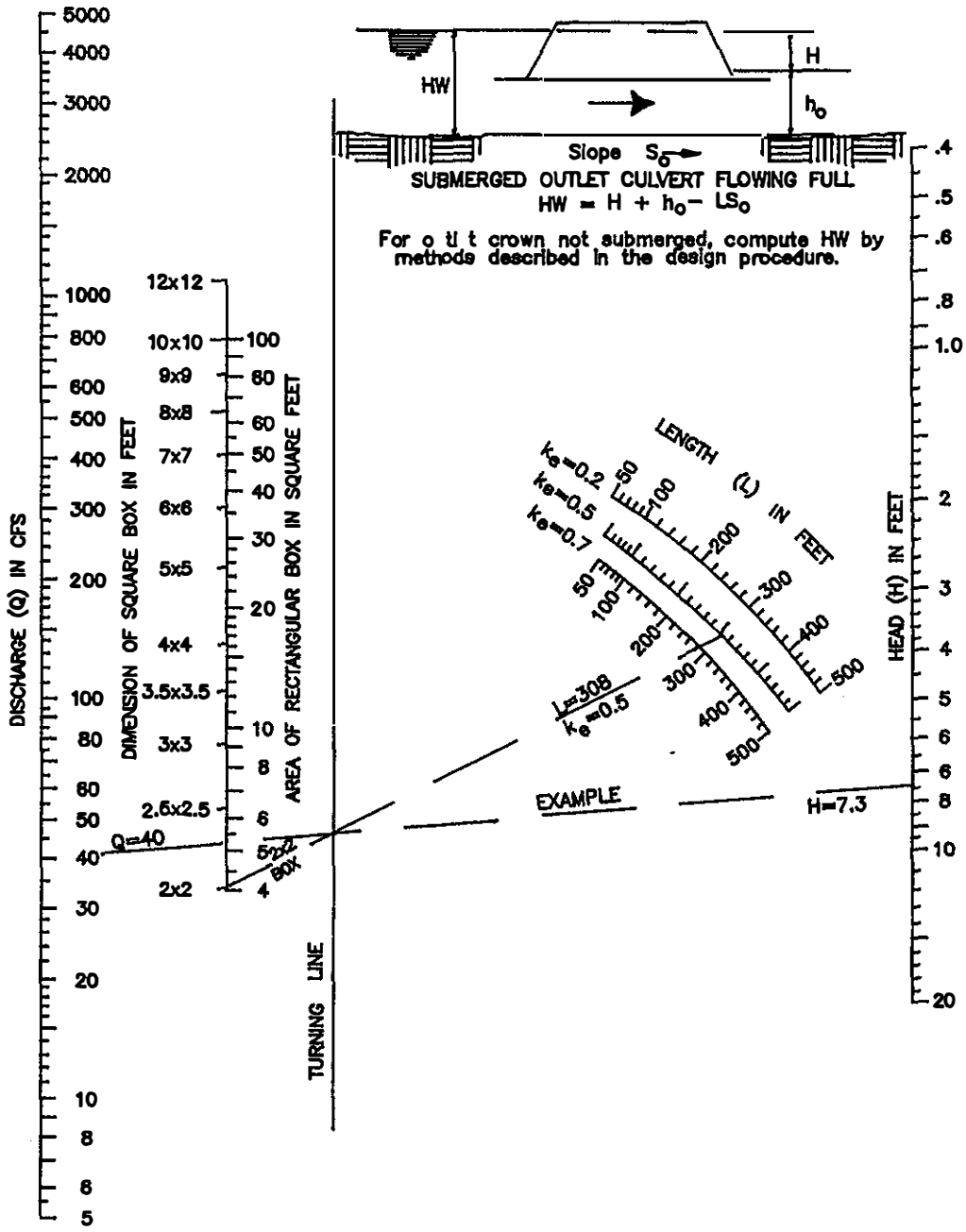


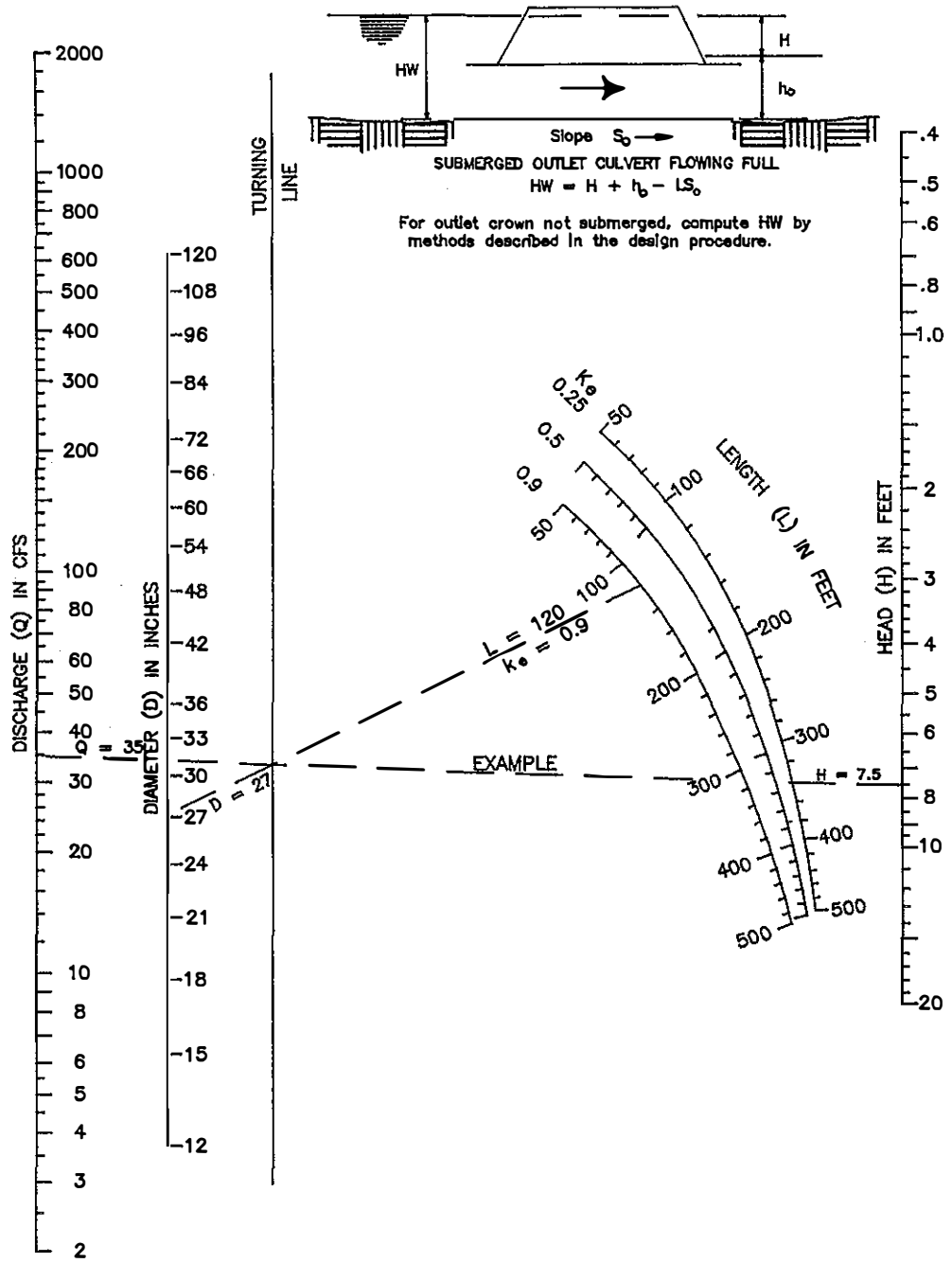

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CRITICAL DEPTH RECTANGULAR SECTION | DRAWING NO. CDRS–1 |
|---|---|---|---|



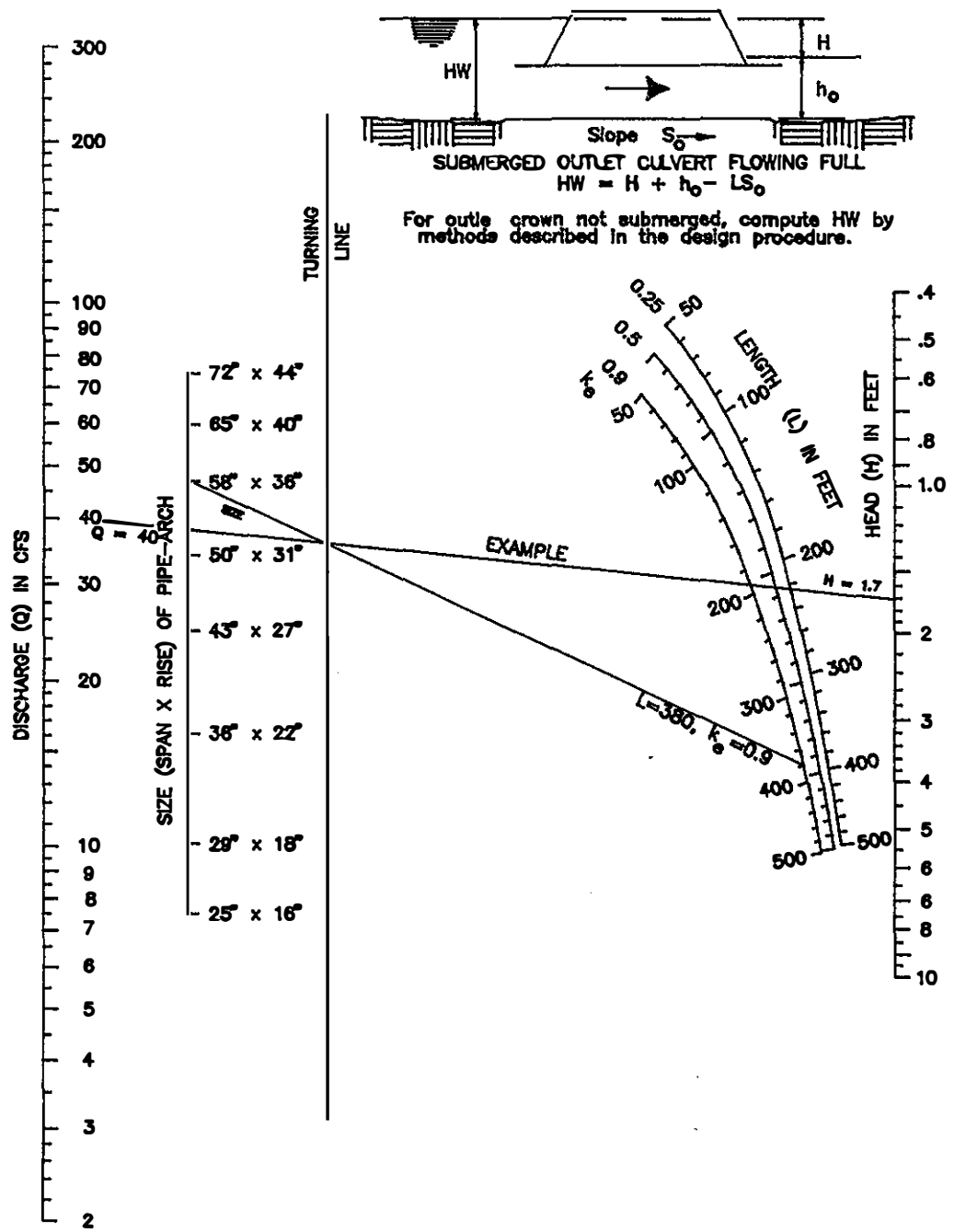

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR CONCRETE PIPE CULVERTS FLOWING FULL n = 0.012 | DRAWING NO. HCPC–1 |
|---|---|---|---|



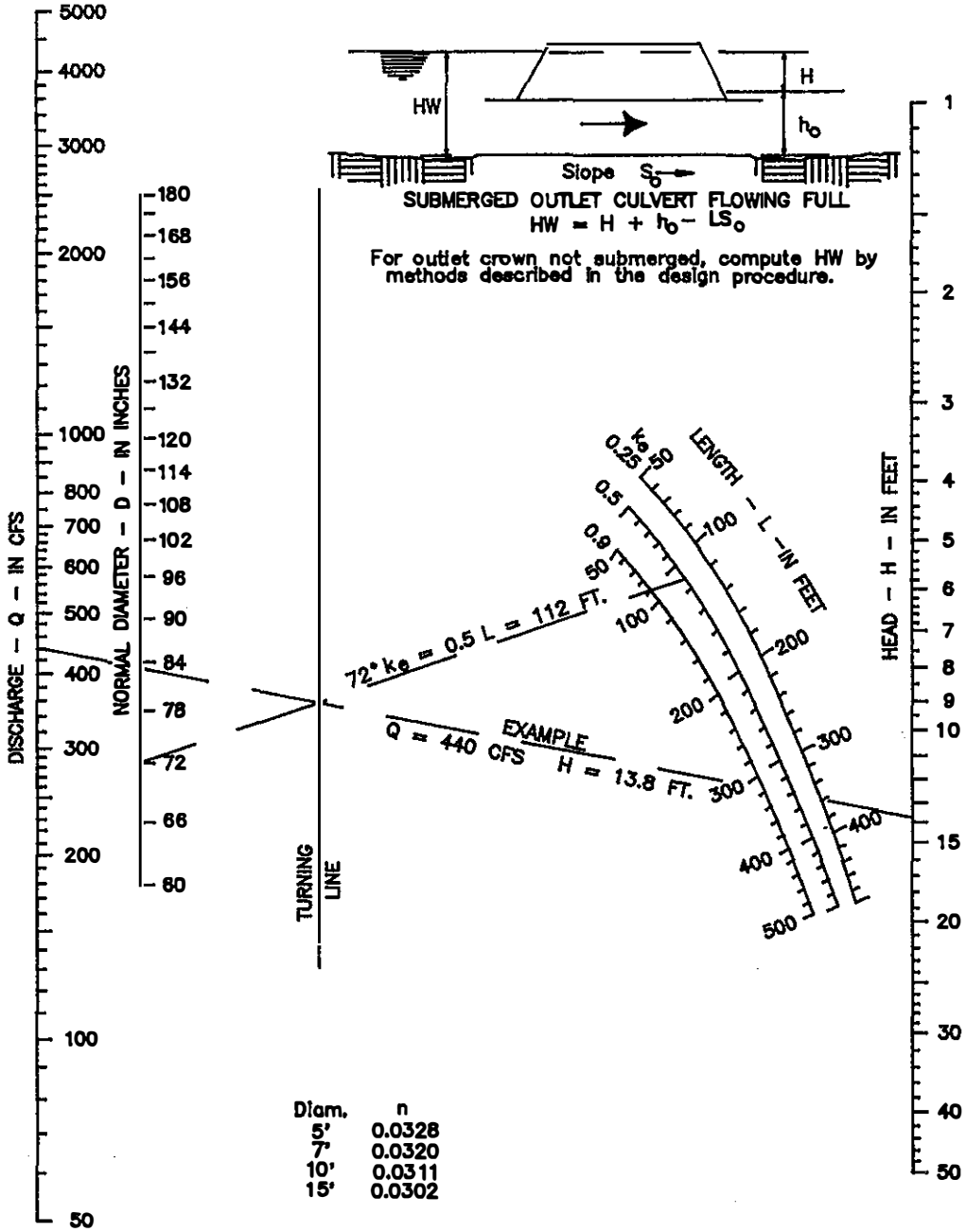

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR CONCRETE BOX CULVERTS FLOWING FULL n = 0.012 | DRAWING NO. HCBC−1 |
|---|---|---|---|



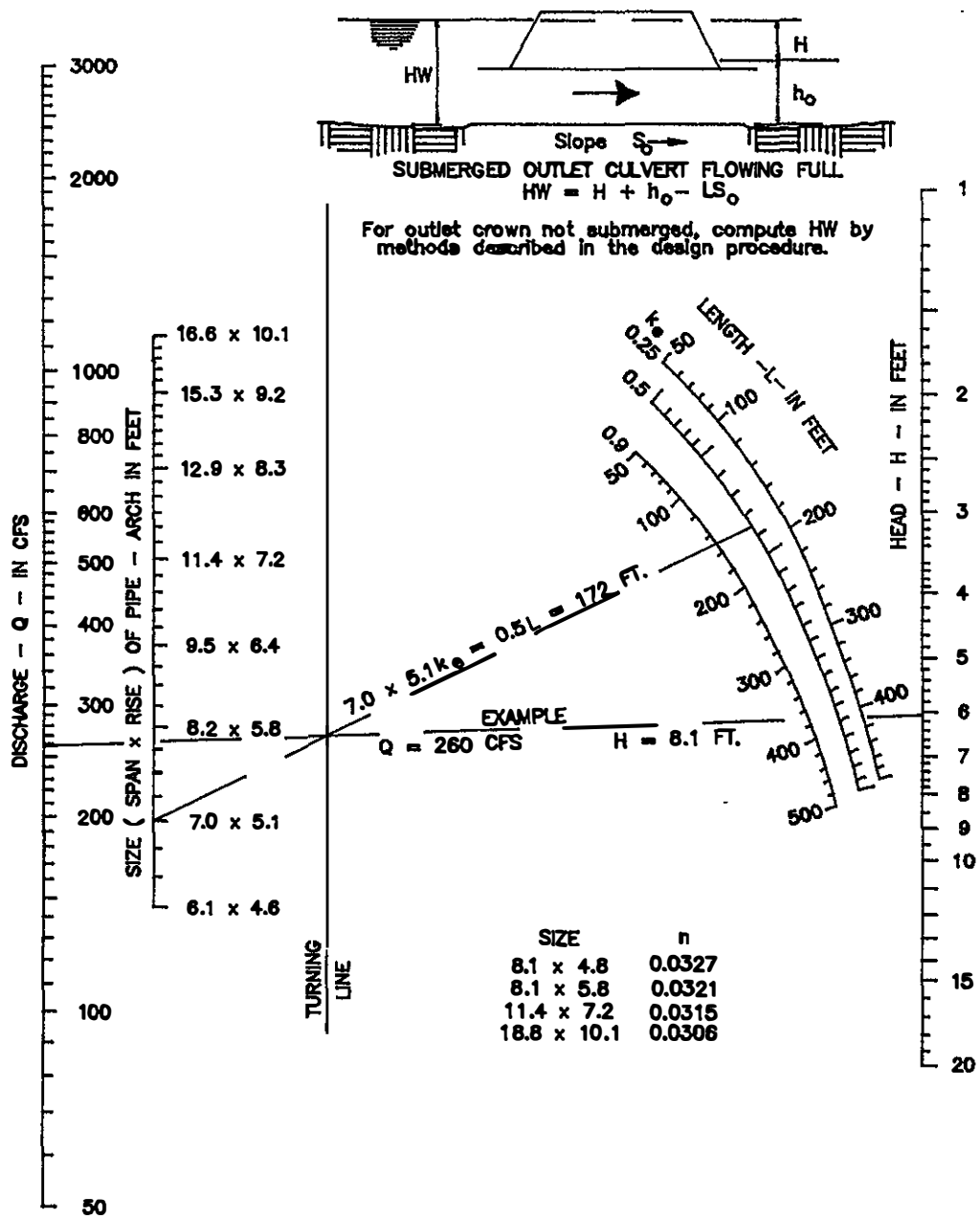

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR STANDARD CORRUGATED METAL PIPE CULVERTS FLOWING FULL n = 0.024 | DRAWING NO. HSCMPC–1 |
|---|---|---|---|




| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR STANDARD CORRUGATED METAL PIPE-ARCH CULVERTS FLOWING FULL n = 0.024 | DRAWING NO. HSCMPAC-1 |
|---|---|---|---|

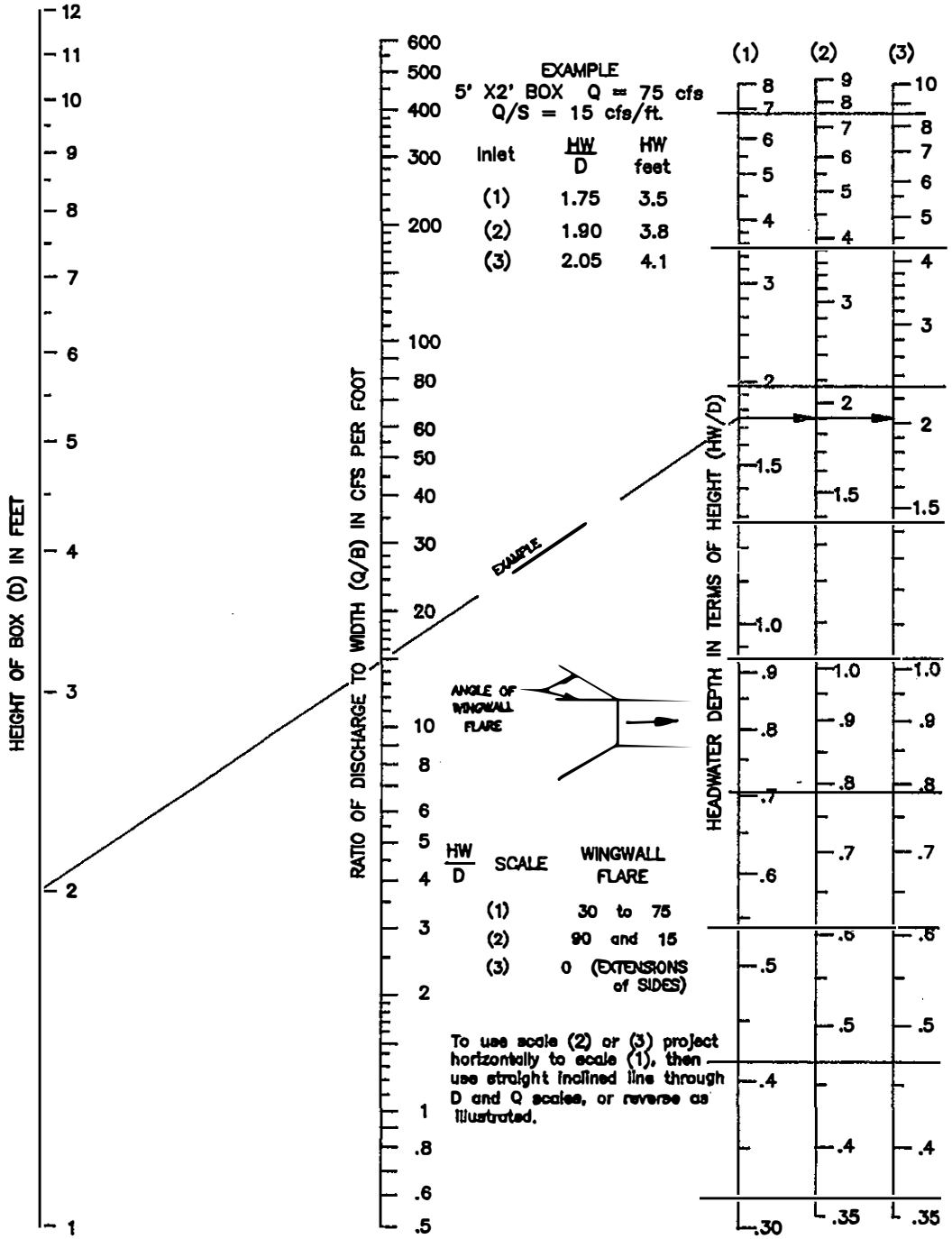



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR STRUCTURAL PLATE CORRUGATED METAL PIPE CULVERTS FLOWING FULL n = 0.0328 to 0.0302 | DRAWING NO. HSPCMP-1 |
|---|---|---|---|

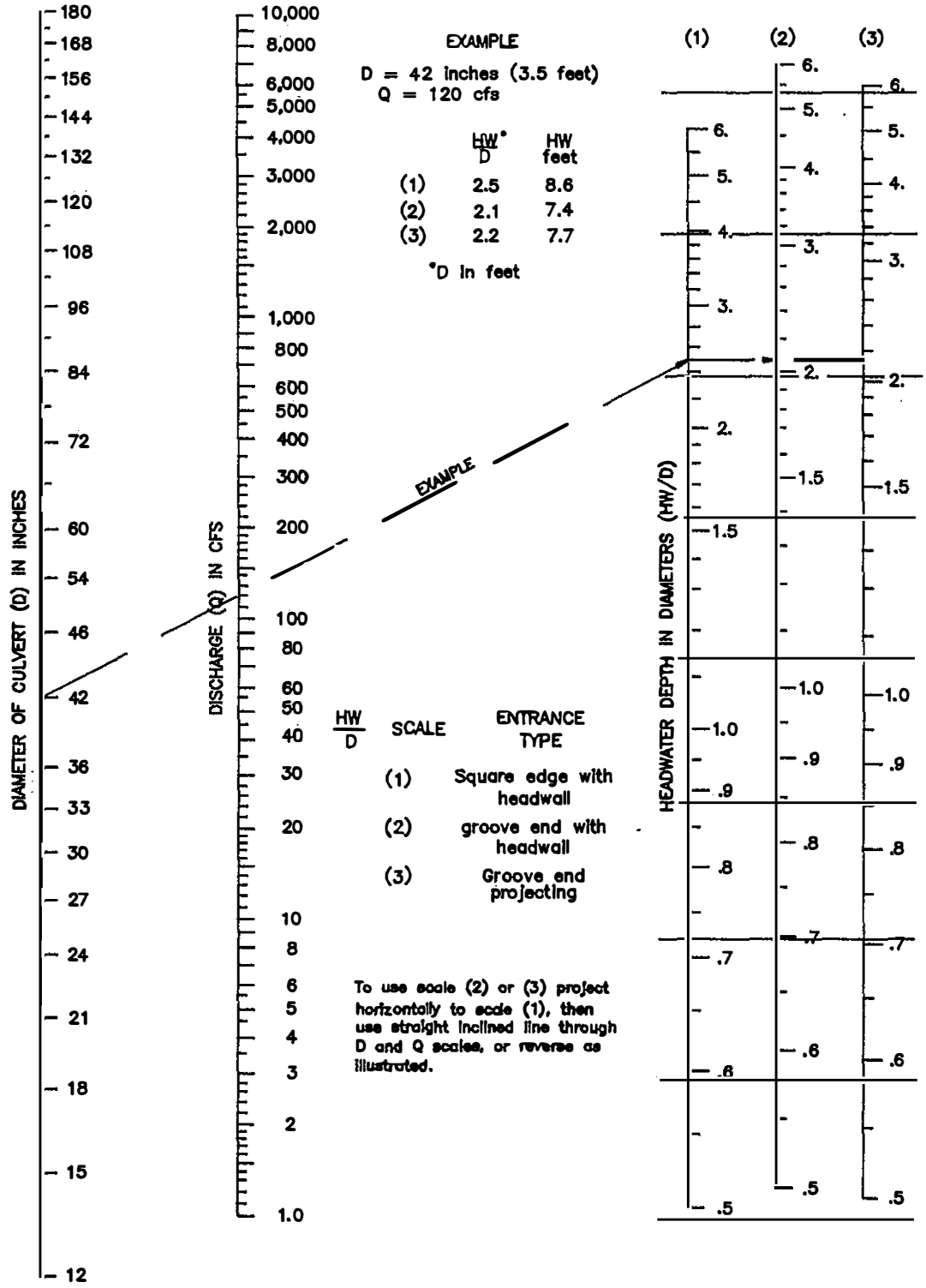



⊗ n = 0.0327 to 0.0306

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEAD FOR STRUCTURAL PLATE CORRUGATED METAL PIPE-ARCH CULVERTS 18 INCH CORNER RADIUS FLOWING FULL | DRAWING NO. HSPCMPAC-1 |
|---|---|---|---|

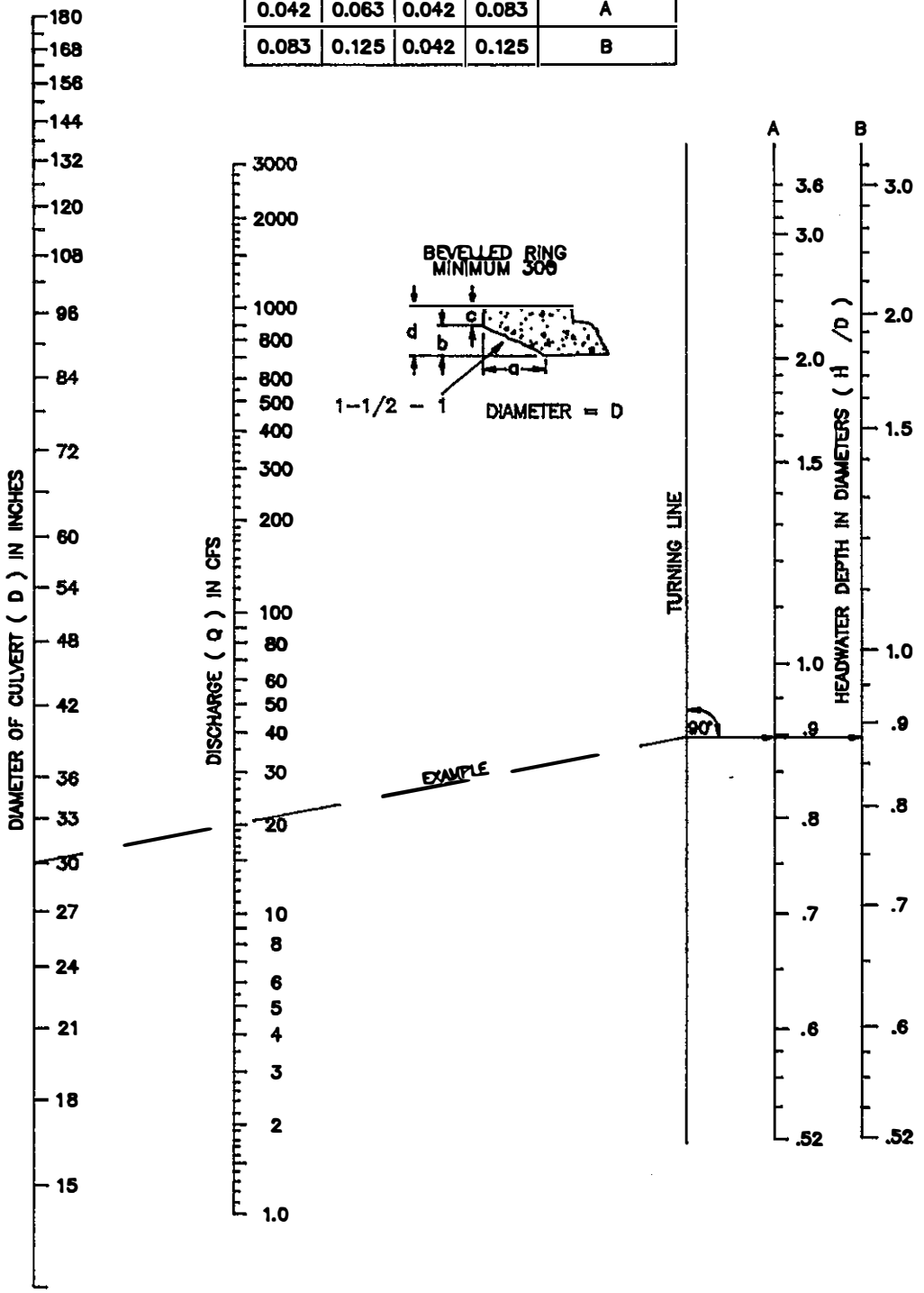



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEADWATER DEPTH FOR BOX CULVERTS W/ INLET CONTROL | DRAWING NO. HWDBC-1 |
|---|---|---|---|

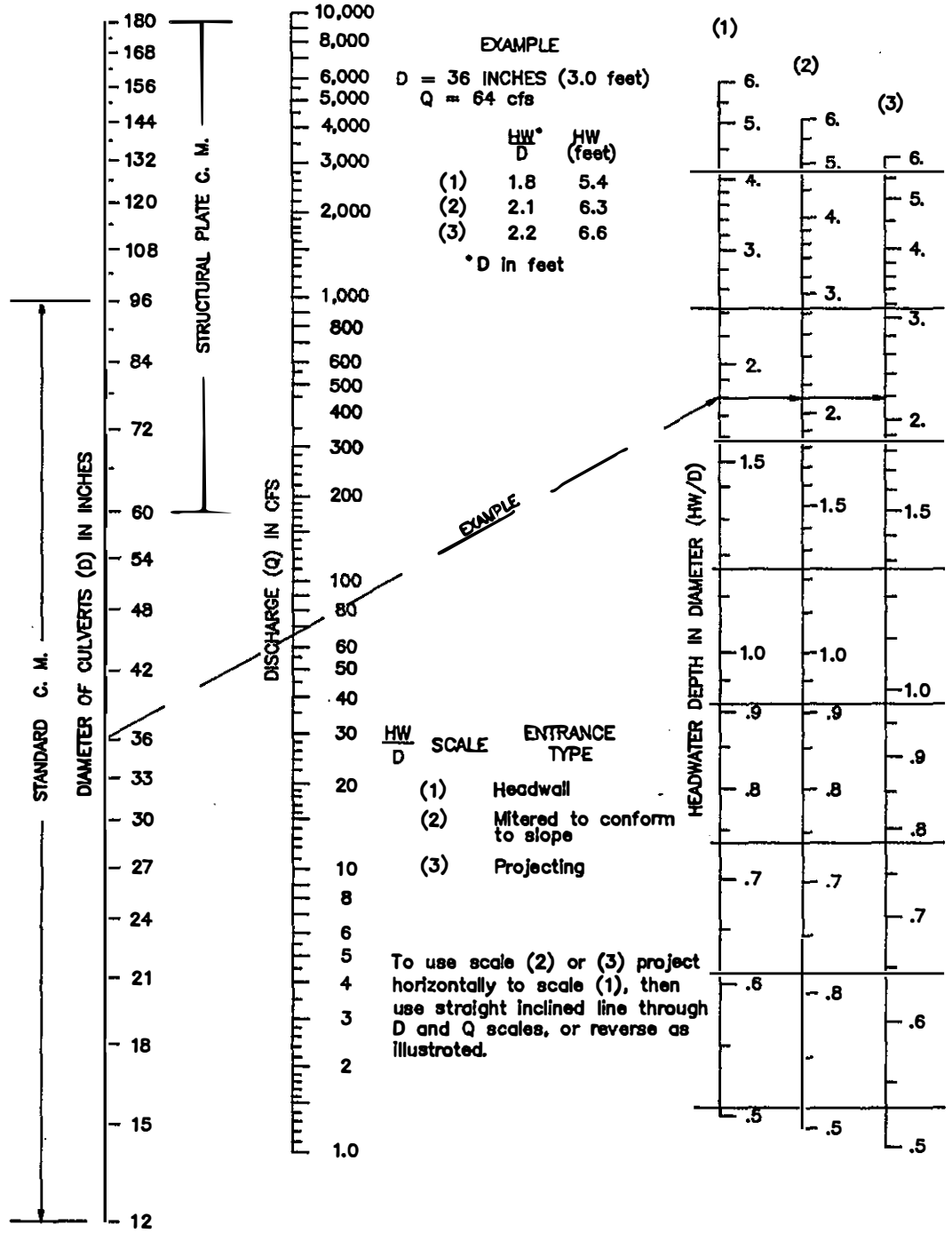



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS W/INLET CONTROL | DRAWING NO. HWDCPC–1 |
|---|---|---|---|

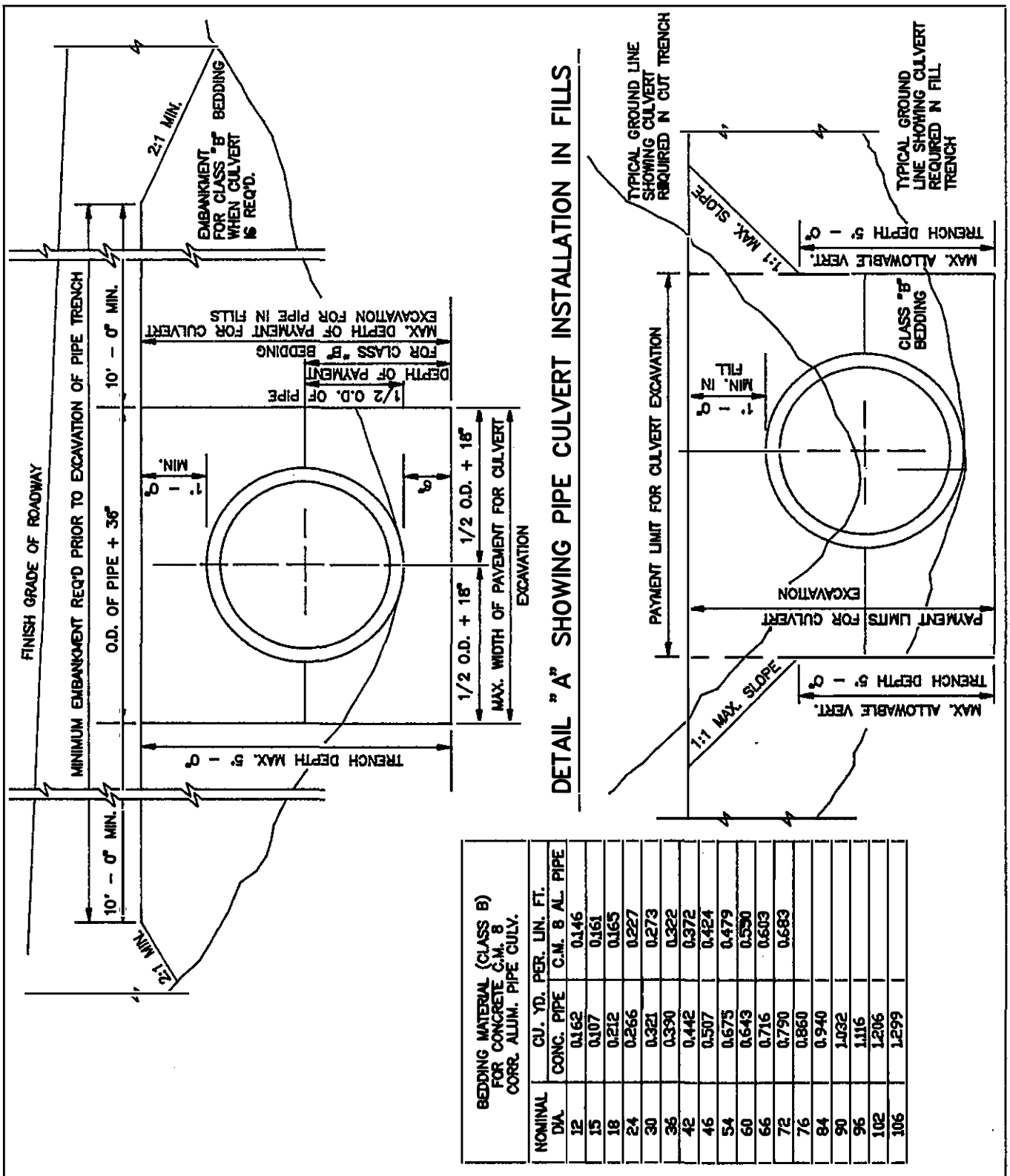
| b/D | a/D | c/D | d/D | ENTRANCE TYPE |
|---|---|---|---|---|
| 0.042 | 0.063 | 0.042 | 0.083 | A |
| 0.083 | 0.125 | 0.042 | 0.125 | B |




| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS W/ BEVELED RING INLET CONTROL | DRAWING NO. HWDCPC--BR--1 |
|---|---|---|---|

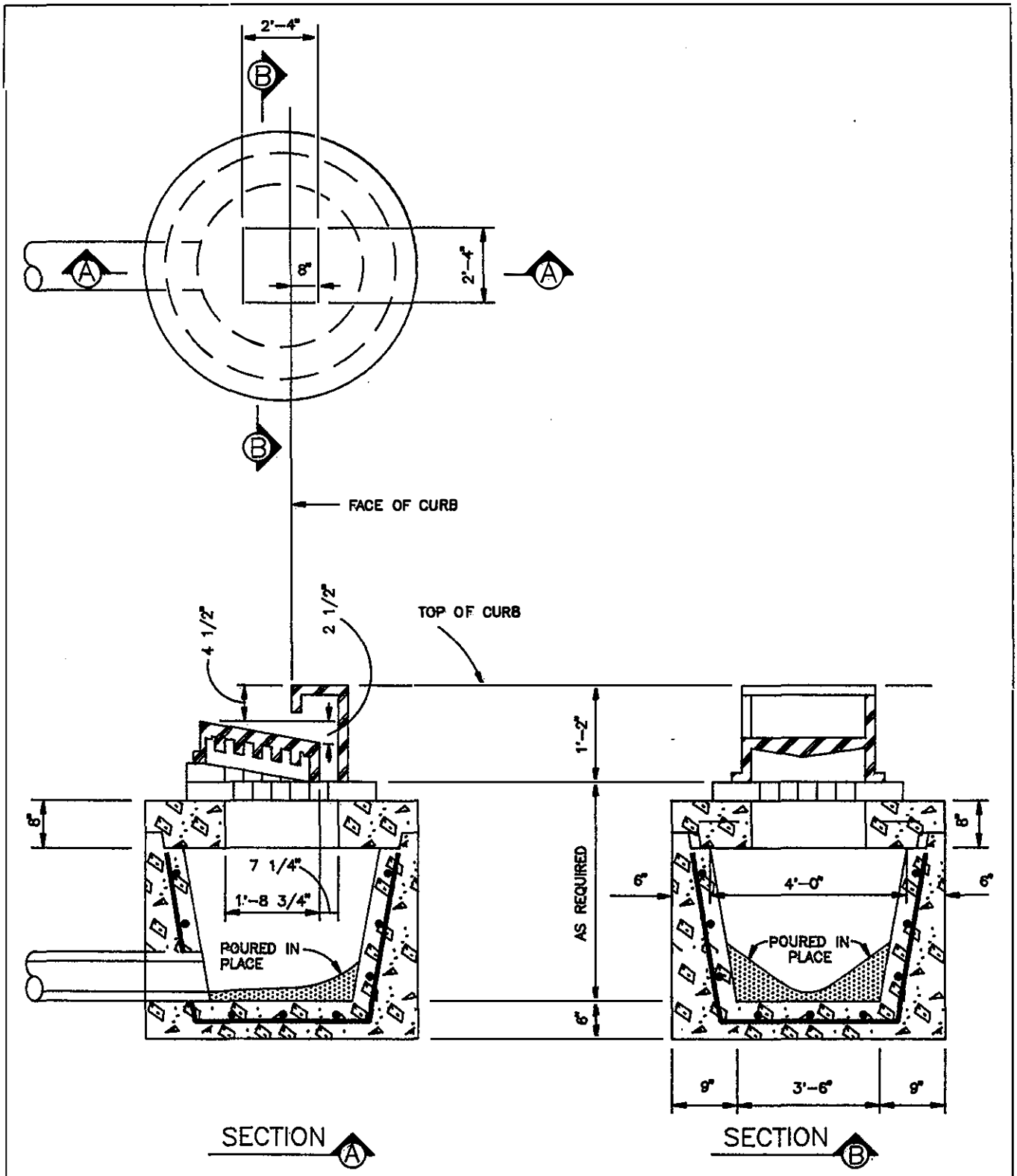



| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HEADWATER DEPTH FOR CORRUGATED METAL PIPE CULVERTS W/INLET CONTROL | DRAWING NO. HWDCMPC–1 |
|---|---|---|---|

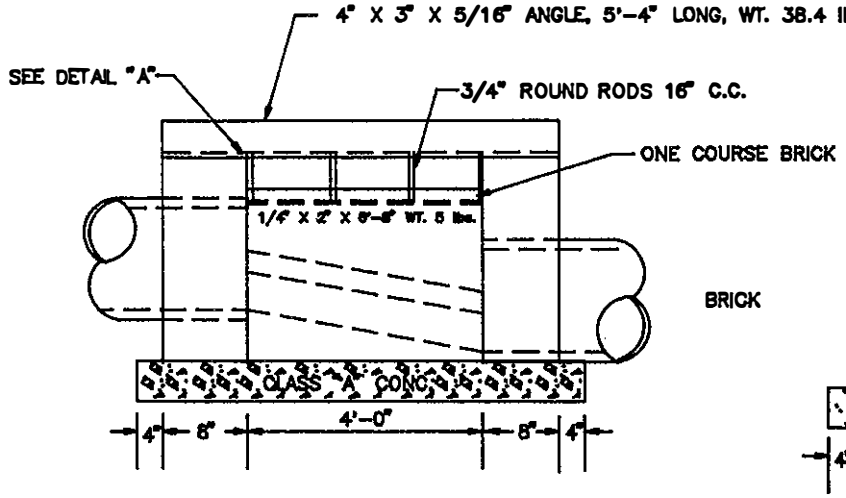



| BEDDING MATERIAL (CLASS B) FOR CONCRETE C.M. & CORR. ALUM. PIPE CULV. | | | |
|---|---|---|---|
| NOMINAL DIA. | CU. YD. PER. LIN. FT. | | |
| | CONC. PIPE | C.M. & AL. PIPE | |
| 12 | 0.162 | 0.146 | |
| 15 | 0.107 | 0.161 | |
| 18 | 0.212 | 0.165 | |
| 24 | 0.266 | 0.227 | |
| 30 | 0.321 | 0.273 | |
| 36 | 0.390 | 0.322 | |
| 42 | 0.442 | 0.372 | |
| 48 | 0.507 | 0.424 | |
| 54 | 0.675 | 0.479 | |
| 60 | 0.643 | 0.530 | |
| 66 | 0.716 | 0.603 | |
| 72 | 0.790 | 0.683 | |
| 76 | 0.860 | | |
| 84 | 0.940 | | |
| 90 | 1.032 | | |
| 96 | 1.116 | | |
| 102 | 1.206 | | |
| 106 | 1.299 | | |

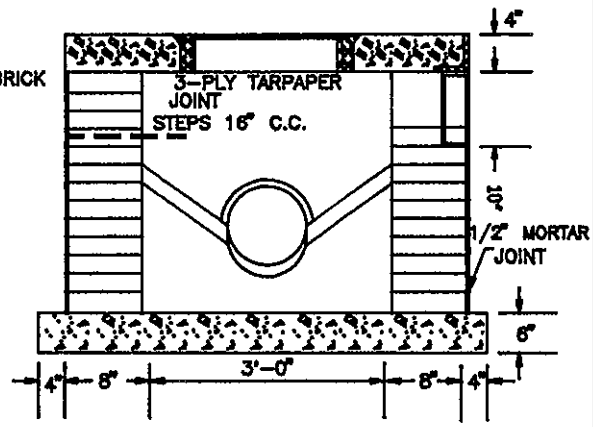
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CULVERT INSTALLATION DETAILS | DRAWING NO. CI-1 |
|---|---|---|---|



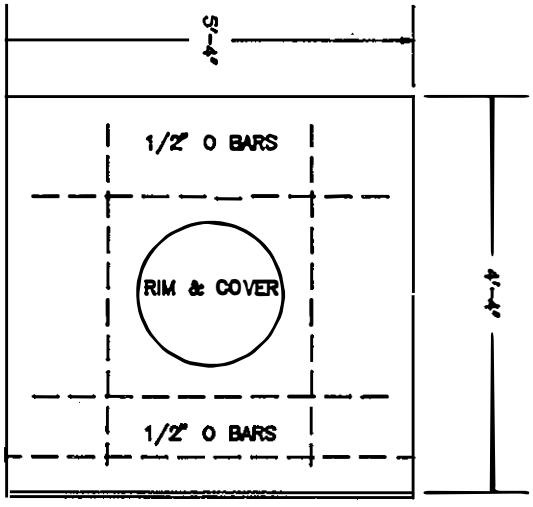

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | PRECAST CATCH BASIN | DRAWING NO. PCB-1 |
|---|---|---|---|



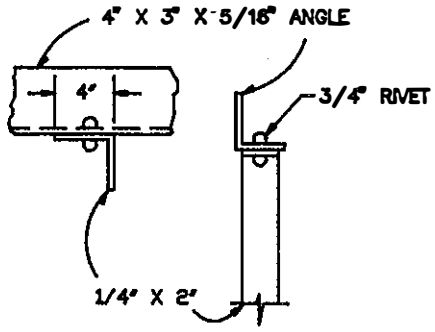

SECTIONAL ELEVATION




SECTION

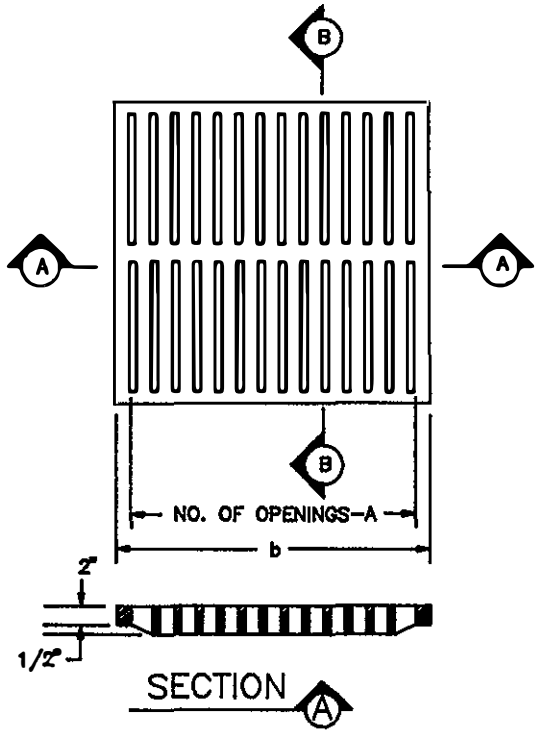



PLAN OF COVER

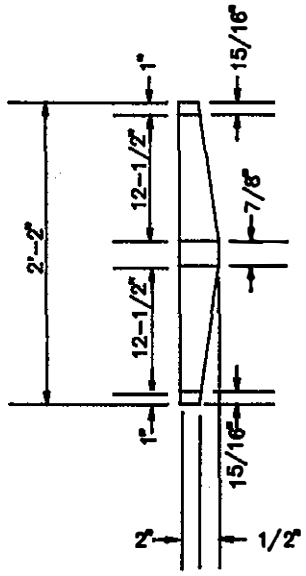



DETAIL "A"

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | FIELD BASIN WITH SIDE OPENING | DRAWING NO. FB-1 |
|---|---|---|---|

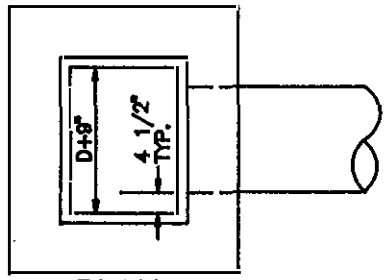



SECTION A

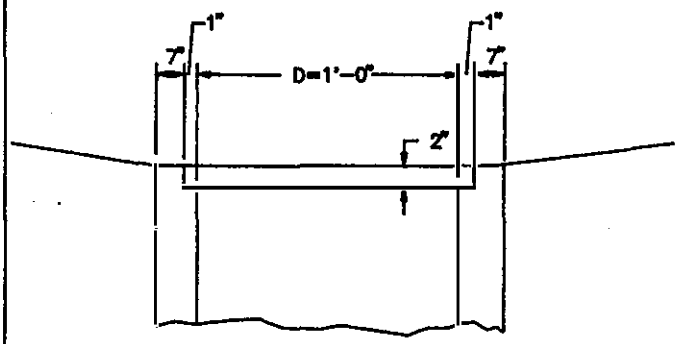



SECTION B

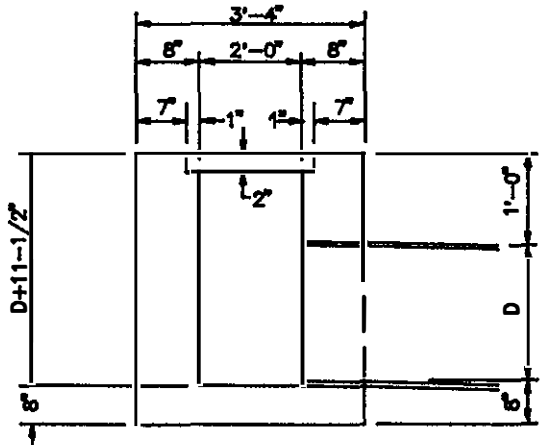
| A | B | GRATING NO. |
|---|---|---|
| 14 | 2'-5" | 6 1 |
| 17 | 2'-11" | 6 2 |
| 20 | 3'-5" | 6 3 |
| 23 | 3'-11" | 6 4 |




PLAN

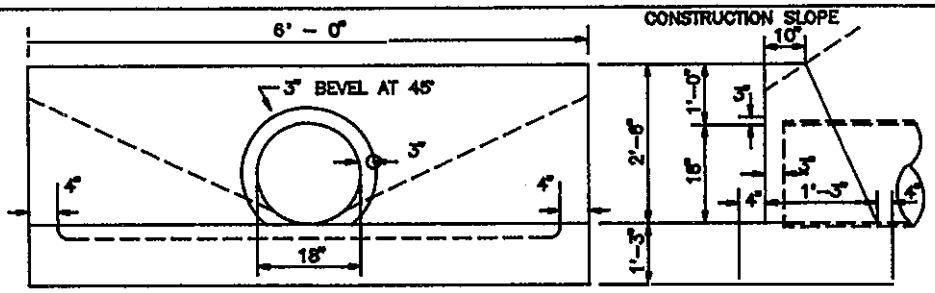



NOTE: TOP OF INLET TO BE LOWER THAN ADJACENT SURFACE TO FORM SUMP AS DIRECTED BY THE ENGINEER

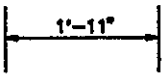



ELEVATION

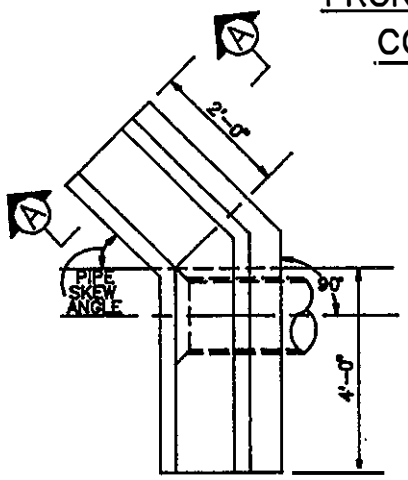
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | FIELD BASIN WITH GRATE | DRAWING NO. FB-2 |
|---|---|---|---|




FRONT ELEVATION FOR STRAIGHT CONCRETE HEADWALL

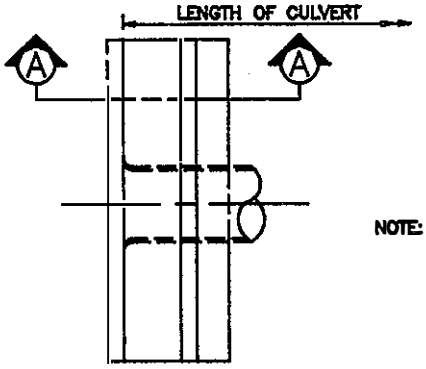



END ELEVATION



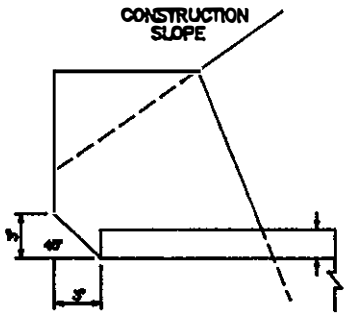

PLAN

HEADWALL FOR INLET END WHEN PIPE IS SKEWED

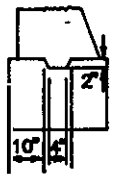



PLAN

NOTE: DIMENSIONS ARE FOR AN 18" ϕ PIPE

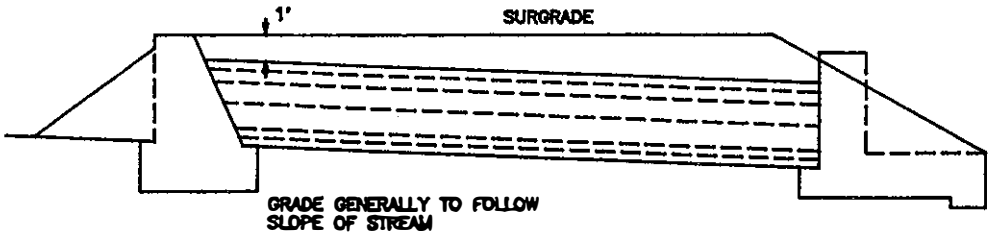



DETAIL OF BEVEL




SECTION A

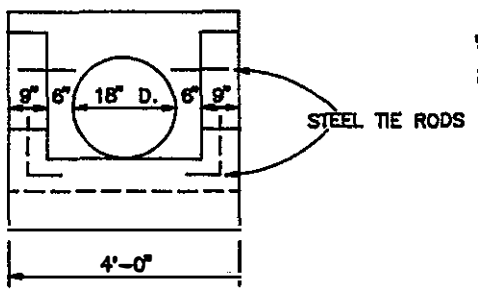
SHOWING CONST. JOINT




SECTION OF ROADWAY

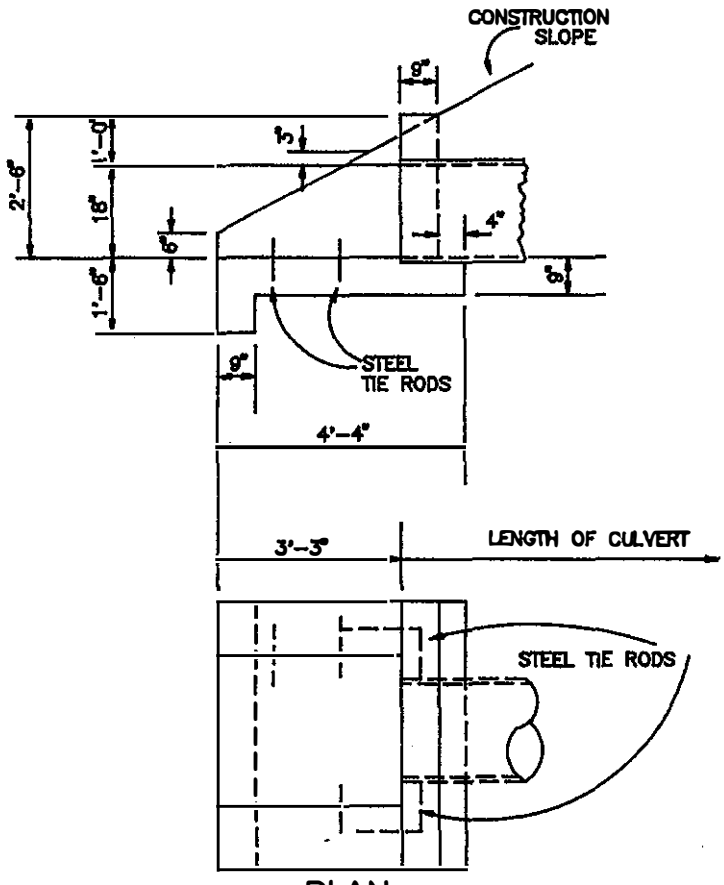
SHOWING REQUIRED MINIMUM DEPTH OF FILL OVER CULVERT

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CULVERT HEADWALL DETAILS | DRAWING NO. CH–1 |
|---|---|---|---|

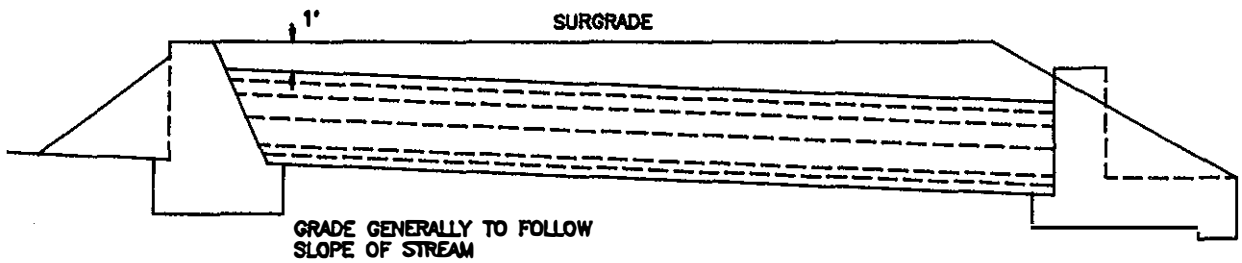



FRONT ELEVATION FOR CONCRETE ENDWALL WITH U – TYPE WINGS

NOTE: DIMENSIONS ARE FOR AN 18" ϕ PIPE



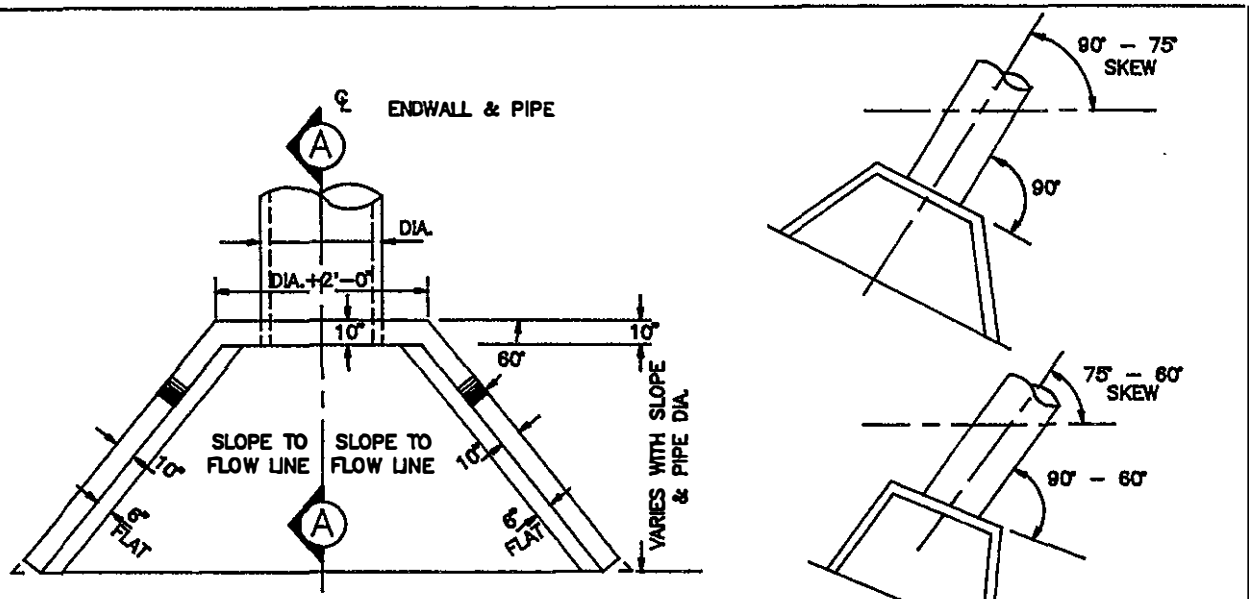

PLAN




SECTION OF ROADWAY

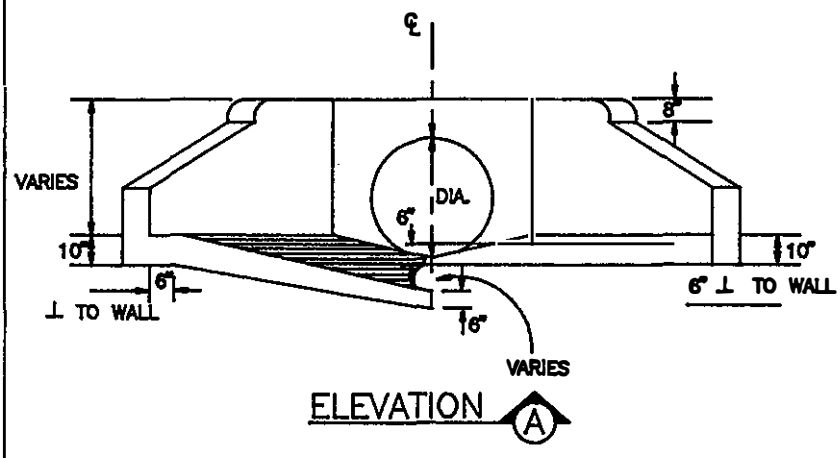
SHOWING REQUIRED MINIMUM DEPTH OF FILL OVER CULVERT

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CULVERT HEADWALL DETAILS | DRAWING NO. CH–2 |
|---|---|---|---|

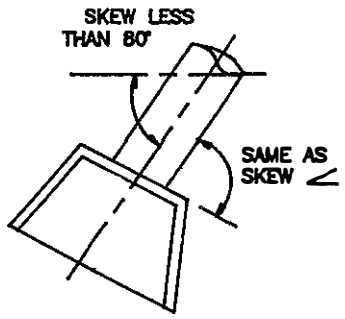


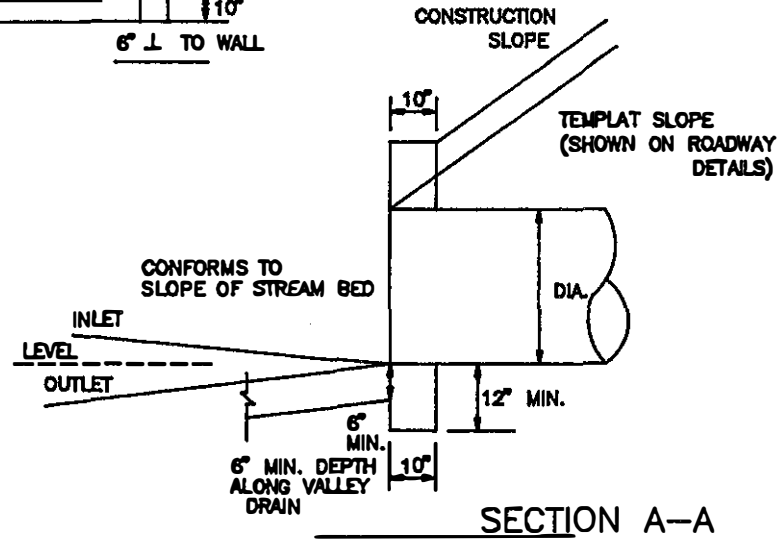

PLAN




ELEVATION A

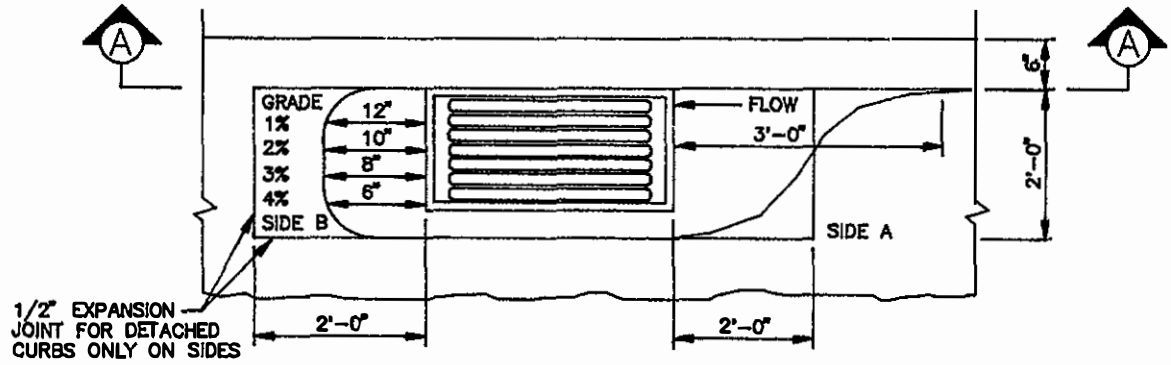


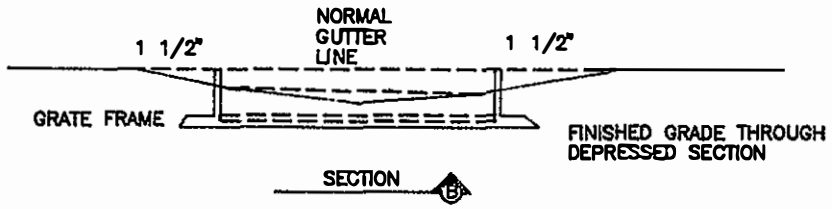




SECTION A–A

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CULVERT HEADWALL DETAILS | DRAWING NO. CH–3 |
|---|---|---|---|

NOTE: IN LOW POINTS BUILD SIDE A ON BOTH SIDES OF GRATE.

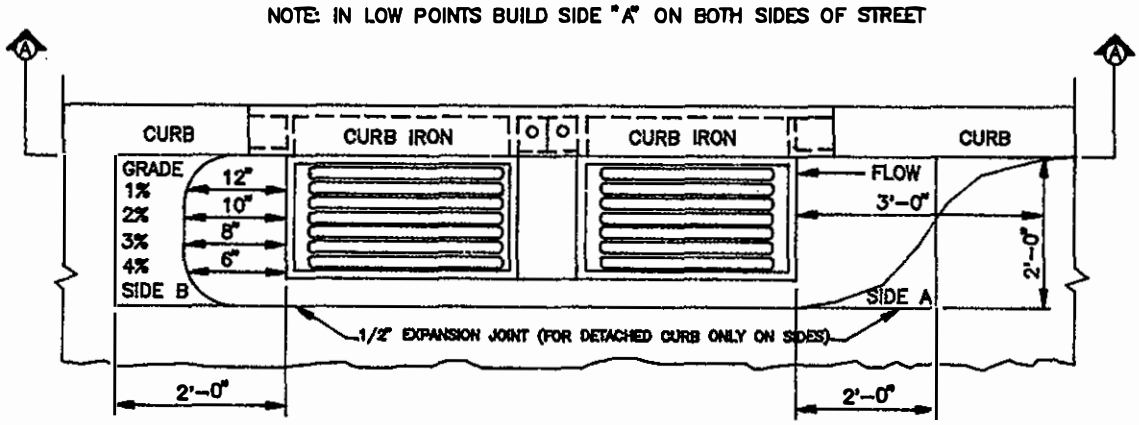


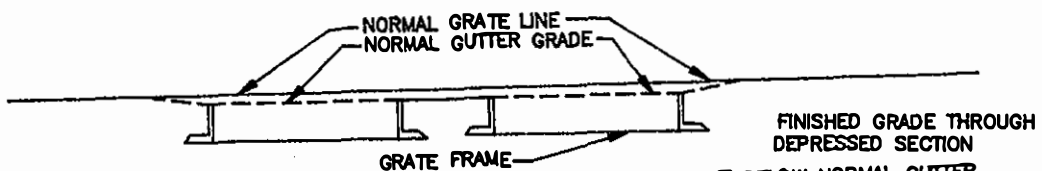




SECTION (B)

SUMP DIAGRAM FOR GRADES LESS THAN 5%
DROP EACH CORNER OF GRATE FRAME 1 1/2" BELOW NORMAL GUTTER LINE

NOTE: IN LOW POINTS BUILD SIDE "A" ON BOTH SIDES OF STREET

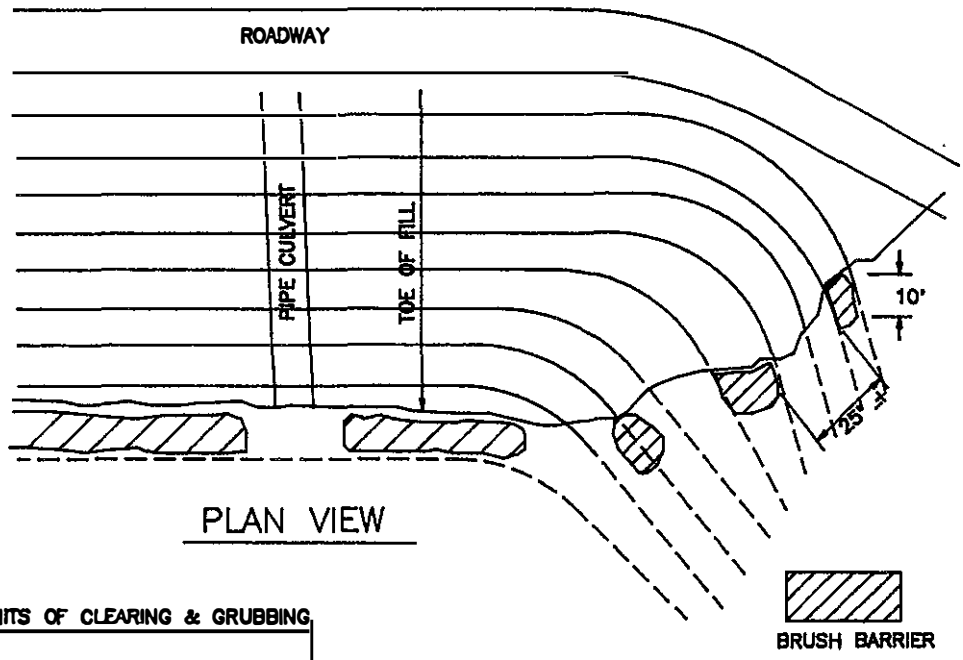


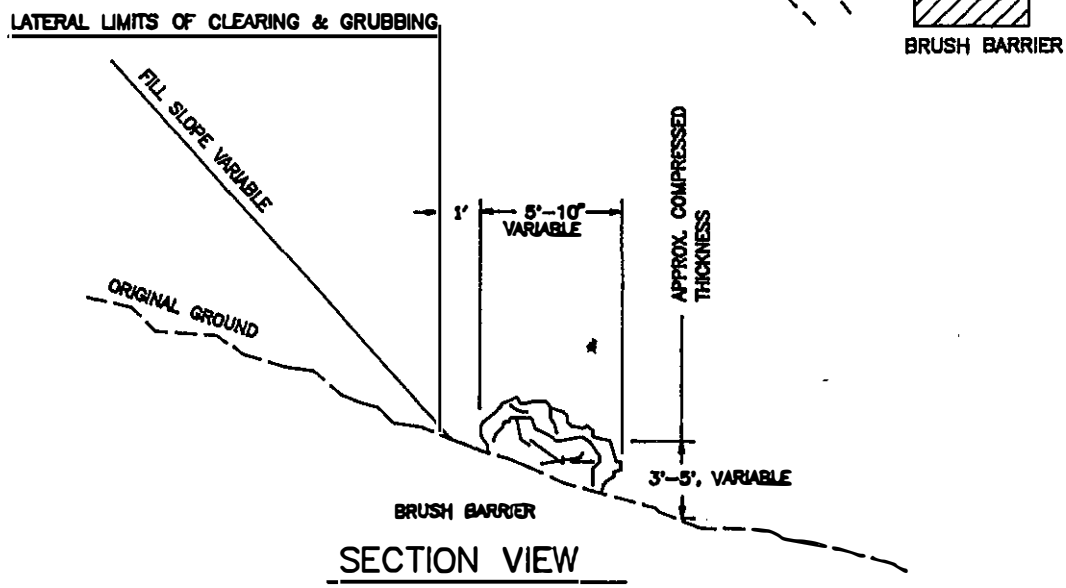




DROP GATE FRAME 1 1/2" AT BACK & FRONT BELOW NORMAL GUTTER
SUMP DIAGRAM FOR GRADES LESS THAN 5%

SECTION (A)

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SINGLE & COMBINATION CURB INLETS | DRAWING NO. SCCI-1 |
|---|---|---|---|




① BRUSH BARRIERS SHALL CONSIST OF BRUSH, TREES AND TRIMMINGS, SHRUBS, PLANTS OR OTHER APPROVED REFUSE FROM THE CLEARINGS AND GRUBBING OPERATION.

② BRUSH BARRIERS SHALL BE CONSTRUCTED AT LOCATIONS WHERE DESIGNATED BY THE ENGINEER.

③ IN BRUSH BARRIER LOCATIONS, CLEARING SHALL BE LIMITED BY TREES, SHRUBS AND PLANTS LESS THAN 12" DIAMETER. GRUBBING SHALL NOT BE PERFORMED.

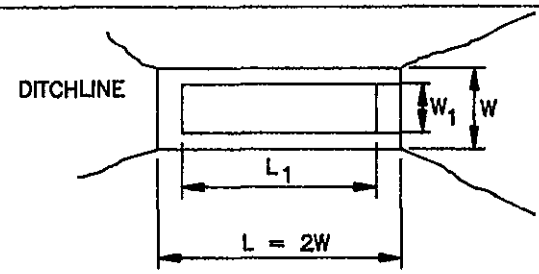
④ THE BRUSH BARRIER SHALL BE CONSTRUCTED APPROXIMATELY PARALLEL TO ORIGINAL GROUND CONTOUR.

⑤ THE TOP OF THE BRUSH BARRIER SHALL BE AT LEAST 5-FEET BELOW THE FINISHED ROADWAY.

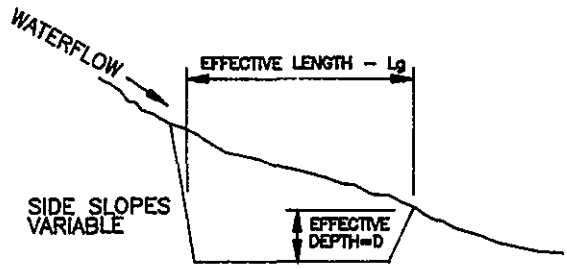
⑥ THE BRUSH BARRIER SHALL NOT SUPPORT THE EMBANKMENT.

⑦ THE BRUSH BARRIER SHALL BE COMPRESSED.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | BRUSH BARRIER | DRAWING NO. BB-1 |
|---|---|---|---|

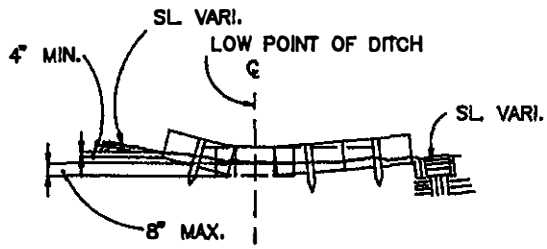



PLAN VIEW

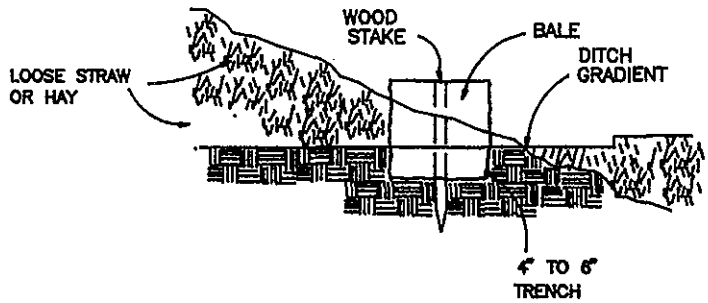


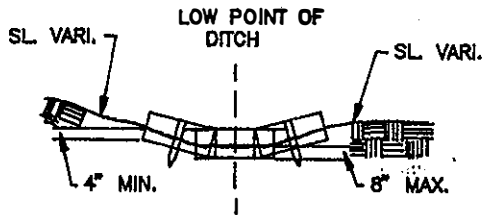

SIDE VIEW

# TYPICAL SEDIMENT TRAP

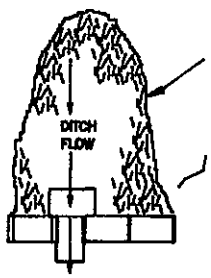



SECTION A

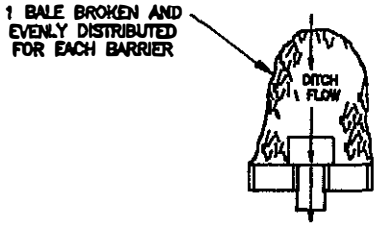



SECTION B

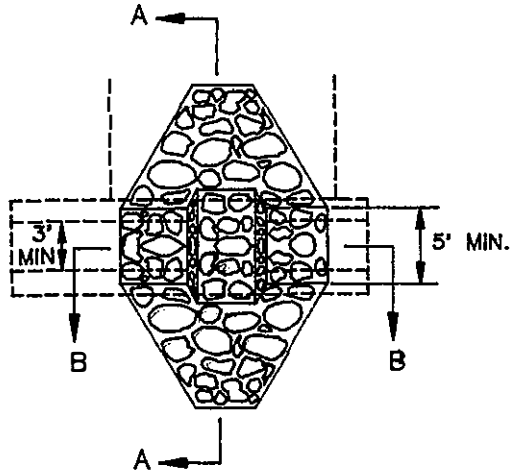



PLAN A

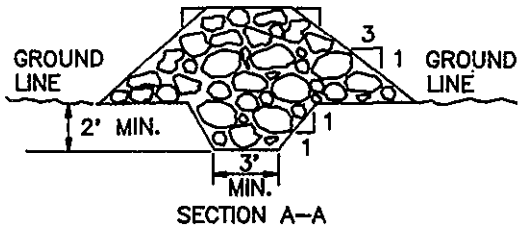



PLAN B

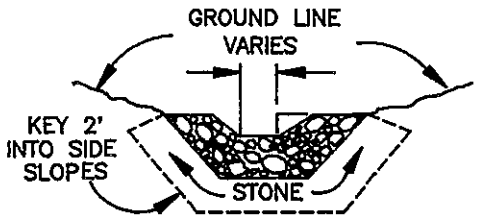
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SEDIMENT TRAP DETAILS | DRAWING NO. ST-1 |
|---|---|---|---|




NOTE: DIRT CORE ALLOWABLE AS WELL AS OTHER MEANS TO SEAL DAM WHEN FINES ARE NOT AVAILABLE

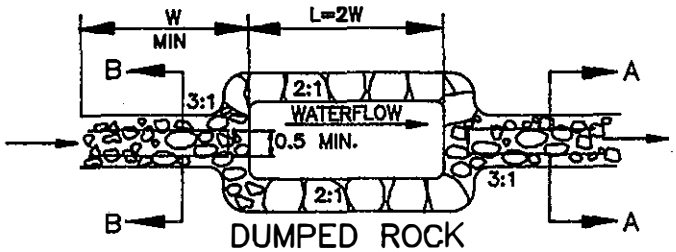



SECTION A–A

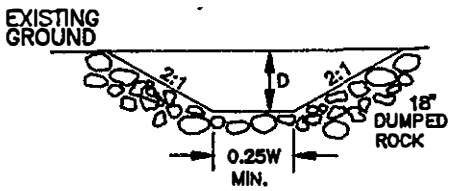



UPSTREAM ELEVATION
SECTION B–B

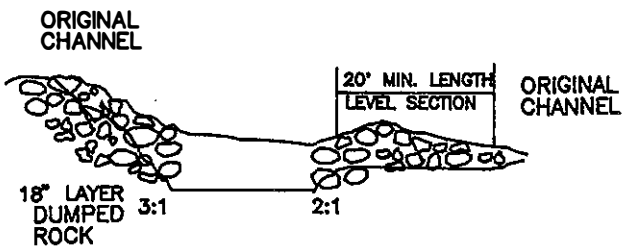
# STONE CHECK DAM



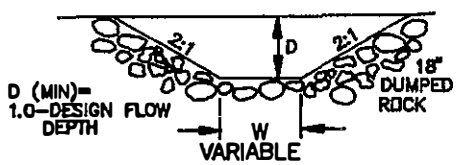

PLAN VIEW




SECTION A–A



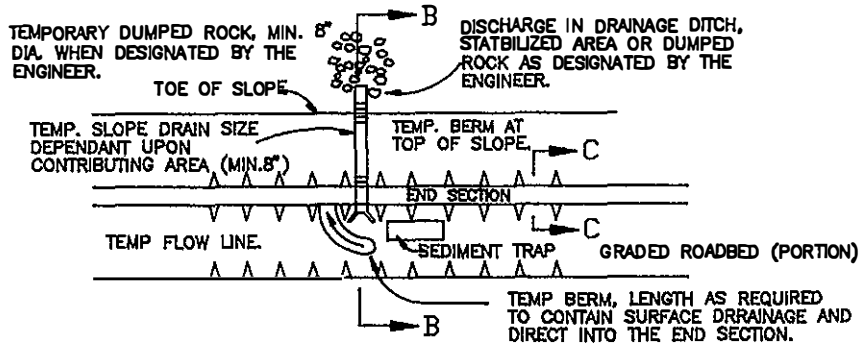

SIDE VIEW



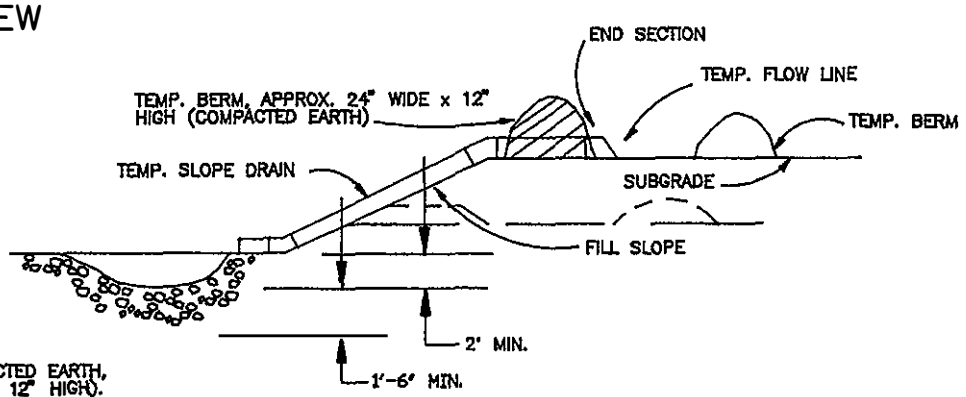

W VARIABLE–VARIES FROM WIDTH OF STREAM TO 1/2 WIDTH OF POND.

SECTION B–B

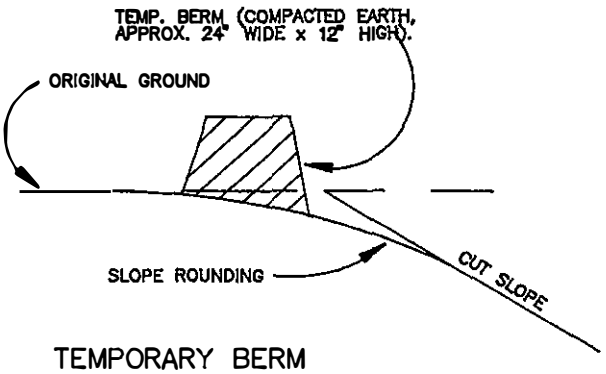
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | SEDIMENT POND DETAILS | DRAWING NO. SP–1 |
|---|---|---|---|



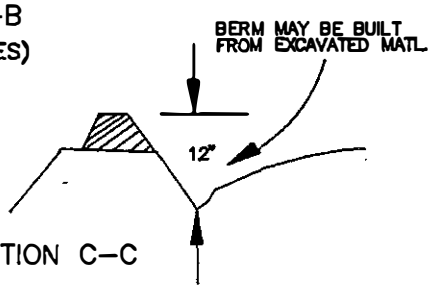

PLAN VIEW




SECTION B–B
(FOR FILL SLOPES)




TEMPORARY BERM




SECTION C–C

1. SEDIMENT TRAPS SHALL BE CONSTRUCTED PRECEEDING ALL CULVERT INLETS OR OTHER DRAINS AND IN ALL DITCHES BEFORE THE WATER (RUNOFF) LEAVES THE PROJECT, CONSTRUCTION LIMITS OR ENTERS A STREAM, AND AT OTHER LOCATIONS DESIGNATE BY THE ENGINEER.

2. SEDIMENT TRAPS SHALL BE CLEANED OF ACCUMULATED SEDIMENT WHEN APPROXIMATELY FIFTY PERCENT FILLED WITH SUCH SEDIMENT.

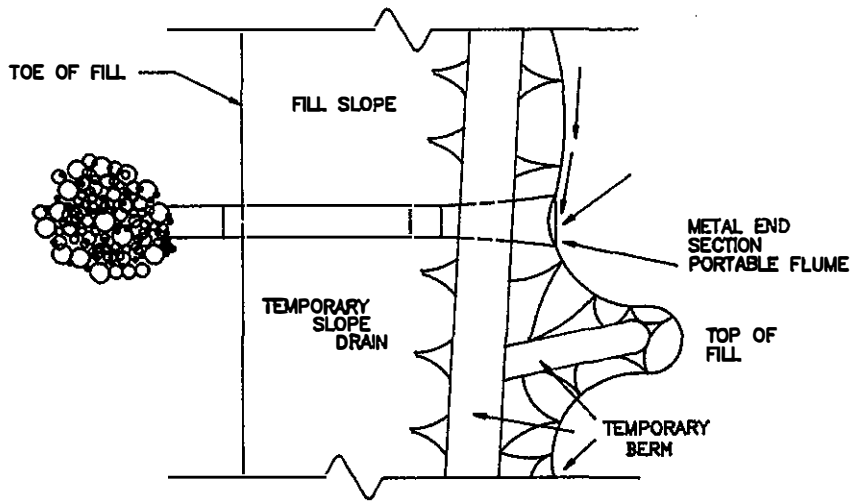
3. TEMP. SLOPE DRAINS (BERMS,DRAINS,AND DUMPED ROCK IF NECESSARY) SHALL BE USED AS THE EMBANKMENT IS CONSTRUCTE LOCATION AND SPACING OF THE DRAIN ASSEMBLY SHALL BE DESIGNATED BY THE ENGINEER. ALL SLOPE DRAINS SHALL BE IN P BY THE END OF EACH WORK SHIFT. THE DRAIN ASSEMBLIES SHALL BE USED UNTIL THE SLOPES ARE PROTECTED WITH PERMANEN SOIL EROSION CONTROL MEASURES.

4. TEMP. BERMS SHALL BE CONSTRUCTED AT THE TOP OF ALL ERODIBLE CUT SLOPES DESIGNATED BY THE ENGINEER. THE GRADIENT OF THE BERMS SHALL BE THE MINIMUM POSSIBLE WHICH CONDITIONS PERMIT. WHERE EXCESSIVE GRADIENTS ARE NECESSARY, CHECK DAMS, SUCH AS EARTH DAMS, LOGS, DUMPED ROCK, ETC., SHALL BE USED IN ORDER TO REDUCE THE VELOCI OF THE RUNOFF.

5. ALL DIMENSIONS AND LOCATIONS OF TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL DEVICES SHALL BE SUBJECT TO ADJUSTMENT, AS DESIGNATED BY THE ENGINEER.

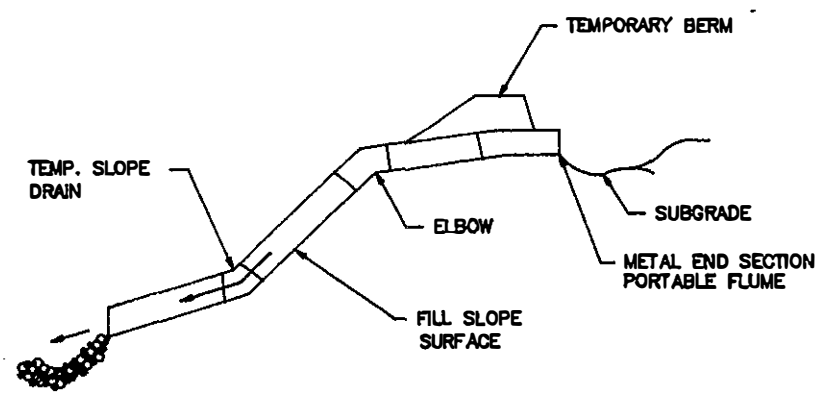
6. WHEN THE TEMP. SOIL EROSION AND WATER POLLUTION CONTROL DEVICES ARE NO LONGER REQUIRED FOR THE INTENDED PURPOSE IN THE OPINION OF THE ENGINEER, THEY SHALL BE OBLITERATED.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | TEMPORARY SLOPE DRAIN | DRAWING NO. TSD–1 |
|---|---|---|---|




PLAN VIEW

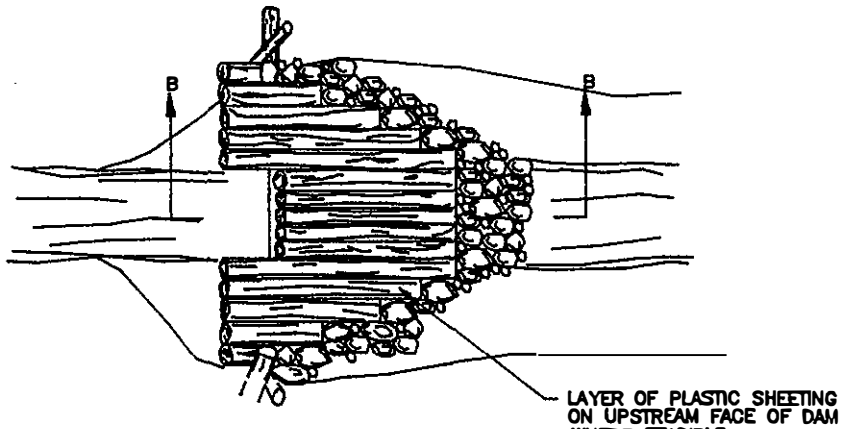
METAL, FLEXIBLE RUBBER, OR PLASTIC PIPE



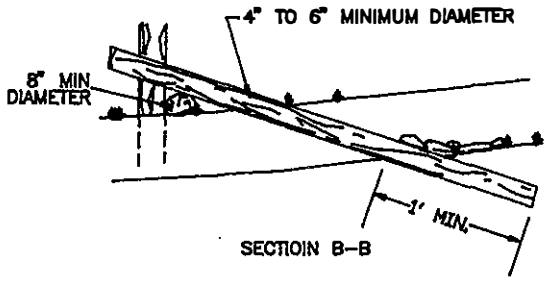

END VIEW

NOTE: IN SOME CASES IT MAY BE NECESSARY TO EMBED METAL OR PLASTIC PIPE INTO THE FILL SLOPE TO SECURE THE PROPER ANCORAGE.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | TEMPORARY SLOPE DRAIN | DRAWING NO. |
|---|---|---|---|
| | | | TSD–2 |

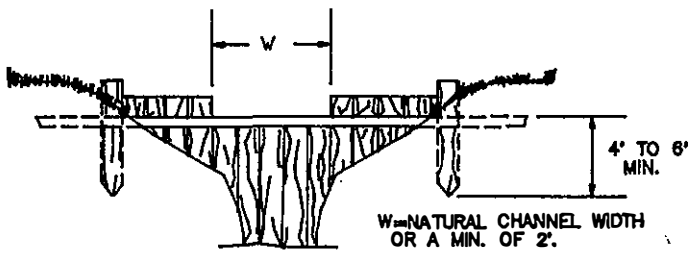



PLAN VIEW

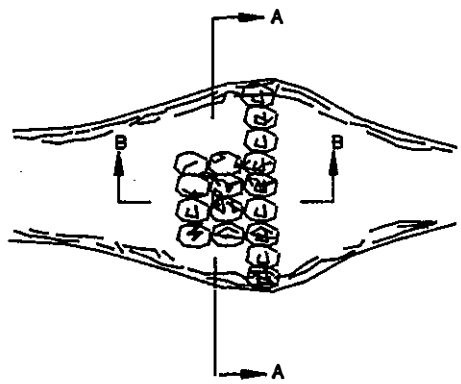



SECTIOIN B–B

KEYED INTO EXIST. GROUND A MIN. OF 1'. IF STREAM BED IS ROCK, A 1' COMPACTED LAYER IS REQUIRED.

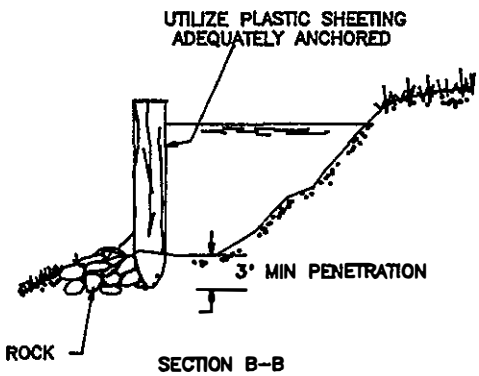



UPSTREAM VIEW



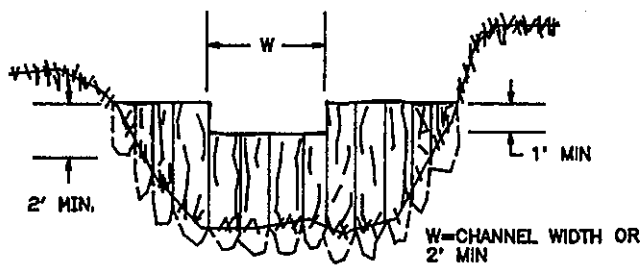

PLAN VIEW

TYPE A




SECTION B–B

TYPE B

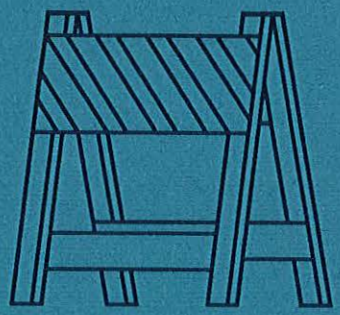



SECTION A–A

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | LOG & POLE CHECK DAM | DRAWING NO. LPCD–1 |
|---|---|---|---|

# DESIGN CRITERIA

## Streets



# DESIGN CRITERIA
# STREETS

## SCOPE

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

## GENERAL

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.

## DESIGN ELEMENTS

### DESIGN TRAFFIC VOLUMES

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.

### DESIGN SPEED AND SIGHT DISTANCE

Relation of Sight Distance to Design Speed

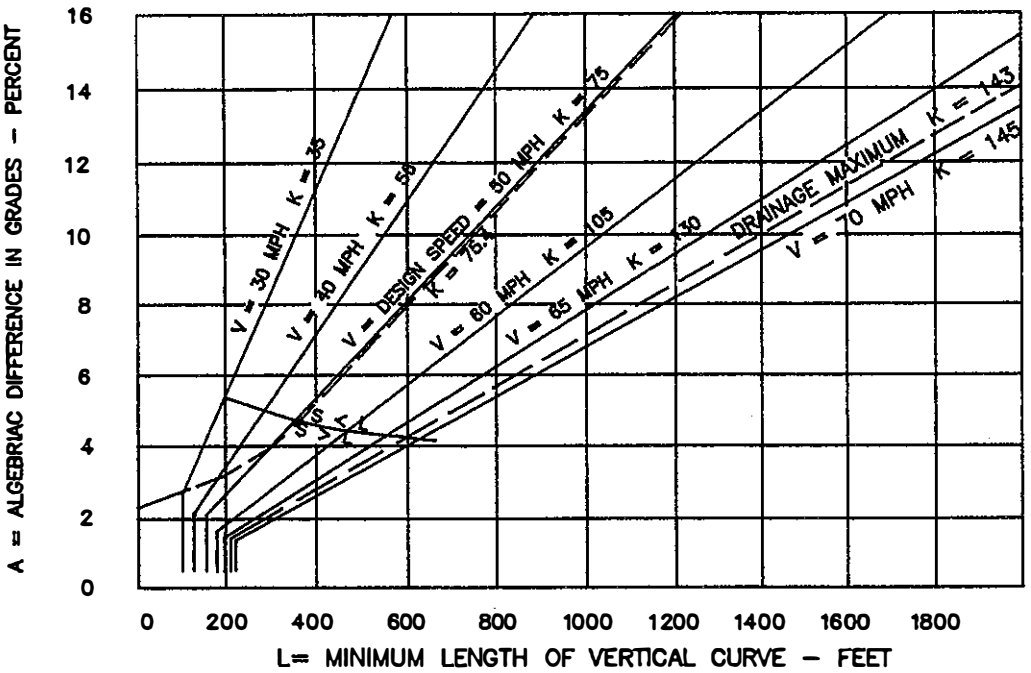
| | — Design Speed, mph — | | |
|---|---|---|---|
| | 30 | 40 | 50 |
| Minimum stopping sight distance, feet | 200 | 275 | 350 |
| Desirable stopping sight distance, feet | 200 | 300 | 450 |
| Minimum passing sight distance, feet | 1,100 | 1,500 | 1,800 |

### ALIGNMENT

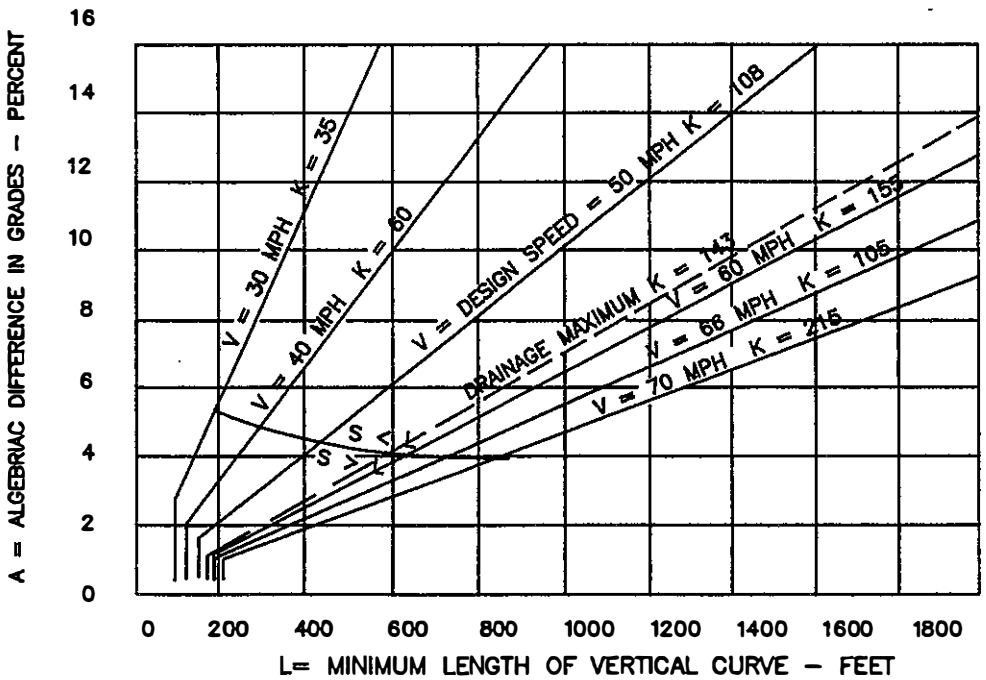
Terrain has considerable influence on the final choice of alignment. Generally, the topography of an area is fitted into one of the following three classifications: flat, rolling, or hilly.

| 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 distances.

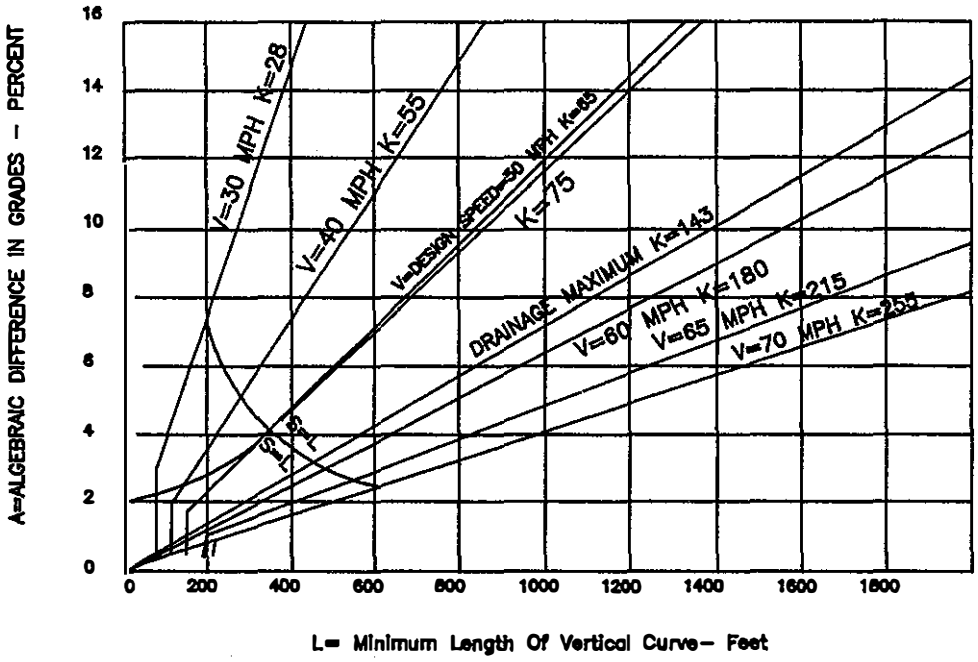



BASED ON MINIMUM STOPPING SIGHT DISTANCE

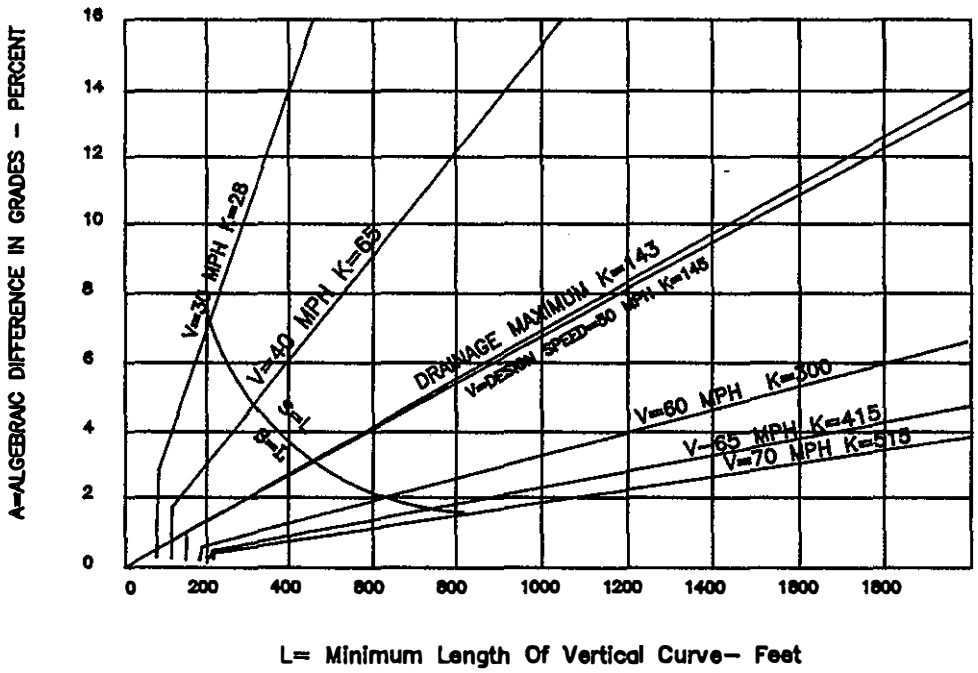



BASED ON DESIRABLE STOPPING SIGHT DISTANCE

DESIGN CONTROLS FOR SAG VERTICAL CURVES




BASED ON MINIMUM STOPPING SIGHT DISTANCE




BASED ON DESIRABLE STOPPING DISTANCE

DESIGN CONTROLS FOR CREST VERTICAL CURVES

Maximum superelevation rates of 0.04 to 0.06 feet per foot shall be used on arterial streets. The lower value should be used where snow and ice are significant factors. This is particularly true on facilities with numerous structures, as bridge decks generally freeze more rapidly than other roadway sections. Use the following table for residential streets.

VALUES FOR DESIGN ELEMENTS RELATED TO DESIGN SPEED AND HORIZONTAL CURVATURE

| | | V=30 mph | | | V=40 mph | | | V=50 mph | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | e | L-Feet | | e | L-Feet | | e | L-Feet | |
| D | R | | 2-lane | 4-lane | | 2-lane | 4-lane | | 2-lane | 4-lane |
| 0°15' | 22918' | NC | 0 | 0 | NC | 0 | 0 | NC | 0 | 0 |
| 0°30' | 11459' | NC | 0 | 0 | NC | 0 | 0 | NC | 0 | 0 |
| 0°45' | 7639' | NC | 0 | 0 | NC | 0 | 0 | RC | 150 | 150 |
| 1°00' | 5730' | NC | 0 | 0 | RC | 125 | 125 | .021 | 150 | 150 |
| 1°30' | 3820' | RC | 100 | 100 | .021 | 125 | 125 | .030 | 150 | 150 |
| 2°00' | 2865' | RC | 100 | 100 | .027 | 125 | 125 | .038 | 150 | 150 |
| 2°30' | 2292' | .021 | 100 | 100 | .033 | 125 | 125 | .046 | 150 | 170 |
| 3°00' | 1910' | .025 | 100 | 100 | .038 | 125 | 125 | .053 | 150 | 190 |
| 3°30' | 1637' | .028 | 100 | 100 | .043 | 125 | 140 | .058 | 150 | 210 |
| 4°00' | 1432' | .032 | 100 | 100 | .047 | 125 | 150 | .063 | 150 | 230 |
| 5°00' | 1146' | .038 | 100 | 100 | .055 | 125 | 170 | .071 | 170 | 260 |
| 6°00' | 955' | .043 | 100 | 120 | .061 | 130 | 190 | .077 | 180 | 280 |
| 7°00' | 819' | .048 | 100 | 130 | .067 | 140 | 210 | .079 | 190 | 280 |
| 8°00' | 716' | .052 | 100 | 140 | .071 | 150 | 220 | .080 | 190 | 290 |
| 9°00' | 637' | .056 | 100 | 150 | .075 | 160 | 240 | D max. = 7.5° | | |
| 10°00' | 573' | .059 | 110 | 160 | .077 | 160 | 240 | | | |
| 11°00' | 521' | .063 | 110 | 170 | .079 | 170 | 250 | | | |
| 12°00' | 477' | .066 | 120 | 180 | .080 | 170 | 250 | | | |
| 13°00' | 441' | .068 | 120 | 180 | .080 | 170 | 250 | | | |
| 14°00' | 409' | .070 | 130 | 190 | D max. = 12.5° | | | | | |
| 16°00' | 358' | .074 | 130 | 200 | | | | | | |
| 18°00' | 318' | .077 | 140 | 210 | | | | | | |
| 20°00' | 286' | .079 | 140 | 210 | | | | | | |
| 22°00' | 260 | .080 | 140 | 220 | | | | | | |
| | | .080 | 140 | 220 | | | | | | |
| | | D max. = 23.0° | | | | | | | | |

e max. = 0.08

D- Degree of curve
R- Radius of curve
V- Assumed design speed
e- Rate of Superelevation

L- Minimum length of run-off or spiral curve
NC-Normal crown section
RC-Remove adverse crown, superelevate at normal crown slope
Spirals desirable but not as essential above heavy line
Lengths rounded in multiples of 25 or 50 feet permit simpler calculations

Alignment design should be so arranged as to avoid superelevation transition on bridge decks, in order to prevent ponding in the area of zero superelevation in the crown change zone.

## PAVEMENT CROWN

Plane sections shall be used on urban streets with .018 feet of drop per foot of width.

Plane or curved sections may be used on residential streets with a total crown of at least 0.2 feet.

Pavement for undivided streets, regardless of the number of lanes, are normally sloped each way from the centerline.

## NUMBER OF LANES

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 for 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

## ROADWAY WIDTHS

Roadway widths are determined by the number of lanes required to accommodate the traffic. The minimum width for any roadway is 29 feet from back of curb to back of curb and included two (2) 12 foot wide lanes. Minimum roadway cross section areas for different locations are shown in the standard detail drawings.

## MEDIAN

Medians shall be a minimum of 14 feet wide. Median widths of 14 to 60 feet are more desirable for streets with design speeds at 50 mph and greater. These wider median strips shall be used and determined according to specific right-of-way restrictions such as building development, right-of-way costs, etc.

## CURBS, GUTTERS, AND SIDEWALKS

Dimensions and other pertinent information for the various types of curbs, gutters, and sidewalks are shown on the detail drawings following this section.

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.

## DRIVEWAYS

### LOCATION INTERIOR LOT

Minimum distance from edge of driveway to property line:
Residential - 5 feet.
Commercial - 12.5 feet.

### WIDTH

Residential - minimum 10 feet, maximum 20 feet.
Commercial - 20 feet maximum one way.
Commercial - 40 feet maximum two way.

### DRIVEWAY ANGLE

Two way operation from two way street - 90 degrees.
One way operation form two way street - 90 degrees.
One way for one way operation with divided highway travel -
60 degrees maximum and 45 degrees minimum.

### INTERSECTING RADIUS OF PAVEMENT

Residential - minimum 5 feet, maximum 15 feet.
Commercial - minimum 5 feet, maximum 20 feet.

### DOUBLE DRIVEWAY

25 feet minimum, but not less than the adjacent width opening of driveway. Minimum distance between double driveways shall be 25 feet, but not less than the width opening of the adjacent driveway.

### CORNER CLEARANCE

The minimum corner clearance shall be 25 feet. Where there are traffic signals at the intersection, desirably the near side clearance should be two or more times the far side.

## BRIDGE WIDTH

The following is recommended width for a two lane road - one lane each way.

| | ---------- ADT - Design Year ---------- | |
|---|---|---|
| **Bridge Length Feet** | 0-2,000<br>**Curb to Curb** | **Above 2,000**<br>**Curb to Curb** |
| 0-80 | Full Shoulder Width | Full Shoulder Width |
| 80-300 | 30 Feet | Full Shoulder Width |
| Above 300 | 30 Feet | 30 Feet |

## LATERAL CLEARANCE

Where there is no curb and gutter or any obstruction in the shoulder or front slope of the roadside ditch, a guardrail shall be erected.

## RIGHT-OF-WAY WIDTH

Right-of-way width will vary from 50 feet to 180 feet, plus construction easement slope, depending on the anticipated volume of traffic 20 year hence.

## ACCOMMODATION OF UTILITIES

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

## RAILROAD GRADE CROSSING

All railroad intersections at grade require proper advance warning signs. At crossings on heavily traveled streets, where conditions justify, automatic devices shall be installed, in accordance with the "Manual on Uniform Traffic Control Devices."

Use grade separations at railroad crossings when train-auto conflict ratios are high.

## STREET LIGHTING

Breakaway light standards should not be utilized on arterial streets in densely developed areas, particularly with sidewalks. Light standards should not be erected along the outside of sharp curves where they are more susceptible to being struck.

Where street lighting is being considered for future installation, conduits under pavements and curbs as a part of initial construction will be required.

## TRAFFIC CONTROL DEVICES

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.

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. All other traffic control devices will be furnished by the local regulatory authority.

## EROSION CONTROL

Erosion control along roadways is discussed in Section 300, Drainage.

## PAVEMENT DESIGN

Pavements and bases are designed together and are classified in two main categories: rigid and flexible. The basic factors which provide input for a pavement design are:

a. Subgrade stability.
b. Climate.

c. Material characteristics.
d. Magnitude and frequency of anticipated traffic wheel loading.
e. Economics related to materials cost and haul distances.

RIGID PAVEMENT

The term "Rigid Pavement" means Portland cement concrete. The design consists of single stage construction which must provide an economic service life. The initial capitol investment is high and also costs for maintaining and/or correcting failures are very expensive and often result in low levels of service. For these reasons, it is recommended that an Engineer provide an individual pavement design when rigid pavement is used. This will assure that the several widely varying design parameters are properly evaluated and at the same time, determine if a rigid design is economical.

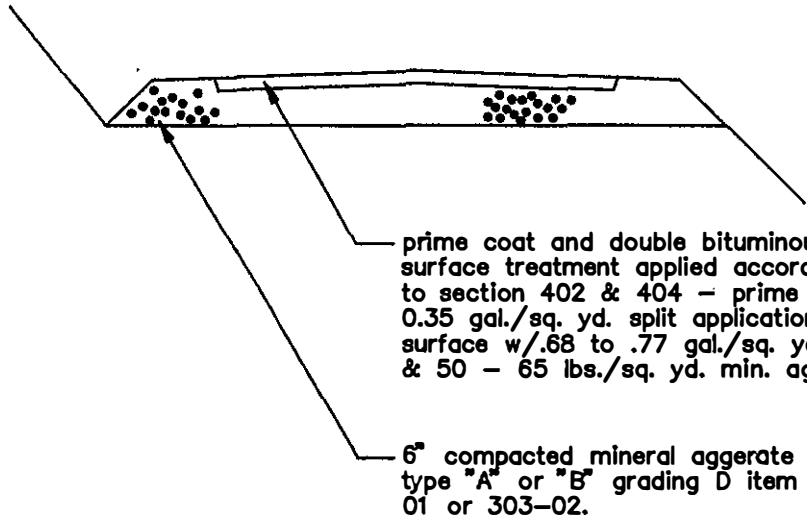
FLEXIBLE PAVEMENT

Flexible pavements can be designed for single or various stages of construction. Two basic advantages of staging the construction are:

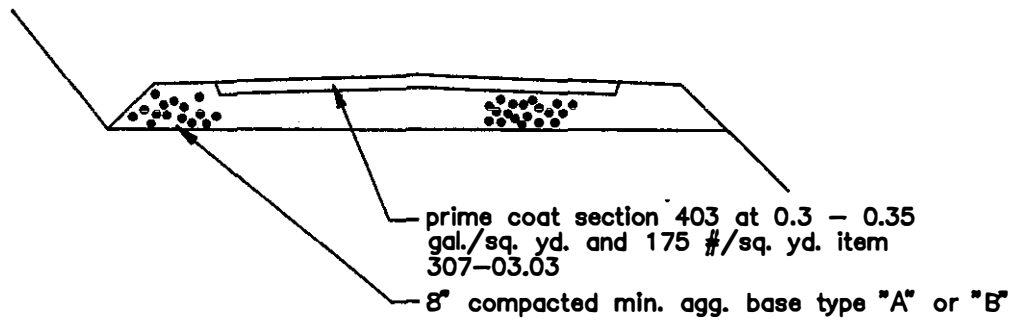
a. Lower initial investment.
b. The average age of the wearing surface is considerably less, which allows for a higher level of service.

The following are examples of base and pavement sections for first stage construction on different types of streets which have provided good, economical service levels for long periods of time. Good subgrade conditions should exist before using the examples as a minimum guide. The base and pavement material section and item numbers are from TDOT specifications.

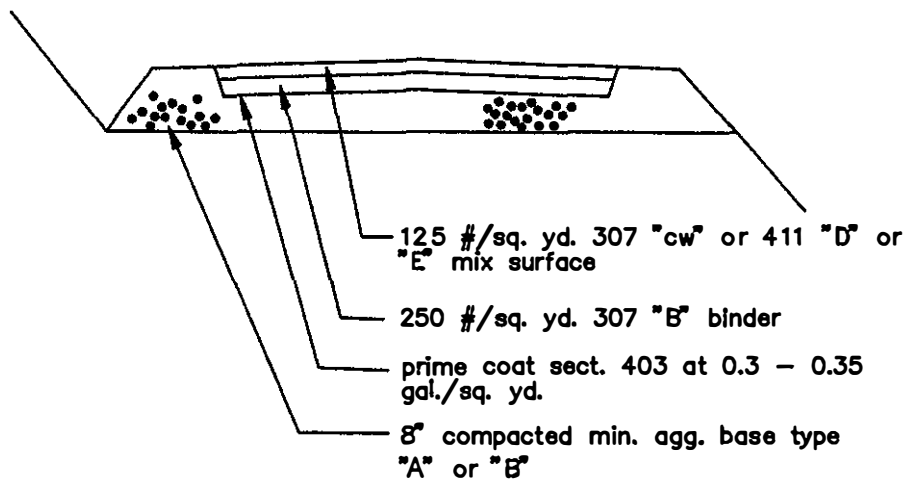
LOW VOLUME RESIDENTIAL SUBDIVISIONS (NO THRU TRAFFIC AND LESS THAN 250 A.D.T.)




OTHER RESIDENTIAL AND LOW VOLUME COLLECTORS W/LIGHT WEIGHT TRAFFIC (LESS THAN 400 A.D.T.)




COLLECTORS AND ARTERIALS WITH LESS THAN 750 A.D.T.




## STREET CROSS SECTION

Sections of additional depth would approximate full depth flexible asphaltic concrete design for many streets. These sections, due to high initial costs, should be designed individually by an Engineer. In pavement design the subgrade and any possible need for additional stabilization shall be evaluated and designed in accordance with TDOT specifications.

### SUB-BASE

A sub-base of granular material or stabilized material may be used in areas where frost action is severe, in locations where the subgrade soil is extremely weak, or where a construction working table is needed. It may also be used, in the interests of economy, in locations where suitable sub-base materials are cheaper than base materials of higher quality.

## PREPARATION OF PLANS

### GENERAL

In urban areas the design process is more involved, reflecting the complexities of urban conditions. Among the conditions that control urban design are:

a. Traffic service.
b. Land use.
c. Off-street parking.
d. Other transportation systems.
e. Topography and geology.
f. Sociological considerations.

### TITLE SHEET

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. The map shall show the point of beginning and point of ending; the main topographical features; county and state lines; and possible detour routes. 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.

### INDEX

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

### TYPICAL SECTIONS AND ESTIMATED QUANTITIES

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.

### PROPERTY MAPS

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. 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.

## PRESENT LAYOUT, PROPOSED LAYOUT, AND PROFILE SHEETS

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.

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.

## DRAINAGE CROSS-SECTION SHEETS

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.

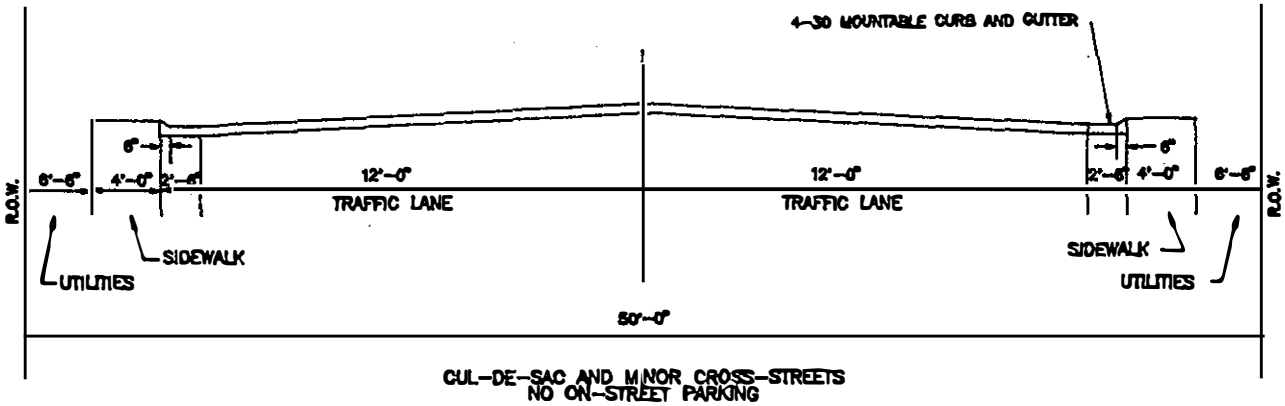
Cross-sections show end areas and quantities between cross-sections.

# STREETS

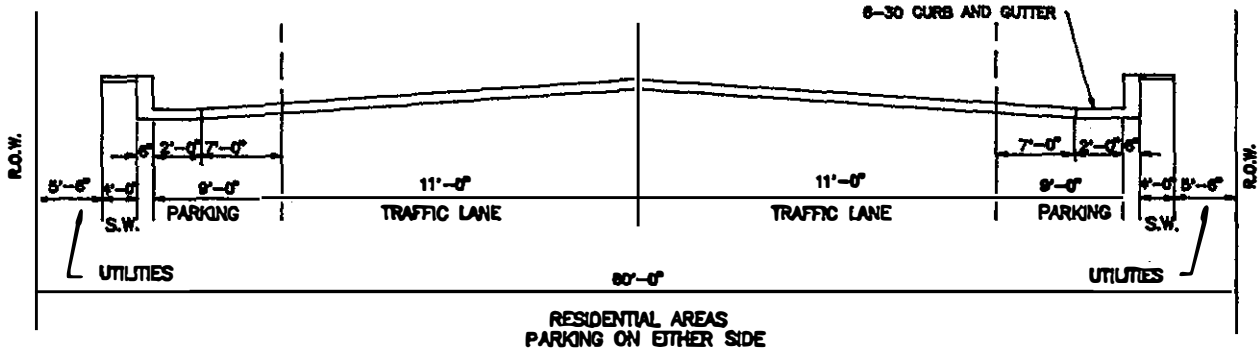
## STANDARD DRAWINGS

The following drawings supplement the criteria. Some are referenced in the criteria, while others need no discussion.

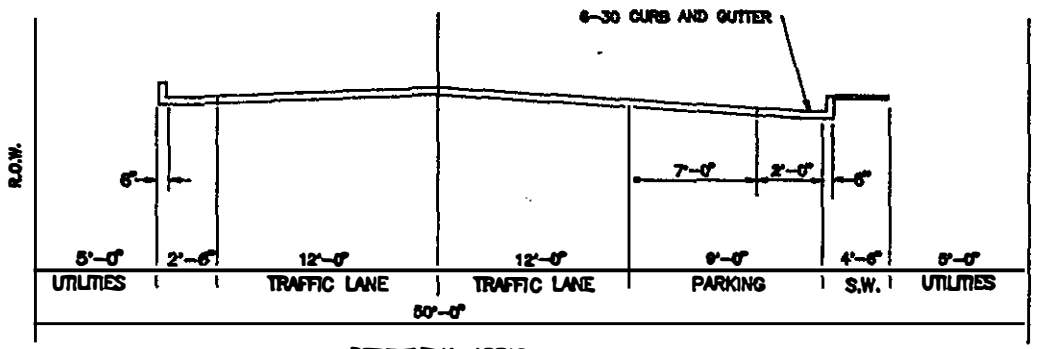
ROADWAY WIDTHS ARE DETERMINED BY THE NUMBER OF LANES REQUIRED TO ACCOMIDATE THE TRAFFIC. THE MINIMUM WIDTH IS TWO 12' LANES WITH TYPE 4-30 CURBS 29'-0" BACK TO BACK OF CURBES



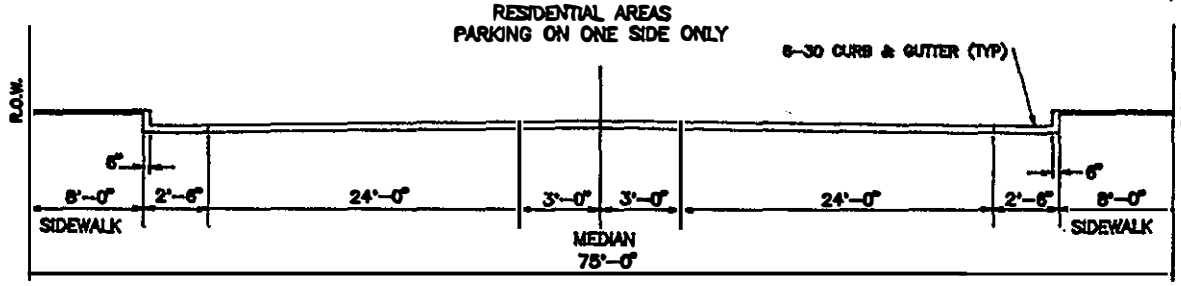

CUL-DE-SAC AND MINOR CROSS-STREETS
NO ON-STREET PARKING




RESIDENTIAL AREAS
PARKING ON EITHER SIDE

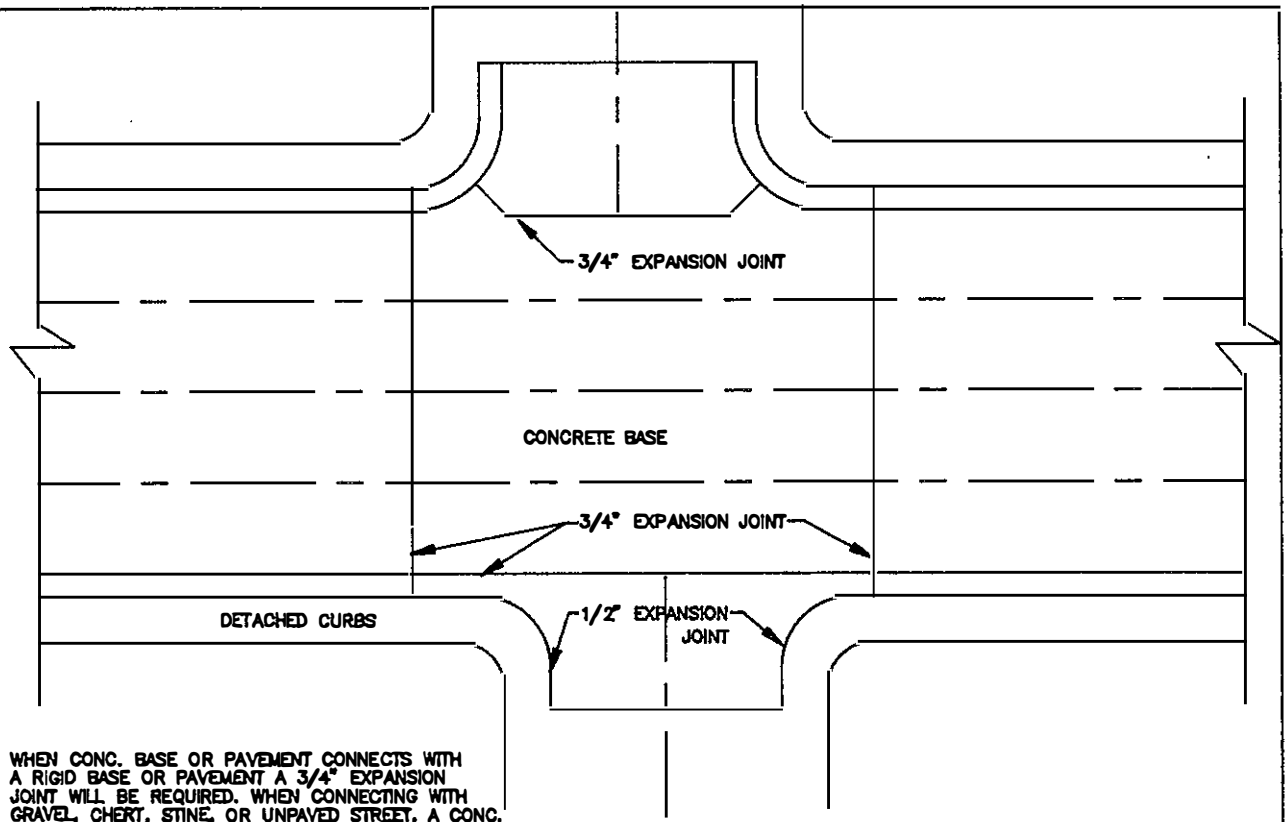



RESIDENTIAL AREAS
PARKING ON ONE SIDE ONLY

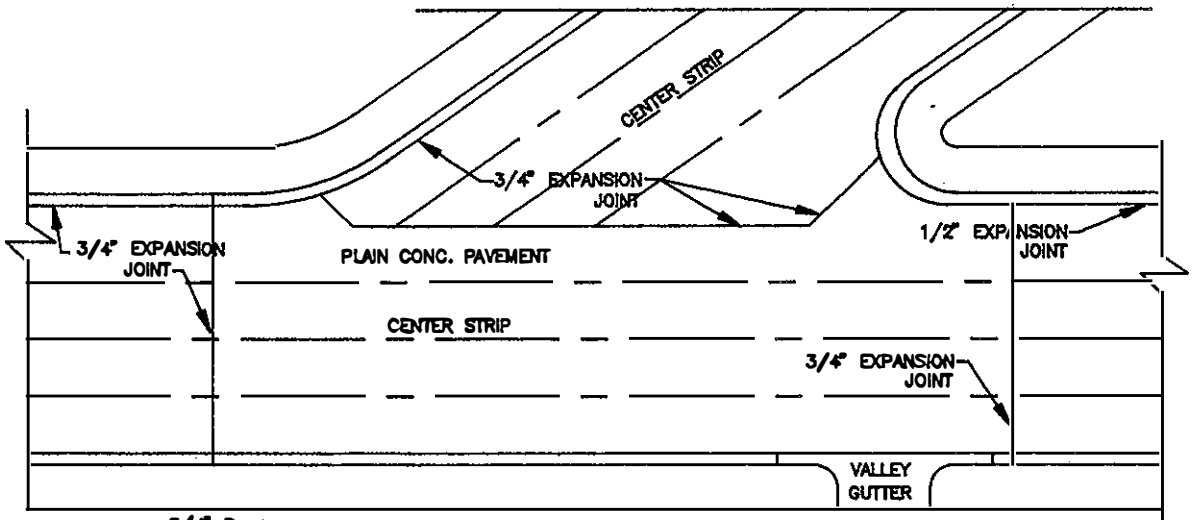


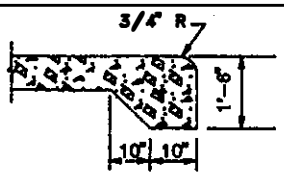

BUSINESS AREA

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | ROADWAY WIDTHS | DRAWING NO. RW-1 |
|---|---|---|---|



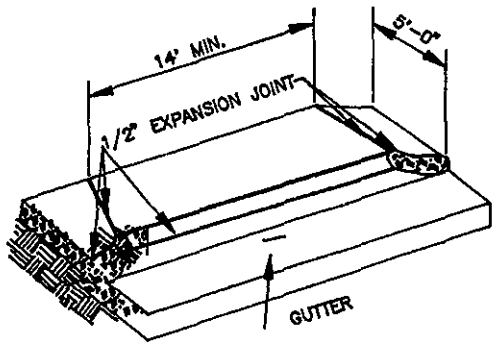

WHEN CONC. BASE OR PAVEMENT CONNECTS WITH A RIGID BASE OR PAVEMENT A 3/4" EXPANSION JOINT WILL BE REQUIRED. WHEN CONNECTING WITH GRAVEL, CHERT, STINE, OR UNPAVED STREET, A CONC. HEADER WILL BE REQUIRED WHEN CONNECTING WITH A NON-RIGID SURFACE BASE IN GOOD CONDITION HEADER OR EXPANSION JOINT NOT REQUIRED.

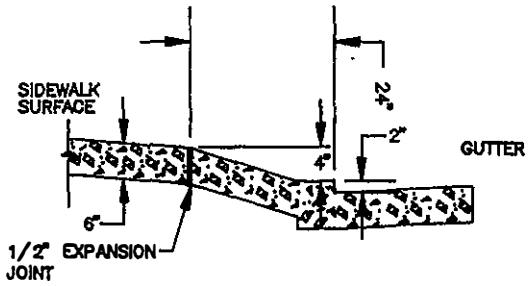


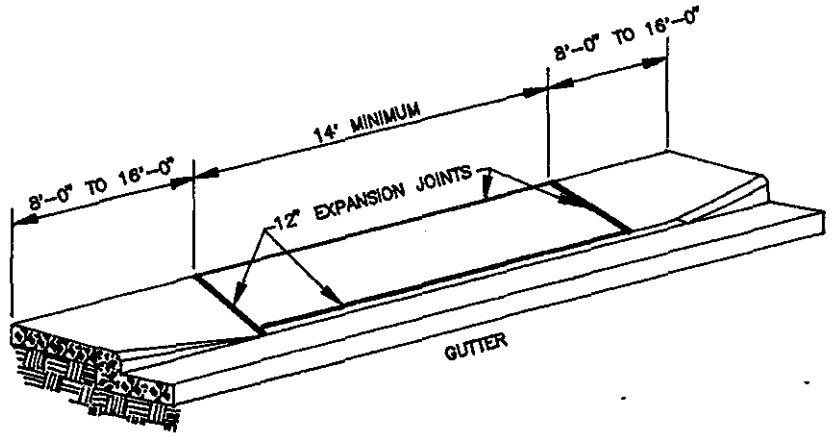

CONCRETE HEADER DETAIL

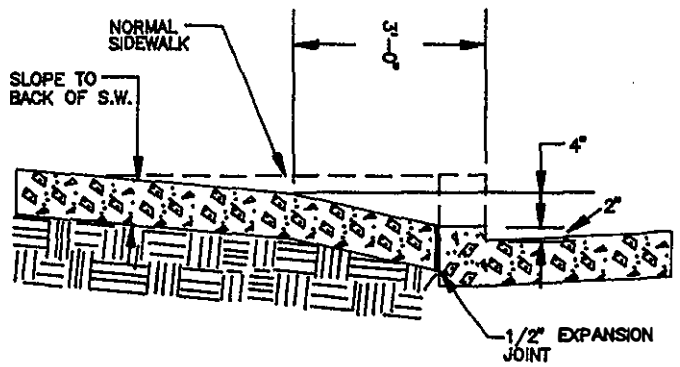
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | TYPICAL STREETS INTERSECTIONS | DRAWING NO. TSI-1 |
|---|---|---|---|



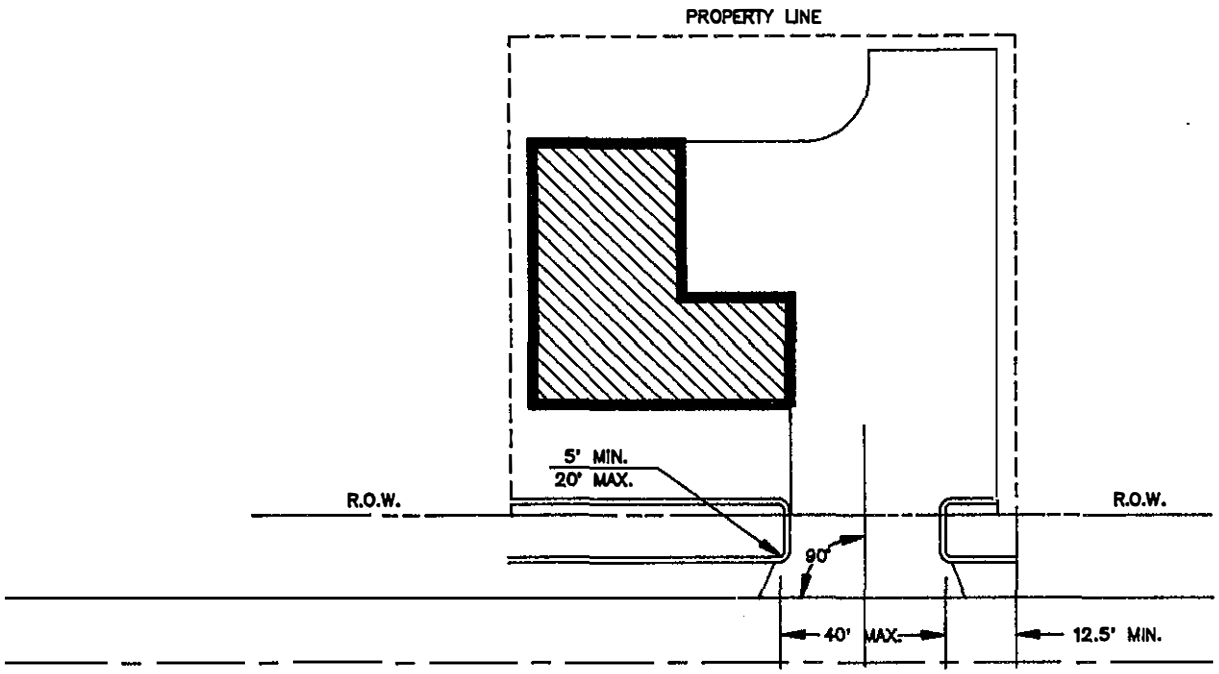

CONCRETE DRIVEWAY – RESIDENTIAL ENTRANCE

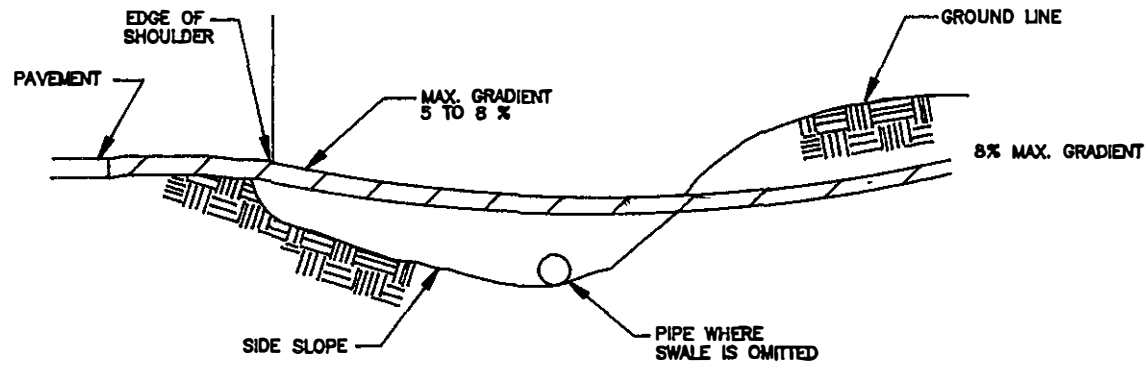


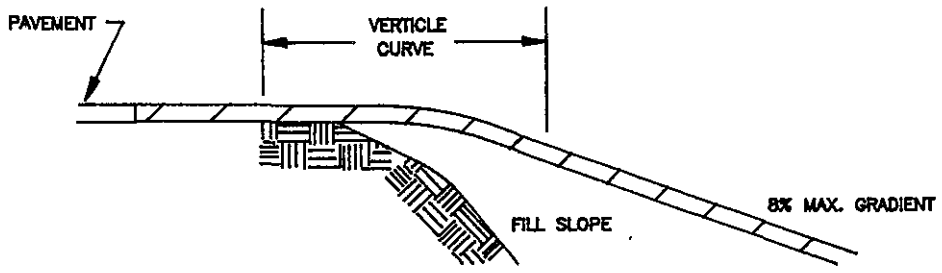

CONCRETE DRIVEWAY – BUSINESS ENTRANCE

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CONCRETE DRIVEWAY DETAILS | DRAWING NO. CD-1 |
|---|---|---|---|



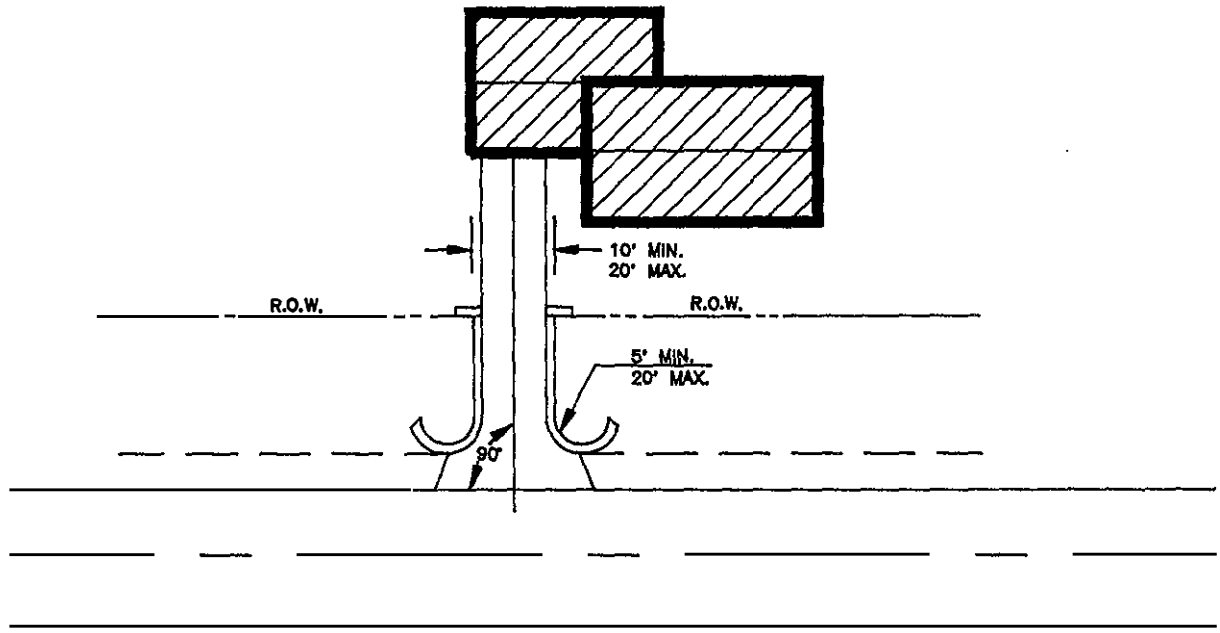



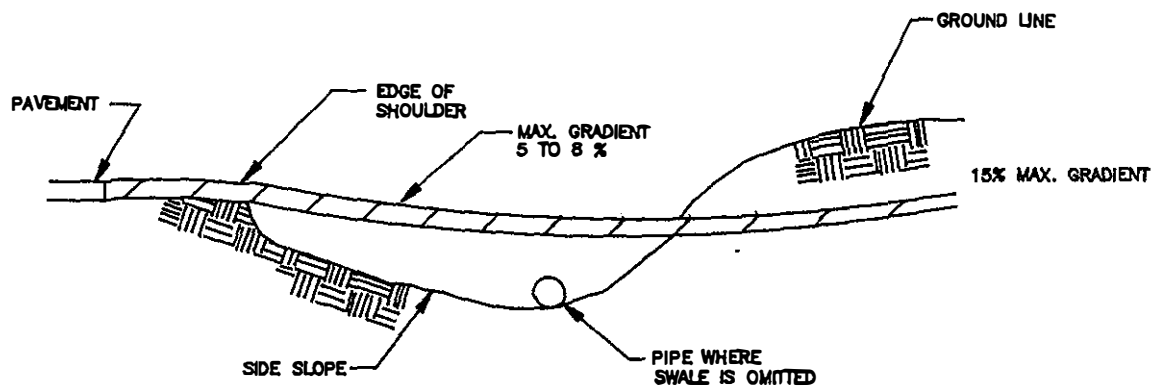

DRIVEWAY IN CUT SECTION



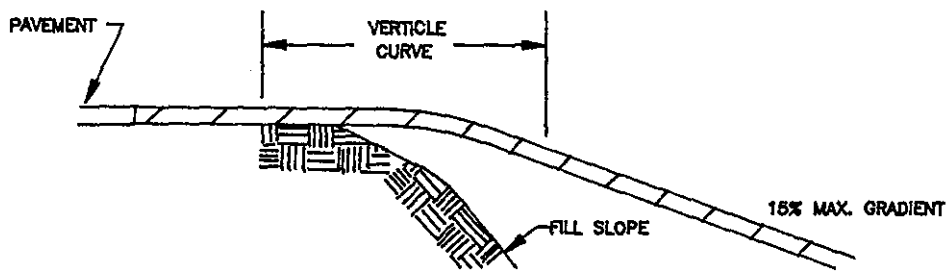

DRIVEWAY AT FILL SECTION

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | RURAL COMMERCIAL DRIVEWAY | DRAWING NO. RCD–1 |
|---|---|---|---|



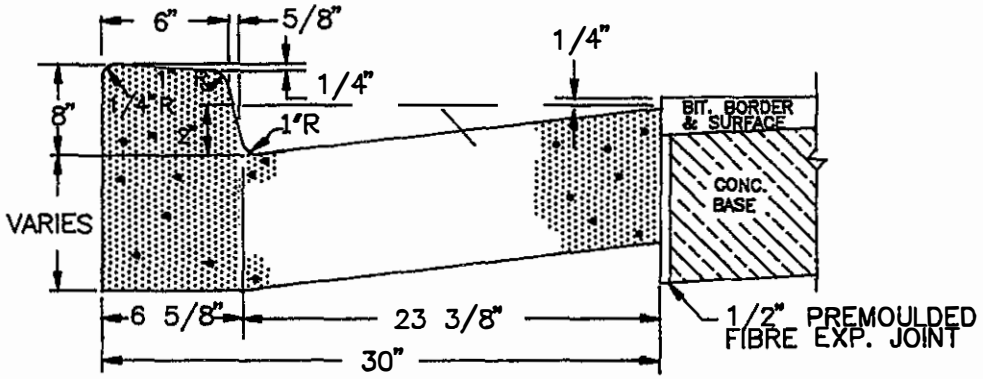




DRIVEWAY WITH VALLEY GUTTER

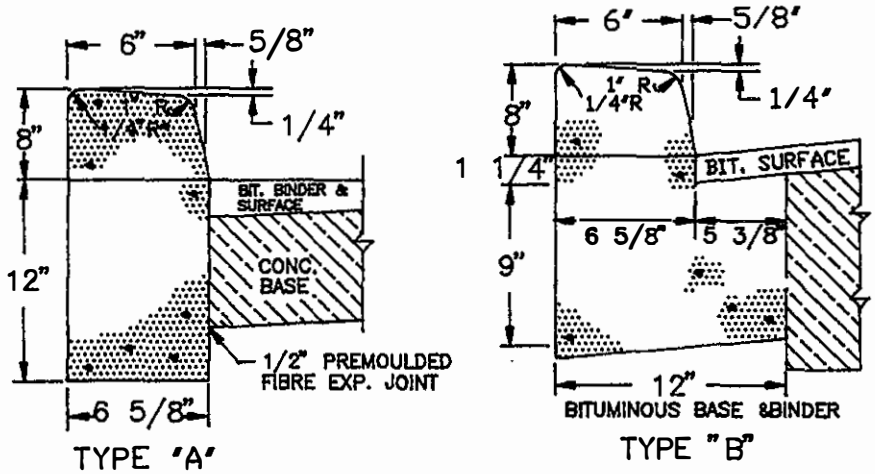



DRIVEWAY AT FILL SECTION

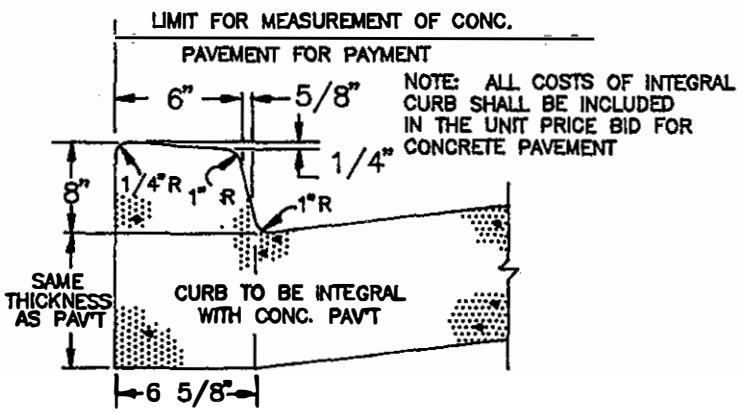
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | RURAL RESIDENTIAL DRIVEWAY | DRAWING NO. RRD–1 |
|---|---|---|---|




8" CONC. COMBINED CURB & GUTTER

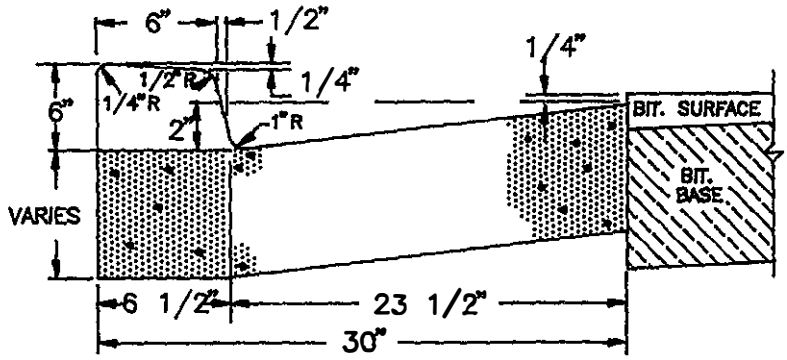



8" DETACHED CONCRETE CURBS

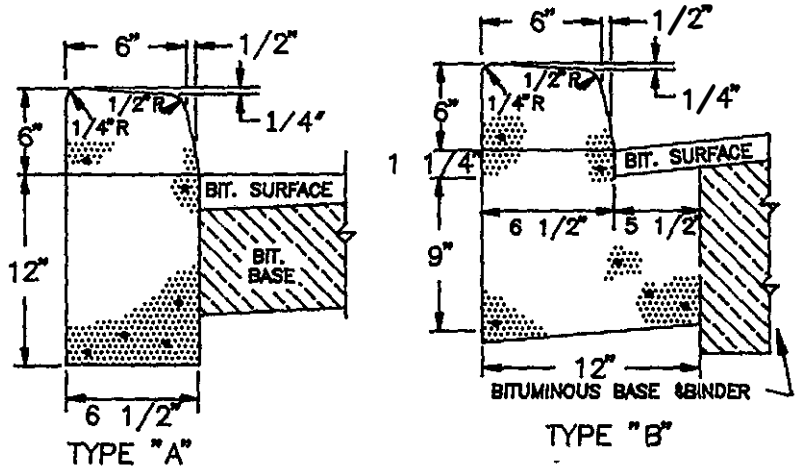



8" INTEGRAL CONC. CURB

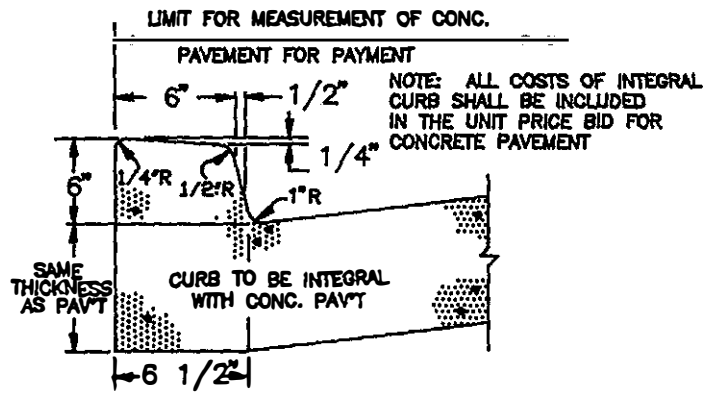
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CURB AND GUTTER DETAILS | DRAWING NO. CGD-1 |
|---|---|---|---|




6" CONC. COMBINED CURB & GUTTER

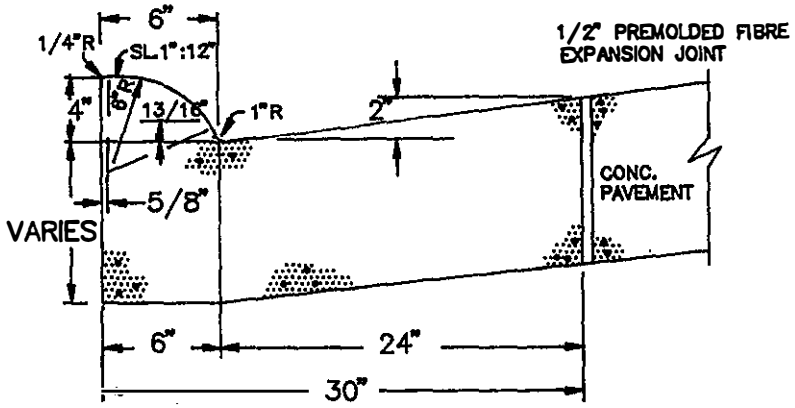



6" DETACHED CONCRETE CURBS

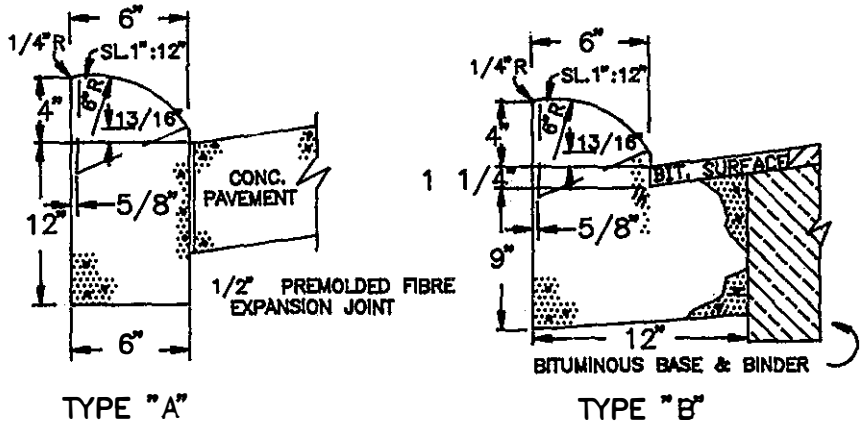



6" INTEGRAL CONC. CURB

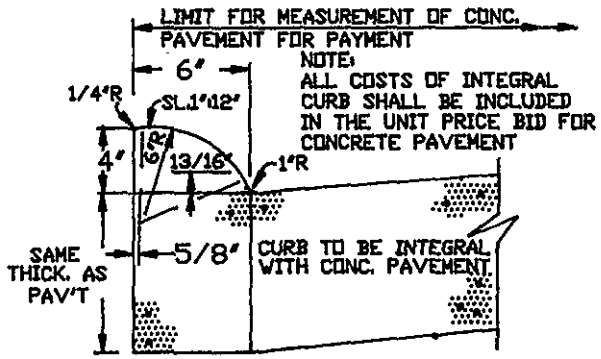
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CURB & GUTTER DETAILS | DRAWING NO. CGD-2 |
|---|---|---|---|




4" MOUNTABLE CONC.
COMBINED CURB & GUTTER

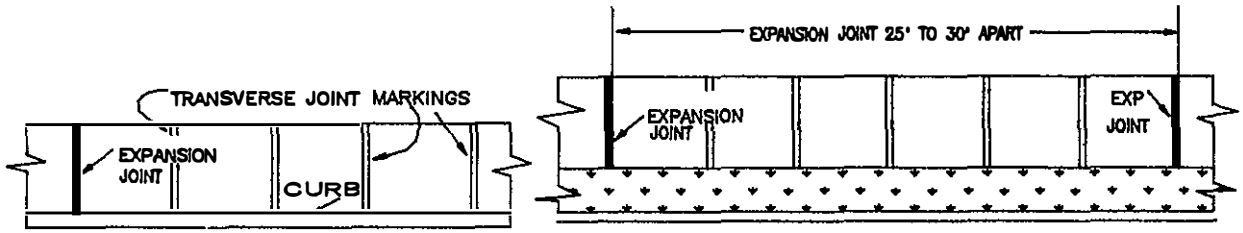



4" MOUNTABLE DETACHED CONCRETE CURBS




4" MOUNTABLE INTEGRAL CONC. CURB

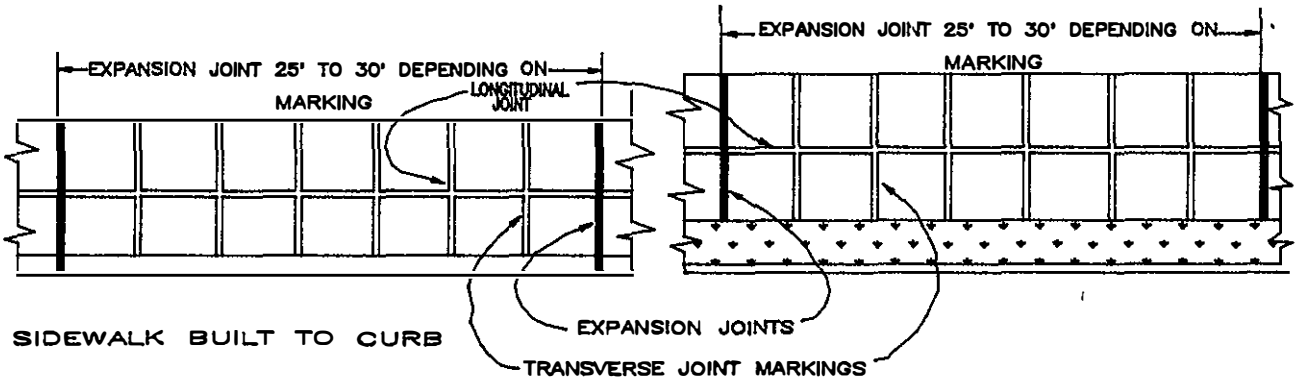
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CURB & GUTTER DETAILS | DRAWING NO. CGD-3 |
|---|---|---|---|




5'SIDEWALK BUILT TO CURB

5'SIDEWALK WITH GRASS PLOT

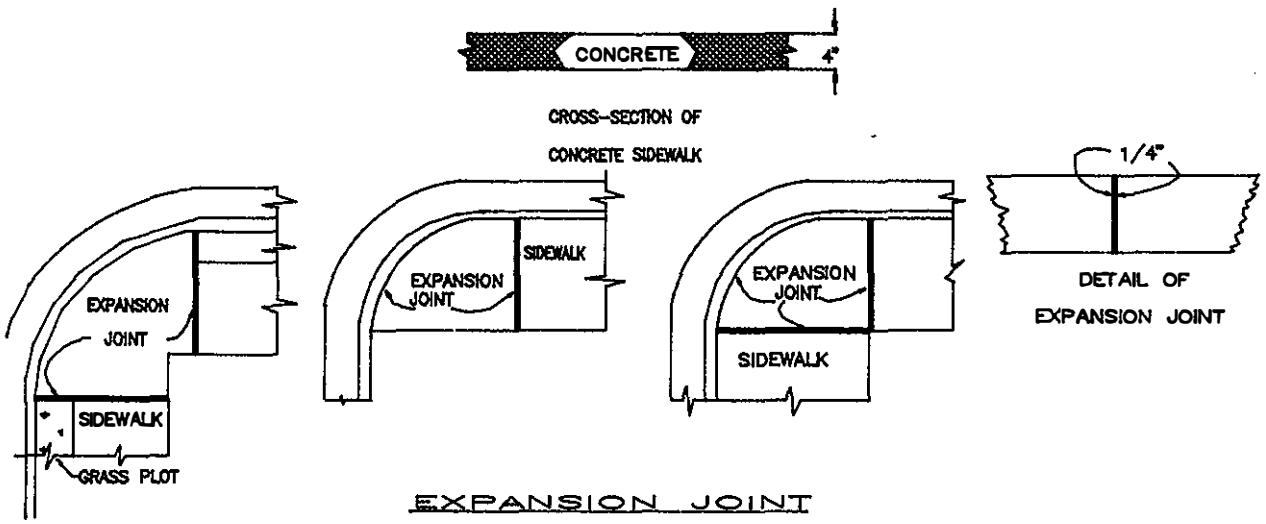
## RESIDENTIAL SIDEWALK




SIDEWALK BUILT TO CURB

SIDEWALK WITH GRASS PLOT

## BUSINESS SIDEWALK

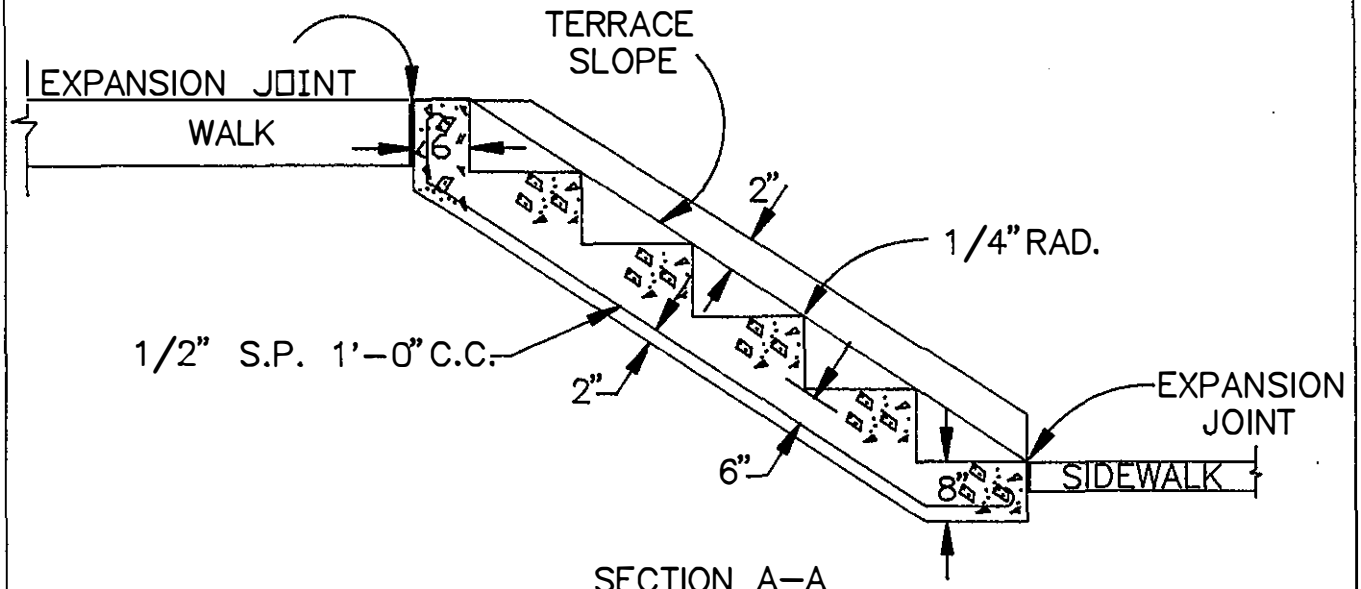



## EXPANSION JOINT

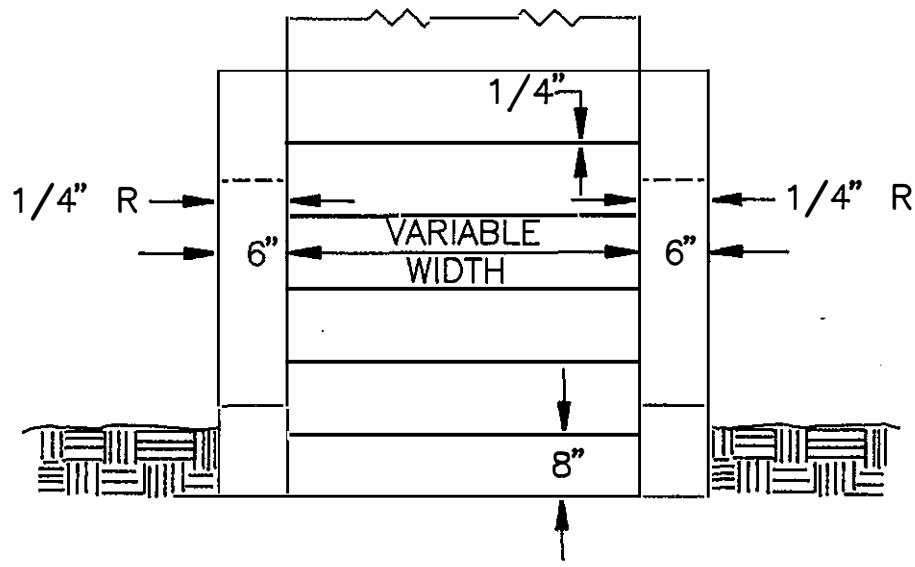
NOTE: 1" JOINTS TO BE PLACED WHERE THE SIDEWALK IS IN CONTACT WITH CIRCULAR CURB,BUILDINGS AND RETAINING WALLS 1/2" JOINTS TO BE USED AT OTHER LOCATIONS.

* ONE LONGITUDINAL JOINT MARKING REQUIRED ON SIDEWALK OVER 5' IN WIDTH TO LESS THAN 9'.TWO LONGITUDINAL JOINTS FOR SIDEWALK 10' TO 12'.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | EXPANSION JOINT DETAILS | DRAWING NO. EJ-1 |
|---|---|---|---|




SECTION A–A




FRONT ELEVATION

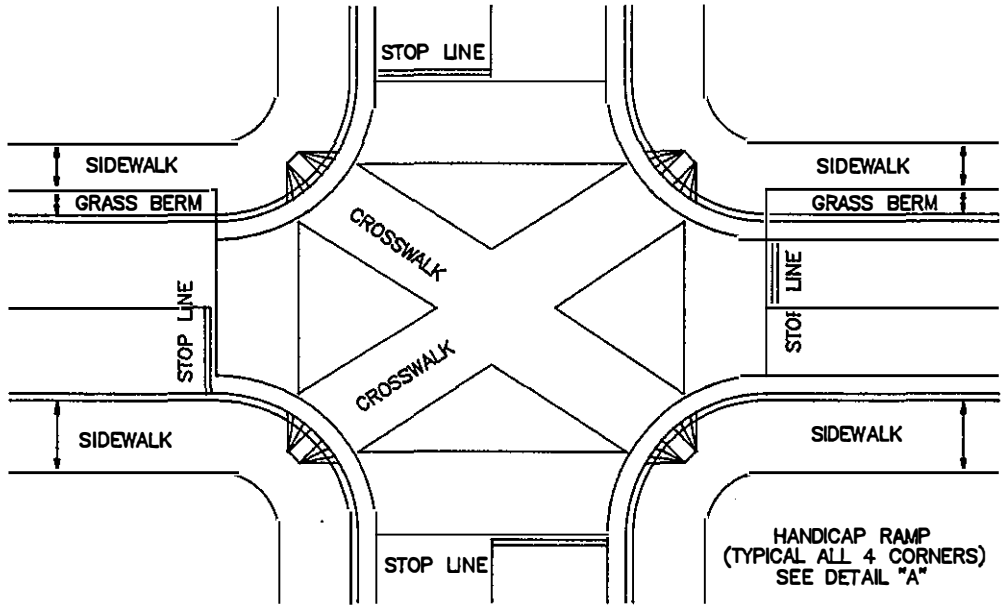
TREAD TO BE 12". RISER TO BE VARIED SO THAT SLPOE WILL CONFORM TO SLOPE OF TERRACE (MAX. RISER 9")

COST OF EXPANSION JOINTS TO BE INCLUDED IN UNIT PRICE BID FOR CLASS "A" CONCRETE

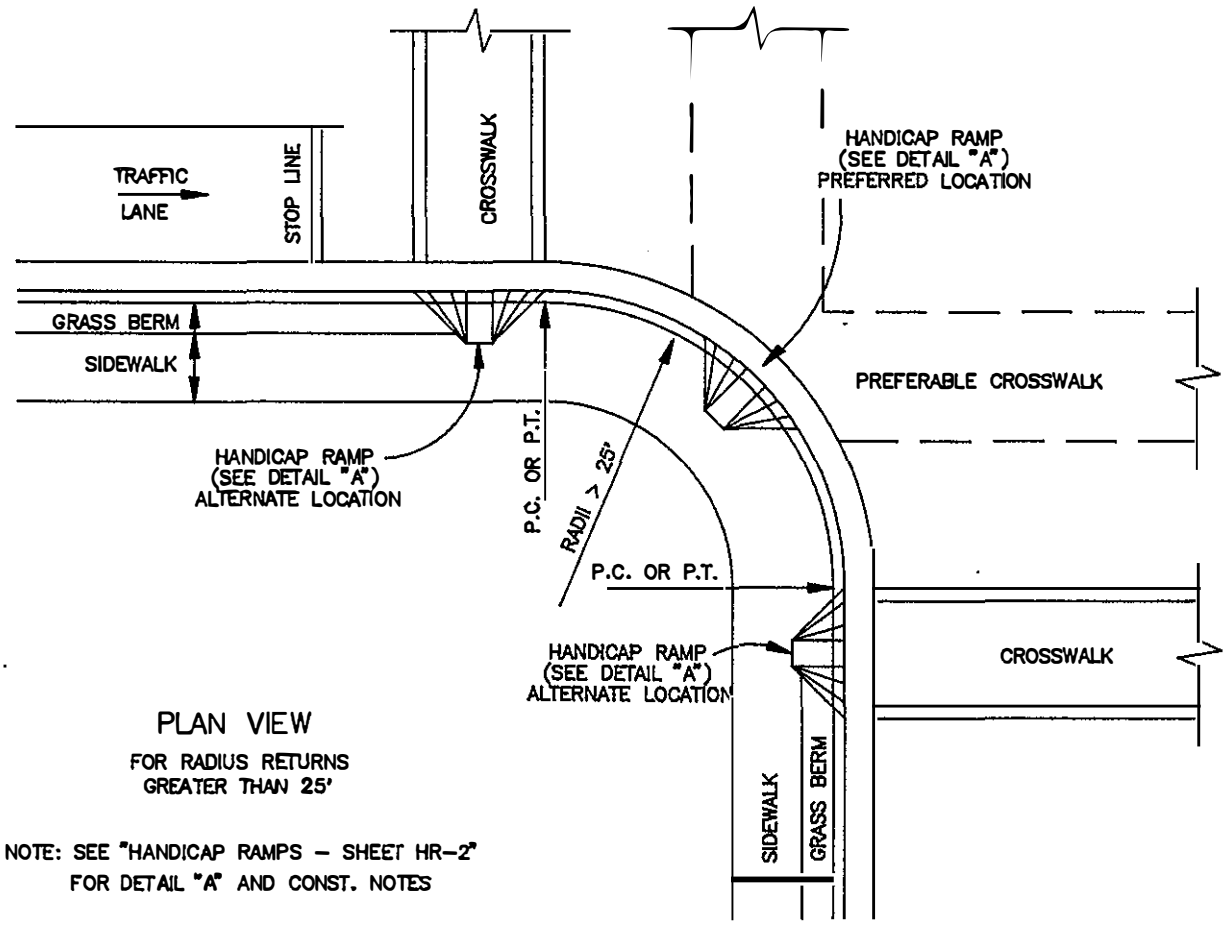
EXCAVATION BELOW TERRACE SLOPE TO BE INCLUDED IN PRICE BID FOR CLASS "A" CONCRETE

STEEL BAR REINFORCEMENT WILL BE INCLUDED IN COST OF CONCRETE

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | CONCRETE STEPS | DRAWING NO. CS–1 |
|---|---|---|---|




PLAN

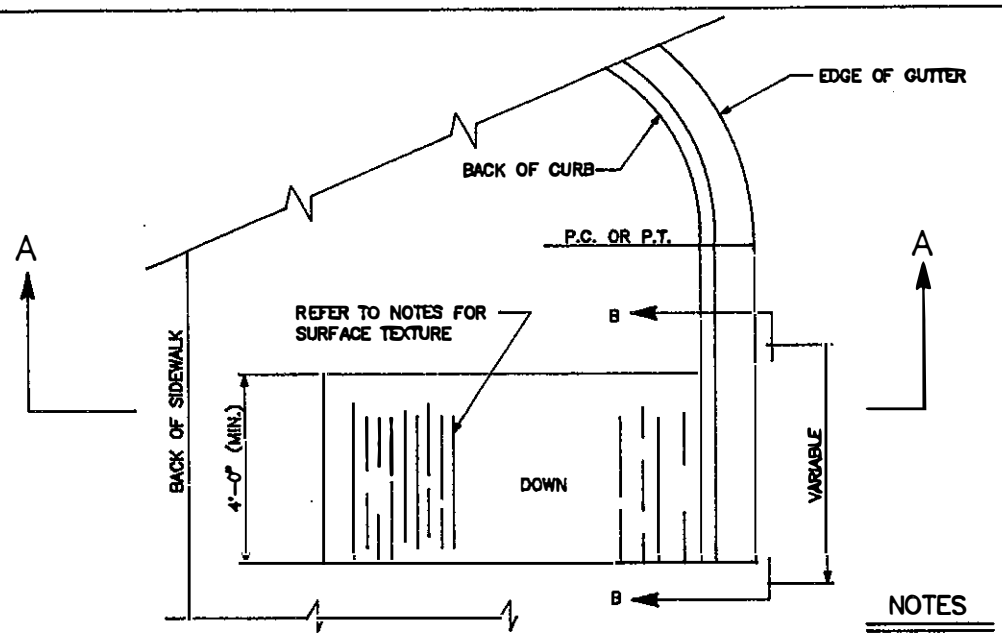



PLAN VIEW

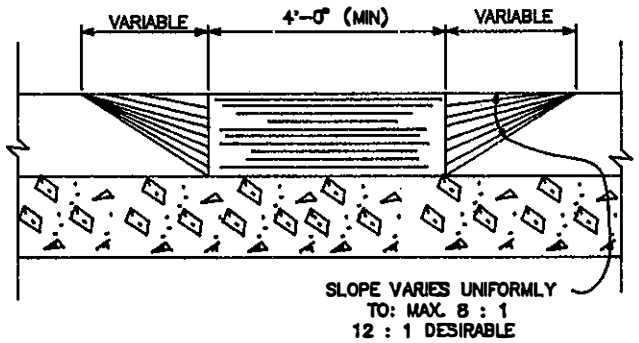
FOR RADIUS RETURNS
GREATER THAN 25'

NOTE: SEE "HANDICAP RAMPS – SHEET HR–2"
FOR DETAIL "A" AND CONST. NOTES

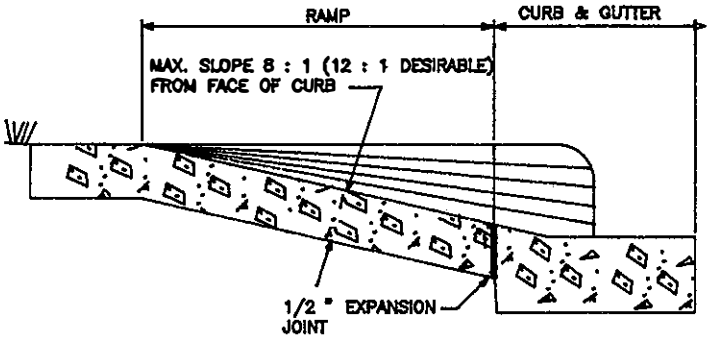
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED | HANDICAP RAMP | DRAWING NO. |
|---|---|---|---|
| | | | HR–1 |




DETAIL "A"




SECTION B–B




SECTION A–A

## NOTES

DETAILS SHOWN ON THIS PLAN APPLY TO ALL CONSTRUCTION OR RECONSTRUCTION OF STREETS, CURBS, OR SIDEWALKS.

CURB CUT RAMPS ARE TO BE LOCATED AS SHOWN ON PLANS.

RAMPS SHALL BE PROVIDED AT ALL CORNERS OF STREET INTERSECTIONS WHERE THERE IS EXISTING OR PROPOSED SIDEWALKS AND CURB. RAMPS SHALL ALSO BE PROVIDED AT WALK LOCATIONS IN MID-BLOCK.

SURFACE TEXTURE OF THE RAMP SHALL BE THAT OBTAINED BY A COURSE BROOMING, TRANSVERSE TO THE SLOPE OF THE RAMP.

CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON THE RAMP, FREE OF SAGS AND SHORT GRADE CHANGES. DRAINAGE STRUCTURES SHALL NOT BE PLACED IN LINE WITH RAMPS.

THE NORMAL GUTTER LINE SHALL BE MAINTAINED THROUGH THE AREA OF THE RAMP.

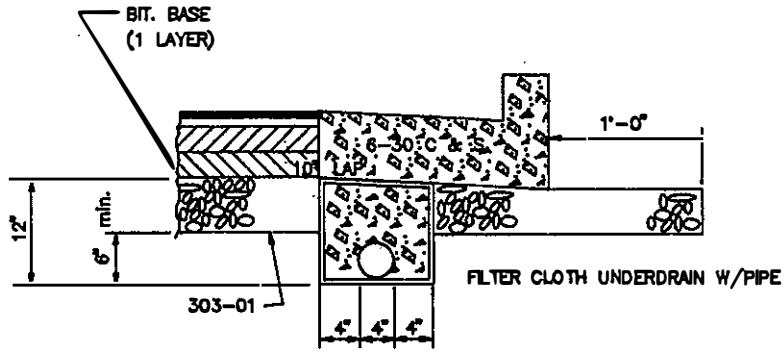
CROSSWALK AND STOPLINE MARKINGS, IF USED, SHALL BE SO LOCATED AS TO STOP TRAFFIC SHORT OF THE RAMP CROSSINGS.

COST OF THE LOWERED CURB AND GUTTER TO BE INCLUDED IN THE PRICE OF THE CONCRETE COMBINED CURB AND GUTTER.

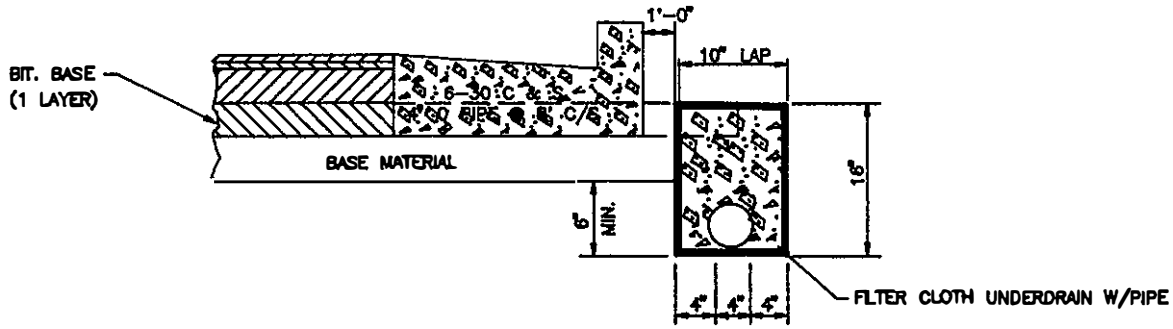
COST OF THE CONCRETE RAMP TO BE INCLUDED IN THE PRICE OF THE CONCRETE SIDEWALK.

DESIRABLE DIMENSION TO BE USED UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

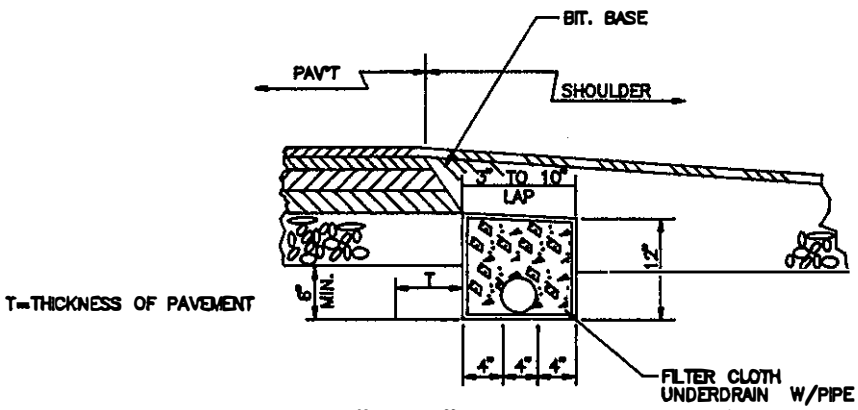
| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | HANDICAP RAMP | DRAWING NO. HR–2 |
|---|---|---|---|




UNDERDRAINS IN
TYPICAL THIN PAVEMENT SECTION



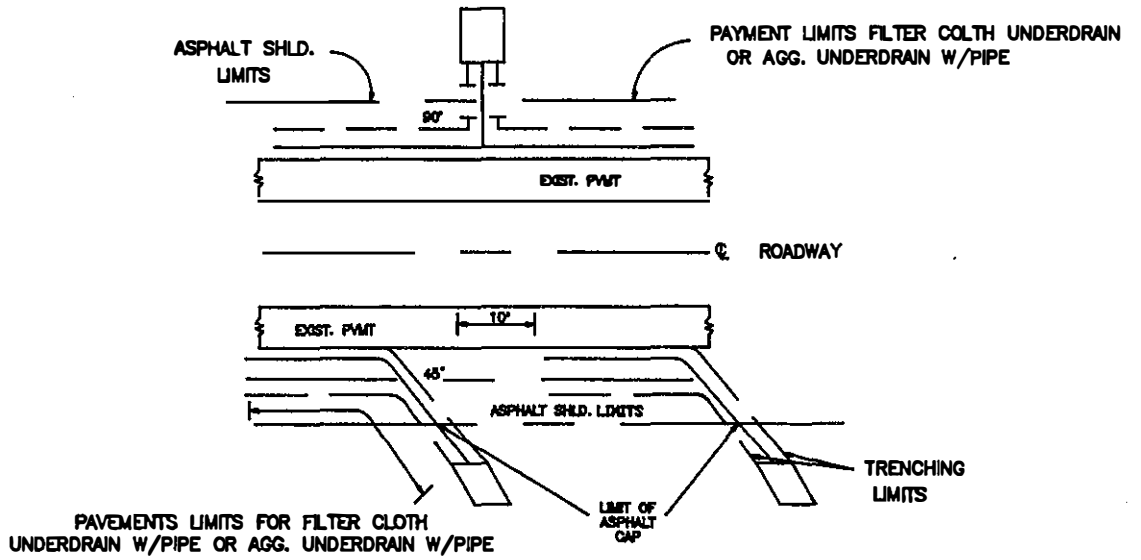

UNDERDRAINS IN
TYPICAL THIN PAVEMENT SECTION

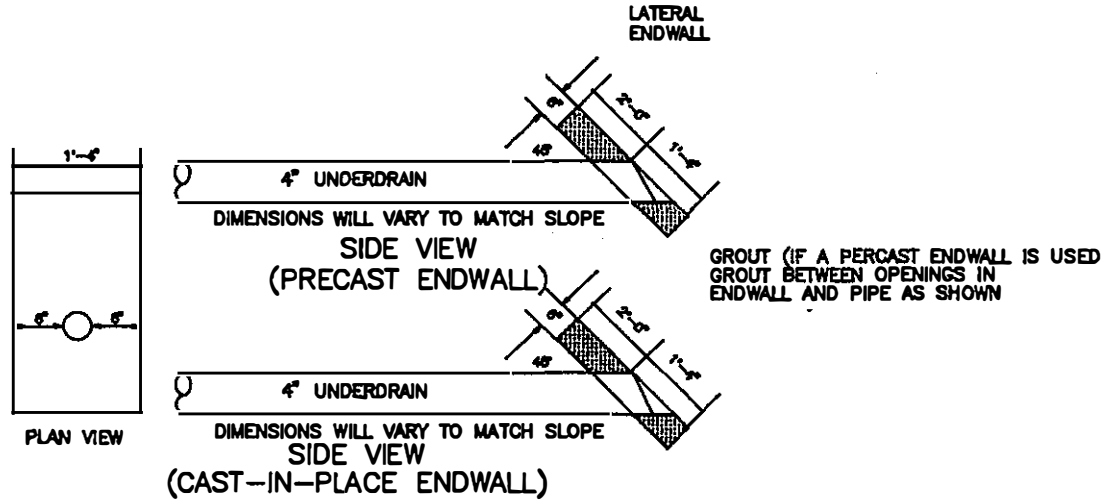



UNDERDRAINS IN "NEW" PAVEMENT W/STONE BASE

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | UNDERDRAIN DETAIL | DRAWING NO. U-1 |
|---|---|---|---|

NOTE: USE "T" JOINT IN SAG POINTS

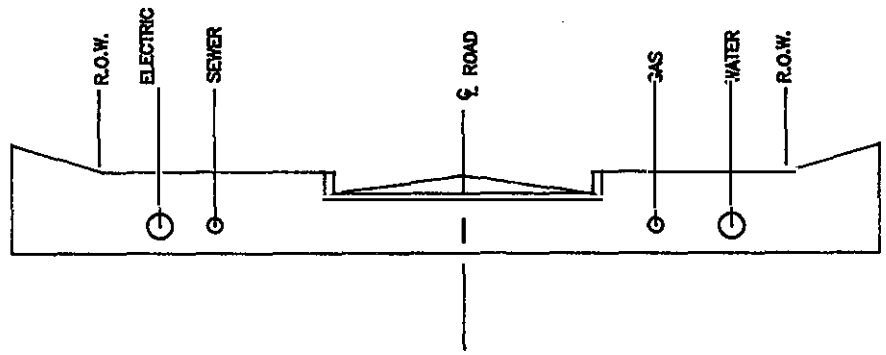


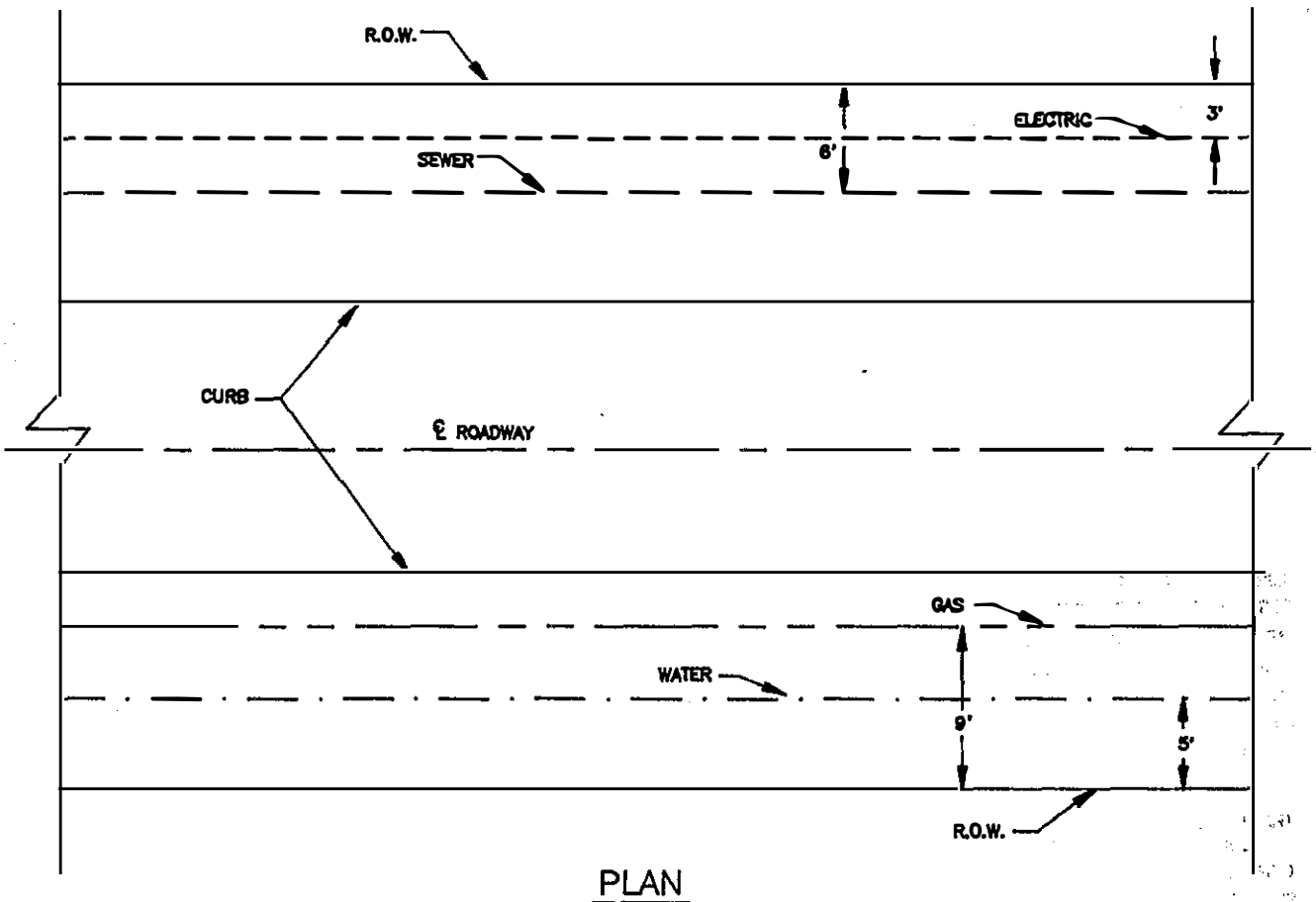

AGGREATE UNDERDRAIN USING FILTER CLOTH AND 4" PERFORATED PIPE WILL BE INSTALLED ADJACENT TO THE OUTSIDE LOW EDGE OF PAVEMENT, SWITCHING THE INSIDE EDGE OF PAVEMENT ON CURVES WHERE THE SUPERELEVATION DRAINS THE PAVE-MENT TO THE INSIDE. THIS UNDERDRAIN SYSTEM WILL BEGIN AT THE BEGINNING OF THE PROJECT AND EXTEND TO THE END OF THE PROJECT INCLUDING PAVING LIMITS ON INTERCHANGE RAMPS. THE LATERAL PORTION OF THE UNDREDRAIN TO THE CUT DITCHES OR THROUGH THE FILL SLOPES WILL BE PLACED AT LOW POINTS OR 109' TO 210' MAXIMUM INTERVALS. A 10' SPACE BE LEFT AT EACH LATERAL BEFORE STARTING THE NEXT 190' TO 210' LENGHT OF UNDERDRAIN. THIS DISCONTINUITY WILL FOR WATER OUT OF THE LATERAL.

THE TRENCH FOR THE UNDERDRAIN SHALL BE EXCAVATED TO A DEPTH OF 0'-6" BELOW THE SUBGRADE, EXCEPT WHEN NECESSARY TO EXCAVATE DEEPER TO OBTAIN A MIN. SLOPE OF 0.5% FOR THE UNDERDRAIN FLOW LINE. UNDER NO CONDITIONS SHALL THE TRENCH BE EXCAVATED IN SOLID ROCK. IF A SUBSTANTIAL AMT. OF ROCK IS ENCOUNTERED. THE ENGINEER MAY DIRECT THAT THE TRENCH DEPTH BE ADJUSTED TO OBTAIN A MIN. SLOPE OF 0.5% FOR THE UNDERDRAIN FLOW LINE. IF THE ROCK ENCOUNTERED IS ONLY MINOR SUCH AS A SMALL BOULDER, THE ENGINEER MAY DIRECT THAT THE TRENCH BE TURNED TO THE SIDE AND TERMINATED WITH AN ENDWALL EVEN THOUGH THE 190' TO 210' INTERVAL HAD NOT BEEN COMPLETED. THE TRENCH MAY THEN BEGIN AGAIN ON THE OTHER SIDE OF THE MINOR ROCK ENCOUNTERED AS DIRECTED BY THE ENGINEER.

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | UNDERDRAIN DETAIL | DRAWING NO. U-2 |
|---|---|---|---|




SECTION




PLAN

| TENNESSEE PUBLIC WORKS CONSTRUCTION STANDARDS | REVISED: | UTILITIES LOCATION | DRAWING NO. UL-1 |
|---|---|---|---|