BID AND CONTRACT DOCUMENTS, SPECIFICATIONS AND CONSTRUCTION PLANS FOR

W. POLARIS ST. AND E. SWORDFISH ST. WIDENING IMPROVEMENTS 2016

CITY OF SOUTH PADRE ISLAND

SCF Consulting, LLC
5593 Wildbird Lane, Brownsville, Texas 78526
Telephone (956) 455-7488 - Fax (956) 832-0162

SEPTEMBER 2016

INVITATION TO BIDDERS

PROJECT: W. POLARIS ST. AND EAST SWORDFISH ST. WIDENING IMPROVEMENTS 2016 PROJECT

BID DATE: October 21, 2016

BID TIME: 10:00 a.m.

ENGINEER: SCF CONSULTING, LLC TBPE F-8497
SCOTT FRY, P.E.
Telephone - (956) 455-7488
Fax - (956) 832-0162

Sealed Bids for the W. POLARIS ST. AND EAST SWORDFISH ST. WIDENING IMPROVEMENTS 2016 PROJECT, South Padre Island, Texas will be received by the City of South Padre Island, at the office of the City Secretary, located at 4601 Padre Boulevard, South Padre Island, Texas, until the time stated above. All bids will be publicly opened, read aloud, and tabulated thirty minutes after the time stated above.

All Bids must be on a Unit Cost basis for the Contract Work. Bids received after the stated time will not be accepted.

Copies of the above documents may be obtained at the office of the Department of Public Works in accordance with the Instructions to Bidders. There is no charge for the documents.

Bid security in the amount of 5% of the bid submitted must accompany each bid in accordance with the Instructions to Bidders.

Statutory Bonds for performance of the contract and for payment of mechanics and materials will be required in an amount equal to 100% of the accepted bids.

The Owner reserves the right to hold all bids for 30 days from date of receipt without action, to reject any and all bids, to waive irregularities and to require statements or evidence of bidder's qualifications including financial statements.

INSTRUCTIONS TO BIDDERS

1. Proposal shall be submitted on the Bid form furnished. Fill in all blank spaces and all amounts must be in figures clearly marked.

   It is the intent of the City of South Padre Island to award the contract for the work as deemed the most advantageous by the City of South Padre Island.

   Proposals shall be signed with the name typed below the signature. Where the bidder is a Corporation, proposals shall be signed with the legal name of the Corporation followed by the name of the officer authorized to bind the Corporation to a contract. The completed form shall be without interlineation, alternation, or erasure. Seal bid documents in an envelope addressed to the office of the City Secretary, City of South Padre Island, 4601 Padre Blvd.,
   South Padre Island, Texas, 78597, and clearly labeled with the full title of the project. The bidder's firm name shall appear on the outside of the envelope.

2. Causes for Rejection; Waiver of Irregularities; Disqualification.
   The Owner reserves the right to reject any and all bid, and to waive any and all informalities and irregularities in bids, whenever the Owner deems the rejection or waiver to be in its interest. In any case of ambiguity or lack of clarity in stating the prices in the bid, the Owner will use the construction most advantageous to it, or reject the bid. Other causes for the Owner to disqualify a bidder or reject its bid include:
   a. The bid has any omission, alteration of form, addition or condition not called for, or unreasonable or unbalanced unit bid prices.
   b. The bid is incomplete or is not accompanied by an acceptable bid guarantee.
   c. More than one bid is submitted by the bidder.
   d. There is evidence of collusion among bidders.
   e. There is evidence of unsatisfactory performance, default or litigation with an owner by the bidder under a previous contract, either with this Owner or with another owner, including work by the bidder as a subcontractor.
   f. There is evidence that the bidder is behind schedule, in arrears in payment to an employee, subcontractor or material supplier, in default, or in litigation with an owner under an existing contract.
   g. The Owner determines that the bidder is not responsible because there is evidence that the bidder does not have sufficient qualifications (including without limitation, lack of experience, a poor safety record, insufficient personnel, equipment, financial resources, or any other attribute) to assure the satisfactory completion of the Project.
   h. The Owner determines that the bidder has been convicted of a criminal offense committed in Cameron County, Texas involving fraud, theft, bribery, kickbacks, or unlawful gifts to a public official if the conviction occurred within three years immediately preceding either the date of submission of your bid, the submission of your statement of

bidder's qualifications or the advertised contract award date.

i. More than 70 percent of the work will be performed by subcontractors to the Contractor.

j. The bidder does not meet the minimum experience qualifications established in the Statement of Bidder's Qualifications.

The Owner reserves the right to determine which bidder is the lowest responsible bidder and to award the contract on this basis, as well as the right to know how much of the work will be performed with the bidder's own forces. Each bidder by submission of a bid waives any claims it has or may have against the Owner, the Engineer, its sub-consultants and their employees and any other consultants, and any trustees, officers, and employees of Owner, connected with or arising out of the bid administration, bid evaluation, recommendation for Contract award, the award of the Contract and the rejection of any bids.

3. Subcontractors.

The Owner requires you to submit the names and qualifications of the subcontractors and material suppliers which you propose to use for the work. You must submit this list using the Owner's Subcontractor List Form included in these documents with your bid. Bidders are advised that all persons, firms, corporations or other parties to whom the bidder proposes to award a subcontract hereunder must be acceptable to the Owner. The Owner will notify you in writing before the award of the contract if the Owner has an objection to any subcontractor. If the Owner objects to a subcontractor, you may withdraw your bid without forfeiting your bid guaranty, or submit a substitute subcontractor for the Owner's acceptance. If there is a change in your bid price to cover a difference in cost, the Owner may accept the changed bid price, or disqualify your bid. If the Owner has reviewed and accepted any subcontractors, you must use only the accepted subcontractors on the work for which they were accepted. Accepted subcontractors may be changed only with the written approval of the Owner. The Owner may require you to submit to the Owner non-collusion affidavits of subcontractors before subcontracts are executed.

4. Bidder Qualification.

You must submit on the form furnished in these documents a statement of your qualifications. The Owner has the right to take any steps it deems necessary to determine the ability of a bidder to perform its obligations under the Contract, and you will be required to furnish the Owner with all information and data for this purpose as it may request. The Owner reserves the right to reject any bid where an investigation of the available data does not satisfy the Owner that a bidder is qualified to properly carry out the terms of this Contract. The Owner will disqualify a bidder from award of the Contract if the bidder has been convicted of a criminal offense committed in Cameron County, Texas involving fraud, theft, bribery, kickbacks, or unlawful gifts to a public official if the conviction occurred within three years immediately preceding either the date of submission of your bid, the submission of your statement of bidder's qualifications or the advertised contract award date. A bid from an entity disqualified under this provision will not be considered for any purpose. If this is a federally funded project, all contractors/subcontractors that are debarred, suspended or otherwise excluded from or ineligible for participation on federal assistance programs may

not perform any work on this Project.

5. Certified or Cashier's check from a State or National Bank of the State of Texas, or a Bidder's Bond from an acceptable Surety Company authorized to transact business in the State of Texas, in the total amount of not less than five percent (5%) of the maximum amount of the proposal payable without recourse to the City of South Padre Island, must accompany each proposal as a guarantee that if awarded the contract, the bidder will promptly enter into contract and execute required bonds on the forms provided. The financial guarantee shall be submitted in an envelope clearly marked and attached to the envelope containing the proposal. All bid securities will be returned thirty (30) days after bid opening.

6. The City of South Padre Island will require payment and performance bonds in the amount of 100% of the contract amount payable to the City of South Padre Island.

7. The bidder, before submitting the proposal, shall investigate and familiarize himself with existing conditions on the site, and be prepared to complete the work as indicated and specified.

8. Within thirty (30) days after the opening of the proposal, the City of South Padre Island will act upon them. The acceptance of the proposal will be in writing.

9. The successful bidder shall commence work within ten (10) days after receipt of written notice to proceed and shall progress therewith so that the work shall be completed in accordance with the terms of the contract documents within the time allowed after the date of the written notice to proceed.

PROPOSAL

The Bidder shall fill in all blanks with the required information.

TO: CITY OF SOUTH PADRE ISLAND
4601 PADRE BOULEVARD
SOUTH PADRE ISLAND, TEXAS 78597
ATTN: CITY SECRETARY

LADIES AND GENTLEMEN:

The undersigned, as bidder, declares that the only person or parties interested in this proposal as principals are those named herein; that this proposal is made without collusion with any other person, firm or corporation; that I/we have examined the invitation to Bid, Instructions to Bidders, the Contract, the General and Supplementary Conditions, General Requirements and the Drawings and Specifications referred to therein; that I/we have visited the site and hereby offer to and will furnish all necessary equipment, appliances, tools, labor, supervision, insurance and other accessories and services required by said documents for the following work for the following sum of money:

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	MOBILIZATION				
1	Mobilization, Storage, including Construction Barricades and Signage				
	Subtotal				
	W. POLARIS STREET				
1	Sawcut Existing Asphalt Pavement	355	l.f.		
2	Clearing, Grubbing, Demolition of Existing Road, including Asphalt, Base and Subbase.	284	s.y.		
3	Prepare, Cut to Grade, and Compact Existing Subgrade, including Proof Rolling	447	S.Y.		
4	Furnish and Install Tensar Geo-Grid	372	S.Y.		
5	Furnish, Place and Compact Limestone Base (Depth of 5-inches)	372	S.Y.		

6	Furnish, Place, and Compact 2-inch thick HMAC Pavement, Type-D, Including Prime Coat @ 0.2 Gal/s.y.	372	S.Y.		
7	24-Inch Wide Concrete Valley Gutter Poured in Place	341	L.F.		
8	Install 4-Inch Thick A.D.A. Compliant Concrete Sidewalk	1,785	S.F.		
ALT	Alternate Bid-Deduct 24" Valley Gutter (Item 7) and substitute "Poured in Place Curb and Gutter"	341	L.F.		

SUBTOTAL $_____

No.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
	E. SWORDFISH STREET				
1	Sawcut Existing Asphalt Pavement	228	l.f.		
2	Clearing, Grubbing, Demolition of Existing Road	92	S.Y.		
3	Remove Palm Trees	2	ea.		
4	Prepare, Cut to Grade, and Compact Existing Subgrade	289	S.Y.		
5	Tensar Geo-Grid	238	s.y.		
6	Furnish, Place and Compact Limestone Base (Depth of 5-inches)	238	s.y.		
7	Furnish, Place and Compact 2-inch thick HMAC, Type D Pavement, Including Prime Coat @ 0.2 Gal/s.y.	238	s.y.		
8	24-Inch Wide Concrete Valley Gutter Poured in Place	205	L.f.		
9	Variable Width Concrete Valley Gutter Poured in Place	43	S.F.		
10	Install 4-inch Thick Concrete A.D.A. Compliant Sidewalk, including Ramp	1,041	S.F.		
ALT	Alternate Bid-Deduct 24" Valley Gutter (Item 8) and substitute "Poured in Place Curb and Gutter"	205	L.F.		

SUBTOTAL $_____

TOTAL PROJECT COST $_____

Bidder acknowledges receipt of the following addendum(s):

_____ Date _____

_____ Date _____

_____ Date _____

Bidder understands that the City of South Padre Island reserves the right to reject any and all bids, to waive any informalities, and to accept the proposed deemed to be in the best interest of the City of South Padre Island.

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of thirty (30) calendar days after the scheduled closing time for receiving bids.

Bidder hereby agrees to commence work under this contract on or before a date to be specified in written Notice to Proceed from the City of South Padre Island and to fully complete the project within the limits established by the Supplementary Conditions hereto attached and made a part hereof. Bidder further agrees to pay as liquidated damages the amount or amounts specified in the Supplementary Conditions. BIDDER EXPRESSLY ACKNOWLEDGES THAT HE READ AND FULLY UNDERSTANDS THE PROVISIONS FOR LIQUIDATED DAMAGES AS DESCRIBED IN ITEMS 8 AND 9 OF THE SUPPLEMENTARY CONDITIONS, AND; FURTHER BIDDER ACKNOWLEDGES HE IS IN FULL AGREEMENT THEREWITH.

The Bidder further agrees that from the compensation otherwise to be paid, the Owner may retain the sum which is indicated in the schedule set forth in Item 9 of the Supplementary Conditions for each calendar day after the completion date that the work at the time stipulated in Item 8 of the Supplementary Conditions of these documents. This sum is not to be construed in any sense a penalty.

Upon receipt of a written notice to the acceptance of this bid, Bidder will execute the formal contract agreement immediately, and shall deliver the Surety Bonds and Insurance as required by the Instruction to the Bidders.

Bid security as required by the Instructions to Bidder in sum of _____ ($_____) is hereto attached. The Bid security is to become the property of the City of South Padre Island in the event the Proposal is accepted by the City of South Padre Island and the contract and bond are not executed within the time above set forth, as liquidated damages for the delay and additional

expense to the City of South Padre Island caused there by.

Respectfully submitted,

Signature: _____

(Print) By: _____

(Print) Title: _____

(Seal, if bid by a corporation)

_____
Business Name

_____
Business Address

_____
Business Phone

STATEMENT OF BIDDER'S QUALIFICATIONS

Answer all questions. Provide responses that are clear and comprehensive. Attach any additional information provided on separate sheets. **This statement must be notarized.**

1. Company Name:_____

2. Permanent Main Office Address:_____
   _____

3. Telephone Number/Email Address:_____

4. Federal Tax Identification Number:_____
5. Form of Ownership: ____Proprietorship
   ____Partnership (____Limited or ____ General)
   ____ Corporation
   ____LLC
   ____Joint Venture
   ____Other (specify):_____

6. When Organized:_____

7. If a Corporation, when Incorporated:_____

8. How many years has your company been engaged in business under its present name?___
   Give former names of the company, with dates of operation under each name.
   _____
   _____
   _____

9. General Character of work performed by your company:_____
   _____
   _____
   _____

10. Has your company ever failed to complete, defaulted, or been terminated on a project? Yes____ No____. If yes, give the project name and location, owner and engineer, and explain._____
    _____
    _____
    _____

11. Has your company ever been convicted of a criminal offense committed in Cameron County, Texas involving fraud, theft, bribery, kickbacks or unlawful gifts to a public official(s)? If so, did

the conviction occur within three years immediately preceding the date of the submission of your bid, this Statement of Bidder's Qualifications, or the date identified as the contract award date in the Invitation For Bid? Yes____ No____. If yes, explain.

_____

_____

_____

12. Is your company involved in a pending investigation(s) or criminal prosecution of a criminal offense alleged to have been committed in Cameron County, Texas, involving fraud, theft, bribery, kickbacks or unlawful gifts to a public official. _____yes _____no. If yes, explain._____

_____

13. Does your company have previous final judgements filed against the Owner for breach of contract, fraud, misrepresentation or conversion? Yes____ No____.

14. Has your company refused to execute a contract with the Owner following an award of the contract by the South Padre Island City Council? Yes ____ No____

15. Did your company violate the anti-lobbying provisions of a current or previous contract by making contact with a member of the South Padre Island City Council prior to award of the contract? Yes____ No____ If yes, explain.

_____

_____

_____

16. Does your company have any involvement in prior, pending or threatened claims or litigation alleging 1) fraud, misrepresentation or conversion 2) non-compliance by your company with any obligations under any current contract or previous contract within the last five years, including completion, remaining on schedule and cooperation with the Owner; or 3) any error or omission by your company in performing services under any current contract or previous contract within the last five years; and/or 4) non-payment to subcontractors and material suppliers? Yes ____ No____. If you answered yes to either 1, 2, 3 or 4 above, provide project name and location, owner and engineer names, and explanation of the nature, status and/or outcome of such claim or litigation (attach additional pages if necessary).

_____

_____

_____

17. Your company certifies that it will complete the work involved in this Project with no less than 30 percent of its own forces and no more than the remaining 70 percent with subcontractors.

18. Has your company or any of your subcontractors' companies ever failed to take corrective action on items of work under warranty during the warranty period? Yes____ No____. If yes, provide project name and location, owner and engineer names, and explanation of the nature, status and/or outcome of the warranty issue (attach additional pages if necessary).

    _____
    _____

19. Has your company or any of your subcontractors' companies been cited for safety violations on any project within the last five years? Yes ____ No____. If yes, provide project name and location, owner and engineer names, and explanation of the nature, status and/or outcome of the safety issue. (attach additional pages if necessary).

    _____
    _____
    _____

20. Your company certifies that the Superintendent/Manager you propose for this Project assigned has sufficient knowledge, skills and experience in similar Project work. Yes____ No____. If no, explain _____
    _____
    _____

21. Your company certifies that it is able to meet the insurance requirements and provide Certificates of Insurance as specified in the General and Supplemental Conditions of this Contract Yes ____ No. If no, explain.

    _____
    _____

22. Has your company failed to remit sales tax, property tax or utility payments to the City of South Padre Island in a timely manner? Yes ____ No____. Your company certifies that it is not in arrears in the payment of any obligations to the City of South Padre Island, including, without limitation, property or sales taxes, fees or utility charges. Yes____ No____. If no, explain.

    _____
    _____

23. In order to be considered qualified for the work included in this Contract your company must have completed four (4) projects of substantially similar character involving roadway widening and reconstruction for a public entity in the last three (3) years.

24. List ALL projects of a substantially similar character involving roadway widening and reconstruction with a cost in excess of $50,000.00 that your company has completed as a prime contractor or subcontractor within the last two years. You may attach your own list if it contains all of this information.

Project Name	Owner and Telephone	Engineer and Telephone	Completion Date

25. Non-Collusion Certification: Do you certify that all of the following are true and correct concerning your company's bid? Yes ____ No ____.
    a) That you are fully informed of the contents of the bid and the circumstances of its preparation;
    b) That your bid is genuine and is not a collusive or sham bid;
    c) That neither you nor anyone else acting on behalf of your company has agreed, colluded, or conspired in any manner with any other bidder, firm or person to submit a collusive or sham bid, or to refrain from bidding, or sought by communication or conference with any other bidder, firm or person to fix the prices, overhead, profit, or any cost element in your bid or in any other bid, or to secure through any collusion, conspiracy, or agreement any advantage against the City of South Padre Island or any other bidder; and,
    d) The prices quoted in your bid are fair and proper and are not affected by any collusion, conspiracy, connivance or unlawful agreement on the part of your company or anyone acting on its behalf.

26. I authorize and request any person or firm to furnish any information requested by the City of South Padre Island to verify the information contained in this Statement of Bidder's Qualifications.

_____
Printed company name of bidder

_____
Signature

_____
Printed Name and Title

_____
Date

State of Texas
County of Cameron

_____, being duly sworn deposes and says that s/he is

_____ of _____ and that all of

the information contained in this Statement of Bidders Qualifications are true and correct.

Subscribed and sworn to before me on _____

_____

Notary Public, State of _____

STANDARD FORM OF AGREEMENT

As Adopted By
THE TEXAS SECTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS
October 7, 1971

Approved as to Legal Form by
Legal Counsel

STATE OF TEXAS
COUNTY OF CAMERON

THIS AGREEMENT, made and entered into this ___ day of _____ **2016**, by and between the City of South Padre Island of the County of Cameron and State of Texas, acting through Darla Jones, Interim City Manager thereunto duly authorized so to do, Party of the First Part, hereinafter termed OWNER, and _____, of the City of South Padre Island, County of Cameron, and State of Texas, Party of the Second Part, hereinafter termed CONTRACTOR.

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the Party of the First Part (OWNER), and under the conditions expressed in the bond bearing ever date herewith, the said Party of the Second Part (CONTRACTOR), hereby agrees with the said Party of the First Part (OWNER) to commence and complete the construction of certain improvements described as follows:

W. POLARIS AND E. SWORDFISH WIDENING IMPROVMENTS 2016

and all extra work in connection therewith, under the terms as stated in the General Conditions of the Agreement and at his (or their) own proper cost and expense to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said construction, in accordance with the Notice to Contractors, prices stated in the Proposal attached hereto, and in accordance with the Notice to Contractors, General and Special Conditions of Agreement, Plans and other drawings and printed or written explanatory matter thereof, and the Specifications and addenda therefore, as prepared by

SCF Consulting, LLC, herein entitled the ENGINEER, each of which has been identified by the CONTRACTOR and the ENGINEER, together with the CONTRACTOR'S written Proposal, the General Conditions of the Agreement, and the Performance and Payment bonds hereto attached; all of which are made a part hereof and collectively evidence and constitute the entire contract.

The CONTRACTOR hereby agrees to commence work within ten (10) days after the date written notice to do so shall have been given to him, and to substantially complete the same within sixty (60) calendar days after the date of the written notice to commence work, subject to such extensions of time as are provided by the General and Special Conditions of the contract.

The OWNER agrees to pay the CONTRACTOR in current funds the price or prices shown in the proposal, which forms a part of this contract, such payments to the subject to the General and Special Conditions of the contract.

IN WITNESS WHEREOF, the parties to these presents have executed this Agreement in the year and day first above written.

CITY OF SOUTH PADRE ISLAND	_____
Party of the First Part (OWNER)	Party of the Second Part (CONTRACTOR)
By:_____	By:_____
Darla Jones	
ATTEST:	ATTEST:
_____	_____

PERFORMANCE BOND

STATE OF TEXAS
COUNTY OF_____

KNOW ALL MEN BY THESE PRESENTS: That_____
_____ Of the City of_____
County of_____, and State of_____, as
principal, and _____
authorized under the laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto_____(Owner), in the penal sum of_____
_____Dollars ($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the __
_____day of _____, 20___, to which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied a length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and said Contract and shall in all respects duly and faithfully observe and perform all and singular the covenants, conditions and agreements in and by said contract agreed and covenanted by the Principal to be observed and performed, and according to the true intent and meaning of said Contract and Plans and Specification hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect;

“PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of (Article 5160 for Public Work) (Article 5472d for Private Work)* of the Revised Civil Statutes of Texas as amended and all liabilities, on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.”

Surety, for value received, stipulates and agrees that no charge, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in anyway 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 to be performed thereunder.

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*Not applicable for federal work. See “The Miller Act,” 40 U.S.C. S270.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____day of_____20_____.

_____	_____
Principal	Surety
By_____	By_____
Title_____	Title_____
Address_____	Address_____
_____	_____
_____	_____

The name and address of the Resident Agent of Surety is:

_____
_____
_____

PAYMENT BOND

STATE OF TEXAS
COUNTY OF_____

KNOW ALL MEN BY THESE PRESENTS: That_____
_____ Of the City of_____
County of_____, and State of_____, as principal, and _____
authorized under the laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto_____(Owner), in the penal sum of_____
_____Dollars ($_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the __
_____day of _____, 20___, to which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied a length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a subcontractor in the prosecution of the work provided for in said contract, then, this obligation shall be void; otherwise to remain in full force and effect;

“PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Article 5160 of the Revised Civil Statutes of Texas as amended and all liabilities, on this bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.”

Surety, for value received, stipulates and agrees that no charge, extension of time, alteration or addition to the terms of the contract, or to the work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in anyway 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 to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____day of_____20_____.

_____	_____
Principal	Surety
By_____	By_____
Title_____	Title_____
Address_____	Address_____
_____	_____
_____	_____

The name and address of the Resident Agent of Surety is:_____

_____

(SAMPLE FORM)
CERTIFICATE OF INSURANCE

TO: Date_____

Project No._____

_____ Type of_____
Owner

Project_____

_____
Address

THIS IS TO CERTIFY THAT_____
(Name and address of insured)
is, at the date of this certificate, insured by this Company with respect to the business operations hereinafter described, for the types of Insurance and in accordance with the provisions of the standard policies used by this Company, and further hereinafter described. Exceptions to standard policy noted on reverse side hereof.

TYPE OF INSURANCE	Policy No.	Effective	Expires	Limits of Liability
Workmen's Compensation				
Public Liability				1 Person $_____
Contingent Liability				1 Accident$_____
Property Damage				1 Person$_____
Builder's Risk				1 Accident_____
Automobile				
Other				

The foregoing Policies (do) (do not) cover all sub-contractors.
Locations Covered:_____

Descriptions of Operations Covered:_____

The above policies either in the body thereof of by appropriate endorsement provide that they may not be changed or canceled by the insurer in less than five days after the insured has received written notice of such change or cancellation.

Where applicable local laws or regulations require more than five days actual notice of change or cancellation to the assured, the above policies contain such special requirements, either in the body thereof or by appropriate endorsement thereto attached.

_____
(Name of Insurer)

By_____

Title_____


Cl
-1

GENERAL CONDITIONS OF THE AGREEMENT

1. GENERAL

It is the intent of these instructions, plans and specifications to provide guidance for the construction of this project.

2. REGULATIONS AND DISCREPANCIES

All applicable laws, ordinances, policy, rules, regulations and other directives of all authorities having jurisdiction over the projects shall apply to the contract throughout and will be deemed to be included in the contract the same as those written out in full. Discrepancies between regulations or conflicting parts of the Specifications shall be brought to the attention of and clarified by the ENGINEER before proceeding with any work. Proceeding with the affected work without instructions from the ENGINEER can result in the Contractor being responsible for taking the necessary steps in insure the work conforms to the governing regulation.

3. ENGINEER

Whenever the word “ENGINEER” is used in this contract with reference to the preparation, execution, and interpretation of plans, specifications, and contract documents, it shall be understood as referring to the Scott Fry, P.E. of SCF Consulting, LLC.

4. INTERPRETATION OF PHRASES

Whenever the words “Directed”, “Required”, “Permitted”, “Designated”, “Considered Necessary”, “Prescribed”, or words of like importance are used, it shall be understood that the direction, requirements, permission, order, designation, or prescription, of the ENGINEER is intended and similarly, the words “Approval”, “Acceptable”, “Satisfactory”, or word of like importance shall mean approved by or acceptable or satisfactory to the ENGINEER.

Whenever, in the specifications or drawings accompanying this agreement, the terms or description of various qualities relative to finish, workmanship, or other qualities of similar kind which cannot, from their nature, be specifically and clearly described and specified, but are necessarily described in general terms, then, in all such cases, any question of the fulfillment of said specifications shall be decided by the ENGINEER, and said work shall be done in accordance with his interpretations of the meanings of the words, terms, or clauses defining the character of the work.

5. EXHIBITS

All work shall be done and all materials finished in strict conformity with the appended advertisement, “Information for Bidder”, “Proposal”, “Supplementary General Conditions”, “Agreement”, “Bonds”, “Insurance”, specifications and plans all of which are hereto attached.

6. KEEPING OF PLANS AND SPECIFICATIONS ACCESSIBLE

The Contractor shall be furnished with three (3) copies of all plans, profiles, and specifications without expense to him, and shall keep one copy of the same constantly accessible on the work site.

7. QUANTITIES AND MEASUREMENTS

No extra or customary measurements of any kind will be allowed, but the actual length, area, solid, contents, number and weight only shall be considered, unless otherwise specifically provided.

8. LINE AND GRADE STAKING

All layout and construction staking shall be done by the Contractor from control points shown on the plans.

9. ENGINEER AND INSPECTION

It is agreed by the Contractor that the Owner shall be and is hereby authorized to appoint from time to time such engineers and inspectors as the said Owner may deem proper, to inspect the material furnished and the work done under this Agreement, and to see that the said material is furnished, and said work is done in accordance with the specifications therefore. The Contractor shall furnish all reasonable aid and assistance required by the engineers or inspectors for the proper inspection and examination of the work and all parts of the same. The Contractor shall furnish all reasonable aid and assistance required by the engineers or inspectors as appointed, when the same are consistent with the obligations of the Agreement and the accompanying specifications provided; however, should the Contractor object to any order by any subordinate engineer or inspector, the Contractor may within six (6) days make written appeal to the Director of Public Works for his decision.

10. DISCREPANCIES AND OMISSIONS

It is further agreed that it is the intent of this contract that all work must be done, all material must be furnished in accordance with the generally accepted practice, and the event of any discrepancies between the plans and specifications, or otherwise, or in the event of any doubt as to the meaning and intent of any portion of the contract, specifications or plans, the ENGINEER shall define which is intended to apply to the work.

11. LOSSES FROM NATURAL CAUSES

All loss or damage arising out of the nature of work to be done, or from the action of the elements, or from any unforeseen circumstances in the prosecution of the same, or from unusual obstructions or difficulties which may be encountered in the prosecution of the work, shall be sustained and borne by the Contractor at his own cost and expense.

12. ESTIMATED QUANTITIES

This agreement, including the specifications, plans, and estimates, is intended to show clearly all work to be done and material to be furnished under this contract at unit prices are approximate and are to be used only as a basis for estimating the probable cost of the work and for comparing the proposals offered for the work. It is understood and agreed that the actual amount of work to be done and material to be furnished under this contract may differ somewhat from these estimates, and that where the basis for payment under this contract is the unit price method, payment shall be for the actual amount of such work and material furnished.

Where payment is based on the unit price methods, the Contractor agree that he will make no claim for damages, anticipated profits or otherwise on account of any differences which may be found between the quantities of work actually done, the material actually furnished under this contract, and the estimated quantities contemplated and contained in the proposal; provided, however, that in case the actual quantity of any “Major Item” should become as much as 50% more than, or 50% less than the estimated or contemplated quantity for such items, then either parts of this Agreement, upon demand, shall be entitled to a revised consideration upon the portion of the work above or below 50% of the estimated quantity.

A “Major Item” shall be construed to be any individual bid item incurred in the proposal that has a total cost equal to or greater than five percent (5%) of the total contract cost, computed on the basis of the final Contract Price.

13. CHANGES AND ALTERATIONS

The Contractor further agrees that the OWNER may make such changes and alterations as the Owner may see fit, in the line, grade, form, dimensions, plans, or materials for the work herein contemplated, or any part therefore, either before or after the beginning of the construction, without affecting the validity of this contract and the accompanying bond.

If such changes or alterations diminish the quantity of the work to be done, they shall not constitute the basis for a claim for damages, or anticipated profits on the work that may be dispensed with. If they increase the amount of work, and the increased work can fairly be classified under the specifications, such increase shall be paid for according to the quantity

actually done and at the unit price established for such work under this contract; otherwise, such additional work shall be paid for as provided under Extra Work. In case the OWNER shall make such changes or alterations as shall make useless any work, then the OWNER shall recompense the Contractor used in said work, for any material or labor so used, and for any actual loss occasioned by such changes, due to actual expenses incurred in preparation for the work as originally planned.

14. EXTRA WORK

The term "Extra Work" as used in this contract shall be understood to mean and include all work that may be required by the ENGINEER and OWNER to be done by the Contractor to accomplish any change, alteration, or addition to the work shown upon the plans, or reasonably implied by the specifications, and are not covered by the Contractor's Proposal, except as provided under Change and alterations in Paragraph 13 herein above.

It is agreed that the Contractor shall perform all extra work under the direction of the ENGINEER when presented with a Written Work Order signed by the ENGINEER; subject, however, to the right of the Contractor to require a written confirmation to pay the Contractor for performing said Extra Work shall then be determined by one or more of the following methods.

Method (A) - By agreed unit prices;

Method (B) - By agreed lump sum; or

Method (C) - If neither Method (A) nor Method (B) can be agreed upon before the Extra Work is commenced, then the Contractor shall be paid the "actual field cost" of the work, plus (15%).

In the event said Extra Work be performed and paid for under Method (C), then the provisions of this paragraph shall apply and the "actual field cost" is hereby defined to include the cost of all workmen, such as foreman, timekeepers, mechanics, and laborers, and materials, supplies, teams, trucks, rentals on machinery and equipment, for the time actually employed or used on such Extra Work, plus actual transportation charges necessarily incurred, if the kind of equipment or machinery be not already at the jobsite, together with all power, fuel, lubricants, water and similar operating expenses; also, all necessary incidental expenses incurred directly on account of such Extra Work, including Social Security, Old Age Benefits, and other payroll taxes, and a ratable portion of premiums on Construction and Maintenance Bonds, Public Liability and Property Damages and Workmen's Compensation, and all other insurance as may be required by any law or ordinance, or directed by the ENGINEER, or by them agreed to. The ENGINEER may direct the form in which accounts of

the “actual field cost” shall be kept and may also specify in writing, before the work commences, the method of doing the work and the type and kind of machinery and equipment to be used, otherwise these matters shall be determined by the Contactor. Unless otherwise agreed upon, the prices for the use of machinery and equipment shall be determined by using 90 percentage of the latest schedule of Equipment Ownership Expense adopted by the Associated General Contractors of America. Where practicable, the terms and prices for the use of machinery and equipment shall be incorporated in the Written Extra Work Order. The fifteen percent (15%) of the “actual field cost” to be paid the Contractor shall compensate him for his profit, overhead, general superintendence, and field office expenses, and all other elements of cost and expense not embraced within the “actual field cost” as herein defined, saved that where the Contractor’s Camp or Field Office must be maintained primarily on account of such Extra Work, then the cost to maintain and operate the same shall be included in the “actual field cost”.

No claim for Extra Work of any kind will be allowed unless ordered in writing by the ENGINEER. Notice is hereby given that all change orders must be executed in writing before the work is started; any extra work performed otherwise will be at the Contractor’s risk. In case any orders or instructions, whether oral or written, appear to the Contractor to involve Extra Work for which he should receive compensation, he shall make written request to the ENGINEER for written order authorizing such Extra Work. Should a difference of opinion arises as to what does or does not constitute Extra Work, or as to the payment therefore, and ENGINEER insists upon its performance, the Contractor shall proceed with the work after making written request for written order and shall keep an accurate account of the “actual field cost” therefore, as provided under Method (C).

15. PRELIMINARY APPROVAL

No Engineer, supervisor, or inspector shall have any power to waive the obligations of this contract for the furnishing by the Contractor of good material, and of his performing good work as herein described, and in full accordance with the plans and specifications. No failure or omission of any Engineer, supervisor, or inspector to condemn any defective work or material shall release the Contractor from the obligations to at once tear out, remove, and properly replace the same at any time prior to final acceptance upon the discovery of said defective work, or material; provided, however, that the ENGINEER, shall upon request of the Contractor, inspect and accept or reject any material furnished, and in event the material has been once accepted by the ENGINEER, such acceptance shall be binding on the OWNER, unless it can be clearly shown that such material furnished does not meet the specifications for this work.

16. DEFECTS AND THEIR REMEDIES

It is further agreed that the work or any part therefore, or any material brought on the ground for use in the work or selected for the same, shall be deemed by the ENGINEER as

unsuitable or not in conform it with the specifications, the Contractor shall, after receipt of written notice thereof from the ENGINEER, forthwith remove such material and rebuilt or otherwise remedy such work so that it shall be in full accordance with this contract.

17. TIME AND ORDER OF COMPLETION

It is the meaning and intent of this contract, except as otherwise provided or in the Supplementary and General Requirements Specifications, that the Contractor shall be allowed to prosecute his work at such times and seasons, in such order of precedence, and in such manner as shall be most conductive to economy of construction provided, however, that the order and time of prosecution shall be such that the work shall be substantially completed as a whole and in part, in accordance with this contract, plans and specifications and within the time of completion hereafter designated; provided, also, that when the OWNER is having other work done, either by contract or by his own force, the Department of Public Works may direct the time and manner of construction the work done under this contract, so that conflict will be avoided and the construction of the various works being done for the OWNER shall be harmonized.

The Contractor further agrees that he will commence within ten days after the date of the written Notice to proceed, and will progress therewith so that the work shall be substantially completed in accordance with the terms of the agreement as stated in the Proposal and Supplementary conditions. By term “substantially completed” it is meant that the structure has been made suitable for use or occupancy and is in condition to serve its intended purpose, but still may require minor miscellaneous work and adjustment.

18. EXTENSION OF TIME

Should the Contractor be unduly delayed in the completion of the work by any cause which the ENGINEER shall decide justifies the delay, then an extension of time will allowed for completing the work, sufficient to compensate for the delay, the amount of the extension to be determined by the Department of Public Works; provided, however, that the Contractor shall give the Public Works Director/ENGINEER notice in writing within ten days of the cause of such delay.

19. HINDRANCESS AND DELAYS

No charge shall be made by the Contractor for hindrances or delays from any cause (except where the work is stopped by of the OWNER) during the progress of any portion of the work embraced in this contract. In case said work shall be stopped by the act of the OWNER, then such expense as in the judgment of the ENGINEER is caused by such stopping of said work shall be paid by the OWNER to the Contractor.

20. PRICE FOR WORK

In consideration of the furnishing of all the necessary labor, equipment, and material, and the completion of all work by the Contractor, and on the completion of all work and delivery of all material embraced in this contract in full conformity with the specifications and stipulations herein contained, the OWNER agrees to pay the Contractor the prices set forth in the Proposal hereto attached, which has been made a part of this contract; and the Contractor hereby agrees to receive such prices in full furnishing all material and all labor required for the aforesaid work, also for all expenses incurred by him, and for well and truly performing the same and the whole thereof in the manner and according to this Agreement, the attached specifications, and requirements of the ENGINEER.

21. PARTIAL PAYMENT

The Contractor shall submit a written statement showing as completely as practicable the total value of the work he has accomplished up to and including the last day of the preceding month (said statement shall include the value of all sound materials delivered on the job site that are to be fabricated into the work and for which invoices are furnished to the ENGINEER on or before the third (3^{rd}) day of each month).

The Department of Public Works shall then prepare a statement for partial payment to the Contractor on or before the tenth (10) day of each month.

The OWNER shall then pay the Contractor once a month the total amount of the statement (provided the Contractor has timely submitted his statement to the ENGINEER and timely submitted his payroll reports to the OWNER), less then percent (10%) of the amount thereof, which ten percent (10%) shall be retained until final payments, and further less all previous payments, and further less or further sums that may be retained by the Owner under the terms of this Agreement and other Contract Documents, It is understood, however, that in case the whole work be near to completions and some unexpected and unusual delay occur due to no fault or neglect on the part of the Contractor, the OWNER may, upon written recommendation of the ENGINEER , pay a reasonable and equitable portion of the retained percentage to the Contractor; or, the Contractor at the OWNER'S option, may be relieved of the obligation to fully completed the work, and thereupon, the Contractor shall receive payment of the balance due him under the contract subject only to the conditions stated in Paragraph 24 hereof.

22. FINAL COMPLETION AND ACCEPTANCE

Within fifteen (15) days after the Contractor has given the ENGINEER written notice that the work has been completed, or substantially completed, the ENGINEER, and the OWNER shall inspect the work and within said time, if the work is found to be completed in accordance with the Plans and Specifications, the OWNER will issue the Contractor a

Certificate of Completion.

23. FINAL PAYMENT

Upon the issuance of the Certificate of Completion, the ENGINEER shall proceed to make final measurements and prepare final statement of the value of all work performed and materials furnished under the terms of the Agreement and shall certify same to the OWNER, who shall pay to the Contractor on or before the thirtieth (30^{th}) day after the date of the Certificate of Approval has been issued, provided he has fully performed his contractual obligations under the terms of this contract; and said payment shall become due in any event upon said performance by the Contractor.

24. DELAYED PAYMENTS

Should the OWNER fail to make payment to the Contractor of the sum named in any partial or final statement, when payment is due, or should the ENGINEER fail to issue any statement on or before the date above provided, then the OWNER shall pay to the Contractor in addition to the sum shown as due by such statement, interest thereon at the rate of five percent (5%) per annum from date due as provided in Paragraphs 21 and 23, until fully paid, which shall fully liquidate any injury to the Contractor growing out of such delay in payment.

25. ENGINEER'S AUTHORITY AND DUTY

It is mutually agreed between the parties of this Agreement that the ENGINEER shall inspect all work included herein and give directions relative to the execution of the work.

The ENGINEER shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid for under this contract and shall decide all questions which may arise in relation to said work and this construction thereof. The ENGINEER'S estimates and decisions shall be final and conclusive, expect as herein otherwise expressly provided. In any case any question shall arise between the parties hereto relative to said contract or specifications, the determination or decision of the ENGINEER shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.

The ENGINEER shall decide the meaning and intent of any portion of the specifications and of any plans or drawings where the same may be found obscure or be in dispute. Any differences or conflicts in regard to their work which may arise between the Contractor under this contract and other Contractors performing work for the OWNER shall be adjusted and determined by the ENGINEER.

26. CONTRACTOR'S DUTY

The Contractor shall give personal attention to the faithful prosecution and completion of this work and shall be present either in person or by duly authorized representative on the site of the work continually during its progress. The Contractor will make available emergency staff and telephone numbers for non-working hours in case of emergencies or other problems related to the project which must be taken care if immediately. The emergency staff representing the Contractor must respond within 30 minutes from notification.

27. CONTRACTOR'S AGENT

The Contractor during his absence from the work shall keep a competent superintendent or manager upon the work, fully authorized to act for him in his absence and to receive such orders as may be given for the proper continuance of the work. Notice to do any work, to alter work, to cease work which the Contractor is obligated to do; or concerning any imperfections in work or any material furnished when given to the superintendent or manager of the Contractor in charge of any operation of the work in the absence of the Contractor, provided any notice given under this paragraph shall be in writing.

28. CHARACTER OF EMPLOYEES

The Contractor agrees to employ only orderly, competent and skillful employees to do the work; and that whenever the ENGINEER shall inform him in writing that any person or persons on the work are, in his opinion, incompetent, unfaithful or disorderly, such man or men shall be discharged from the work and shall not again be employed on the same without the ENGINEER'S written consent.

29. CONSTRUCTION PLANT

The Contractor shall provide all labor, tools, equipment, machinery, and material necessary in the prosecution and completion of this contract where it is not otherwise specifically provided that the OWNER, shall furnish the same, and it is also understood that the OWNER shall not be held responsible for care, preservation, conservation, or protection of any material, tools or machinery or any part of the work until it is finally completed and accepted. It should be understood that the OWNER will not loan plant tools or equipment to the Contractor.

30. RIGHT OF ENGINEER TO MODIFY METHODS AND EQUIPMENT

If, at any time, the methods or equipment used by the Contractor are found to be inadequate to secure the quality of work or the rate or progress required under this contract, the ENGINEER may order the Contractor in writing to increase their safety or improve their character and efficiency, and the Contractor shall comply with such order.

If at any time the working force of the Contractor is inadequate for securing the progress

herein specified, the Contractor shall, if so ordered in writing increase his force or equipment, or both, to such an extent as to give reasonable assurance of compliance with the schedule of progress.

31. SANITATION

Necessary sanitary conveniences for use of laborers on the work, properly scheduled from public observation, shall be constructed and maintained by the Contractor in such manner and at such points as shall be approved by the ENGINEER and their use shall be strictly enforced.

32. CONTRACTOR'S BUILDINGS

The building of structures or other forms of protection will be permitted only at such places as the ENGINEER shall direct and the sanitary conditions of the grounds in or about such structures shall, at all times, be maintained in a manner satisfactory to the Department of Public Works and the ENGINEER.

33. PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC

Contractor assumes the sole responsibility for the safety and protection of the premises, adjoining property, employees, pedestrian, vehicles, vehicle operators, and other persons and shall provide and maintain suitable signs, barricades, and at night shall also maintain warning lights, as will effectual warn pedestrians and vehicular traffic of any obstruction and safeguard the public and the work from injury or damage.

The Contractor shall be liable for and shall indemnify and save harmless the OWNER, its agents and employees from any and all claims for damages on account of his failure to fully protect the premises, vehicular traffic, all adjoining property, employees and other persons.

34. PROTECTION OF ADJOINING PROPERTY

The Contractor shall take proper means to protect the adjacent or adjoining property or properties in any way encountered and which might be injured or seriously affected by any process of construction, to be undertaken by this agreement, from any damages or injury by reason of said process of construction.
The Contractor shall be liable for and shall indemnify and save harmless the OWNER, its agents and employees from any and all claims for damages on account of his failure to fully protect the premises, all adjoining property, employees and other persons.

35. PROTECTION AGAINST CLAIMS SUBCONTRACTORS, LABORERS, MATERIALMEN AND FURNISHERS OF MACHINERY, EQUIPMENT AND SUPPLIES

The Contractor agrees that he will indemnify and save the OWNER harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools and all supplies, including commissary, incurred in the furtherance of the performance of this contract. When so desired by the OWNER, the Contractor shall furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged or waived. If the Contractor fails to do so, then the OWNER may pay unpaid bills, of which the OWNER has written notice direct and withhold from the Contractor's unpaid compensation a sum of money deemed reasonable sufficient to liquidate any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, whereupon payments to the Contractor shall be resumed in full, in accordance with the terms of this contract, but in no event shall no provisions of this sentence be construed to impose any obligation upon the OWNER by either the Contractor or his Surety.

36. PROTECTION AGAINST ROYALTIES OR PATENTED INVENTION

The Contractor shall protect and save harmless the OWNER from all and every demand for damages, royalties or fees on any patented invention used by him in connection with the work done or material furnished under his contract; provided, however, that if any patented material, machinery, appliance, or invention is clearly specified in this contract, then, and in that event, the cost of procuring the rights of use and the legal release or indemnity shall be borne and paid by the OWNER, direct unless such cost is determined and directed to be included in the bid price at the time the proposal is submitted.

37. LAWS AND ORDINANCES

The Contractor shall, at all times, observe and comply with all Federal, State, and Local law, ordinances and regulations, which in any manner effect the contract of the work, shall be responsible for obtaining all necessary permits, such as buildings, plumbing, fire, tree, creek and etc. as required for the work, and shall indemnify and save harmless the OWNER against any claim arising from the violation of any such law and ordinance, whether by the Contractor or his employees. In case the OWNER is a body politic and corporate, the law from which it derives its powers, insofar as the same regulates the objects for which, or the manner in which, or the conditions under which, the OWNER may enter into contract, shall be controlling, and shall be considered as part of this contract, to the same effect as though embodied herein.

38. LIQUIDATED DAMAGES FOR DELAY

And the Contractor agrees that time is of the essence of this contract, and that for each day of delay beyond the date stated in the Supplementary Conditions for the completion of the work herein specified and contracted for, the OWNER may withhold permanently from the Contractor's total compensation the sum or amount stated in the Supplementary Conditions

as stipulated liquidated damages for such delay.

39. ASSIGNMENT AND SUBLETTING

The Contractor further agrees that he will retain personal control and will give his personal attention to the fulfillment of this contract and that he will not assign by Power of Attorney, or otherwise, nor sublet said contract without the written consent of the Owner, and that no part or feature of the work will be sublet to anyone objectionable to the ENGINEER or the OWNER. The Contractor further agrees that the subletting of any portion or feature of the work or materials required in the performance of this contract, shall not relieve the Contractor from his full obligations to the OWNER, as provided by this Agreement.

40. ABANDONMENT BY CONTRACTOR

In case the Contractor should abandon and fall or refuse in resume work within ten (10) days after written notification from the OWNER, or the ENGINEER, or when such orders are consistent with this Contract, or with this Agreement, or with the Specifications hereto attached, then, and in that case, the Surety on the bond shall be notified in writing and directed to complete the work, and a copy of said notice shall be delivered to the Contractor.

After receiving said notice of abandonment, the Contractor shall not remove from the work any machinery, equipment, tools, materials or supplies then on the job, but the same, together with any materials and equipment under contract for the work, may be held for use on the work by the OWNER or the Surety on the construction bond, or another Contractor, in completion of the work; and the Contractor shall not receive any rental or credit therefore, (except when used in connection with Extra Work, where credit shall be allowed as provided for under Paragraph 15, Extra Work); it being understood that the use of such equipment and materials will ultimately reduce the cost to complete the work and be reflected in the final settlement.

In case the Surety should fail to commence compliance with the notice for completion hereinbefore provided for, within ten (19) days after service of such notice, then the OWNER may provide for completion of the work in either of the following elective manners:

(a) The OWNER may thereupon employ such force on men and use such machinery, equipment, tools, materials and supplies as said OWNER may deem necessary to complete the work and charge the expense of such labor, machinery, equipment, tools, materials, and supplies to said Contractor, and the expense so charged shall be deducted and paid by the OWNER out of such monies as may be due, or that may thereafter at any time become due to the Contractor under any by virtue of the Agreement. In case such expense is less than the sum which would have been payable under this contract, if the same has been completed by the Contractor, then said Contractor shall receive the

difference. In case such expense is greater than the sum which would have been payable under this contract, if the same had been completed by said Contractor, then the Contractor and/or Surety shall pay the amount of such expenses to the OWNER; or

(b) The Owner under sealed bids, after five (5) days notice published one or more times in a newspaper having a general circulation in the county of the location of the work, may let the contract for the completion of the work under substantially the same terms and conditions which are provided in this contract. Incase of any increase in cost under this contract, such increase shall be charged to the Contractor, and the Surety shall be and main bound therefore. However, should the cost to complete any such contract prove to be less than what would have been the cost to complete under this contract, the contractor and/or his Surety shall be credited therewith.

When the work shall have been substantially completed the Contractor and his Surety shall be so notified and Certificates of Completion and Acceptance, as provided in Paragraph 23 hereinabove, shall be issued. A complete itemized statement of the contract accounts certified to by the Department of Public Works and the ENGINEER as being correct, shall then be prepared and delivered to the Contractor and his surety, whereupon the Contractor and/or his Surety, or the OWNER as the case may be, shall pay the balance due as reflected by said statement, within fifteen (15) days after the date of such Certificate of Completion.

In the event the statement of accounts shows that the cost to complete the work is less than that which would have been the cost to the OWNER had the work been completed by the Contractor and/or his Surety shall pay the balance shown to be due by them to the OWNER, then all machinery, equipment, tools, materials or supplies left on the sire of the work shall be turned over to the Contractor and/or his Surety. Should the cost to complete the work exceed the contract price, and the Contractor and/or his Surety fail to pay the amount due the OWNER, within the time designated herein above, and there remains any machinery, equipment, tools, materials, or supplies on the site of the work, notice thereof, shall be mailed to the Contractor and his Surety at the respective addresses designated in this contract; provided, however, that actual written notice given in any manner will satisfy this condition. After mailing, or otherwise giving of such notice, such property shall be held at the risk of the Contractor and his Surety subject only to the duty of the OWNER to exercise ordinary care to protect such property. After fifteen (15) days of said notice, the OWNER may sell such machinery, equipment, tools, materials, or supplies and apply the net sum derived from such sale to the credit of the Contractor and his Surety. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall release any machinery, on the work, and belong to persons other than the Contractor or his Surety, to their proper OWNERS.

41. BOND

It is further agreed by the parties to this contract that the Contractor will execute payment and performance bonds for the satisfactory performance of the work in accordance with this contract in the forms provides for this purpose, and it is agreed that this contract not be affect until such bonds are furnished to and approved by the OWNER.

42. TIME OF FILING CLAIMS

It is further agreed by both parties hereto that all questions or adjustment presented by the Contractor shall be in writing and filed with the Department of Public Works and the ENGINEER within a reasonable time after the ENGINEER has given any directions, orders, or instructions to which the Contractor desires to take exceptions. The Department of Public Works and the ENGINEER shall reply to such written exceptions by the Contractor and render his final decision in writing. In case the Contractor should appeal from the Department of Public Works and the ENGINEER'S decision, such appeal shall be filed with the ENGINEER and the OWNER in writing with ten (10) days after the date of the Department of Public Works and the ENGINEER'S final decision. It is further agreed that final acceptance of the work by the OWNER and the acceptance by the Contractor of the final payment shall be a bar to any claims by either party, except where noted otherwise in the Contract Documents.

END OF GENERAL CONDITIONS OF AGREEMENT

GENERAL REQUIREMENTS

A. GENERAL

The specifications contain detailed instructions and descriptions covering the major items of construction and workmanship necessary for building and completing the various units or elements of the project. The specifications are intended to be so written that only first class workmanship and finish of the best grade quality will result. The fact that these specifications may fail to be so complete as to cover all details will not relieve the Contractor of full responsibility for providing a completed project of high quality, first class finish and appearance and satisfactory for operation all within the apparent intent of the plans and specifications.

B. MATERIALS

These specifications are intended to be so written that only materials of the best quality and grade will be furnished. The fact that the specifications may fail to be sufficiently complete is some detail will not relieve the Contractor of full responsibility for providing materials of high quality. The specifications for materials set out the minimum standard of quality which the owner believes necessary to procure a satisfactory project. No substitutions will be permitted unless the Contractor has received written permission of the ENGINEER to make a substitution for the material which has been specified.

Where the term “Or Equal” or “Or Approval Equal” is used, it is understood that if a material, product or piece of equipment bearing the name so used is furnished, it will be approvable as the particular trade name was used for the purpose of establishing a standard of quality acceptable to the Owner. If a product of any other name is proposed for use, the Engineer’s approval thereof must be obtained before the proposed substitute is procured by the Contractor. Wherever the alternate “Or Equal” is used, it is understood to mean “Or Approved Equal”.

The manufacturer of each item of material and/or equipment shall furnish the Owner with a sworn statement that all material furnished by him under this contract complies with these specifications and all applicable ASTM, AWWA, ASA, and Federal Specification as set forth herein.

C. MANUFACTURER’S QUALIFICATIONS

All material and equipment furnished under this Contract shall be the product of manufacturers who are known to be skilled and who have been regularly engaged for a period of five years or more in the manufacturer of each specified type of equipment, or its counterpart.

D. CHANGE OF LOCATION

No change of the alignment is contemplated. However, should a change be necessary due to difficulty in right-of-way, or other reasons, the Owner, reserved the right to make such change. Unless it can be clearly shown that such change will be allowed the Contractor, except as provided by unit prices applicable to such change.

E. HANDLING MATERIALS NOT APPROVED

The contractor shall remove from the site any materials found to be damaged and any materials not meeting the specifications shall be taken off the site. These materials shall be removed promptly, unless the Department of Public Works and the Engineer will accept the materials after repairing. Materials found to be damaged, or not acceptable to the Engineer, shall be removed if installed and then found to be damaged or not acceptable. Inspection before installation shall not relieve the contractor from any responsibility to furnish good quality materials.

F. SAFETY AND PROPERTY PROTECTION

1. Barricades, Guards and Safety Provision: To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns, and guards as required shall be placed and maintained during the progress of the construction work and until is it safe for traffic to use the roadway. When necessary, watchmen shall be provided to prevent accidents and no extra compensation will be allowed therefore. Rules and regulations of the local authorities respecting safety provisions shall be observed.

2. Property Protection: Trees, Fences, signs, poles, guy wires, and all other property shall be protected unless their removal is authorized, and any property damage shall be satisfactorily restored by the Contractor.

   The Contractor shall make adequate provisions for the protection of permanent paving, both concrete and asphalt, from damage by construction equipment.

SUPPLEMENTARY CONDITIONS

The Supplementary Conditions are in addition to and do not void any portions of the General Conditions of the Agreement or other parts of the Contract Documents; however, wherever there is a direct conflict in meaning, these General Supplementary Conditions take precedence.

1. MATERIAL AND EQUIPMENT

It shall be clearly understood the responsibility for the protection and safekeeping of equipment and materials on the project site will be entirely that of the Contractor and that no claim shall be made against by reason of any act of another Contractor, an employee, or trespasser. It shall be further understood that should any occasion arise necessitating access to the sites occupied by these stored materials and equipment, the Contractor owning or responsible for the stored materials or equipment shall immediately moved same. No materials or equipment may be placed upon any property until the OWNER has approved the location contemplated by the Contractor to be used for storage.

2. USE OF PREMISES AND REMOVAL OF DEBRIS

The Contractor expressly undertakes at his own expense;

a. To take every prevention against injuries to persons or damage to property;

b. To store his apparatus, materials, supplies and equipment in such orderly fashion at this site of the work as will not unduly interfere with the progress of his work or the work of any other Contractor;

c. To clean up frequently and remove all refuse, scrap materials, and debris caused by his operations, to the end that all times the site of the work shall present a neat, orderly and workmanlike appearance.

d. Before final payment, to remove all surplus materials, false work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, and to put the site in a neat, orderly condition.

3. SAFETY REQUIRMENTS

Every reasonable and proper precaution shall be taken by the Contractor to insure the safety of the work and employed personnel, the public, and the adjacent property whether publicly or privately owned.

To protect persons from injury and to avoid property damage, barricades, signs, lanterns, or lights and guards as required shall be placed and maintained by the Contractor at the site and access way during the progress of the construction.

Rules and Regulations governing “Occupational Safety and Health Standards” as published by the Occupational Safety and Health Administration, Department of Labor, shall be observed for all operations and all work performed under this contract.

All costs involved in complying with the above requirements shall be borne by the Contractor.

4. DETOURS

The Contractor shall provide barricades, signs, lights or guards and any other items required to maintain properly marked detours around his operations.

All costs involved in complying with the above requirements shall be born on by the Contractor.

5. SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND PLANS

The specifications and plans are intended to supplement but not necessarily duplicate each other. Any work exhibited in the one and not in the other shall be executed as if it had been set forth in both.

Should anything necessary for a clear understanding of the work be omitted from the specifications and plans or should the requirements appear to be in conflict, the Contractor shall secure written instructions from the ENGINEER before proceeding with the construction affected thereby. It is understood and agreed that the work shall be performed according to the true intent of the contract documents.

All products specified by manufacturer’s name shall be installed in accordance with manufacturer’s printed instructions.

When equipment or material furnished by the Contractor cannot be installed as specified or as shown on the plans, the Contractor shall, without extra cost to the OWNER, make all modifications required to properly install the equipment or material. Such modifications shall be subject to the approval of the ENGINEER.

Dimensions and elevations shown on the plans shall be accurately followed even though they differ from scaled measurements. No work shown on the plans, the dimensions of which are not indicated, shall be executed until necessary dimensions have been obtained from the ENGINEER.

The general arrangement of all accessories and appurtenances shall be as indicated on the plans or as later furnished on approved shop drawings.

Reference to standard specifications of any technical society, organization, or association or to codes of local or state authorities shall mean the latest standard, code, specification or tentative specification adopted and published at the date of taking bids, unless specifically stated otherwise.

No attempt has been made in the specifications to segregate work to be performed by any trade or subcontract. Any segregation between the trades or crafts will be solely a matter for agreement between the Contractor and his employees and his subcontractors.

6. PERMITS AND FEES

The Contractor shall make applications for, secure and pay all costs for permits, inspection fees, licenses and deposits required for the work to be performed.

Each subcontractor shall bear the cost of permits and fees relative to work.

7. SUNDAY, HOLIDAY, AND NIGHT WORK

No work shall be done between the hours of 7:00p.m. and 7:00a.m. nor on Sundays or Legal Holidays without the written approval of the Owner in each case, except such work as may be necessary for the proper care, maintenance, and protection of work already done or of equipment or in case of emergency.

Any work necessary to be performed after or outside regular working hours, on Sundays, or Legal Holidays, shall be performed without additional expense to the OWNER.

8. TIME OF COMPLETION

Article 17 of the General Conditions of the Agreement shall be supplemented as follows.

The Contractor shall have substantially completed all construction work undertaken by him no later than sixty (60) calendar days from the date of issuance or a written notice to proceed from the OWNER

9. LIQUIDATED DAMAGES

Article 38 of the General Conditions of the Agreement shall be supplemental as follows:

The Contractor agrees that time is of the essence on this contract and that for each calendar day of delay beyond the time established for completion of the work specified and contract for the OWNER may withhold permanently from the Contractor's compensation the sum of Two Hundred Dollars ($200.00) as stipulated liquidated damages for delay.

10. PROGRESS SCHEDULES

Prior to beginning work, the Contractor shall furnish the Engineer with an anticipated progress schedule covering all the work to be performed under this contract. During construction, the Contractor shall revise the schedule periodically as requested to reflect as nearly as possible to actual construction operations. The Contractor shall also furnish the ENGINEER as soon as possible with a schedule showing ordering delivery dates of all equipment materials to be incorporated in the work; these dates shall be keyed to the proposed progress schedule for the work.

11. SUBCONTRACTING

a. The Contractor may utilize the service of specialty subcontractors on those parts of the work which, under normal contracting practices, are performed by specialty subcontractors.

b. The Contractor shall not award any work to any subcontractor without prior written approval of the ENGINEER, which approval will not be given until the Contractor submits to the Department of Public Works and the ENGINEER a written statement concerning the proposed award to the subcontractor, which statement shall contain such information as the Department of Public Works and the ENGINEER may require.

c. The Contractor shall be as fully responsible to the OWNER for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them as he is for the acts and omissions of persons directly employed by him.

d. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the Notice to Bidders, General and Supplementary Conditions and other Contract Documents insofar as applicable to the work of subcontractors and to give the Contractor the same power as regards terminating any subcontract that the OWNER may exercise over the Contractor under provisions of the Contract Documents.

e. The General Contractor will be responsible for and make good at is own expense any damage or injury to work done by subcontractors until final completion and final acceptance of all the work to be done.

f. Nothing contained in this contract shall create any contractual relation between subcontractor and the OWNER.

12. INSPECTION AND TESTING

If Contract specifications, codes, or OWNER'S instructions require any work to be specially tested or approval, the Contractor shall give the ENGINEER a 24 hour notion of its readiness

for inspection and make all necessary thereof.
The Contractor shall finish at his expense all labor and assistance that may be needed by the Department of Public Works and the ENGINEER in performing any testing or supervision thereof.

13. MEASURMENT AND PAYMENT

The total bid price of the contract shall cover all work shown on the contract drawings and required by the specifications and other contract documents. All costs in connection with the work, including furnishing of all materials, equipment, supplies, and appurtenances; providing all construction plant, equipment and tools; and performing of all necessary labor to fully complete the work, shall be included in the prices names “Proposal”. No item that is required by the Contract Documents for the proper and successful completion of the work will be paid for outside of or in addition to prices submitted in the “Proposal”. All work not specifically set forth as a pay item in the Proposal shall be considered a subsidiary obligation of the Contractor, and all costs in connection therewith shall be included in the prices names in the “Proposal.

14. PAYMENT WITHHELD

The Department of Public Works and the ENGINEER may withhold, or on account of subsequently discovered evidence, nullify the whole or a part of any certificate to such extent as may be necessary to protect the OWNER from loss on account of:

a. Defective work not remedied.

b. Claims filed or reasonable evidence indicating probable filing of claims.

c. Failure of the Contractor to make payments when due to subcontractors or for materials or for labor.

d. A reasonable doubt that the contract can be completed for the balance then unpaid.

15. DEFENSE OF SUITS

In case any action in court is brought against the OWNER, the Department of Public Works and the ENGINEER, or any officer or agent of either of them, for the failure, omission or neglect of the Contractor to perform any of the covenants, acts matters, or things by this contract undertaken; or for injury or damage caused by the alleged negligence of the Contractor of his subcontractors or his or their agents, or in connection with any claim based on lawful demands of subcontractors, workmen, materialmen, or suppliers; the Contractor shall indemnify and save harmless the OWNER, and the Department of Public Works and the ENGINEER and their officers and agents from all losses, damages, costs, expenses, judgments, or decrees arising out of such action.

16. GUARANTEE

The Contractor shall furnish the OWNER with a Maintenance Bond for a period of one (1) year to be effective from the date of issue of Certificate of Acceptance. This Maintenance Bond is for the guarantee for the work, performed to be free from defects due to faulty workmanship or materials installed on this project. Neither final acceptance nor finally payment not any provision in the Contract Documents relieves notifies the Contractor in writing that certain maintenance work needs to be done, and the Contractor does not do the maintenance work within a reasonable time, such time to be governed by the hazard or inconvenience to the public or the OWNER, the OWNER is to do, or to have such work done, and these charges will be paid for by the Contractor, under the Maintenance Bond provision.

17. DRAWINGS AND SPECIFICATIONS FURNISHED

The contractor will be furnished with three (3) sets of drawings and specifications without cost, additional copies will be paid for by the Contractor. The charges will be the actual cost of reproduction per set.

18. TESTING LABORATORY SERVICES

A recognized testing laboratory will be selected to perform the testing services.

Payment for Testing: The first shall be paid for by the OWNER.

Any re-testing required due to failing test will be paid for by the CONTRACTOR.

All tests shall be made when, according to the Contractor, the item is ready for testing.

19. INSURANCE AND BONDING REQUIREMENTS

The following bonding and issuance requirements shall be provided:

A. A bid guarantee from each bidder equivalent to five percent of the bid price. The “bid guarantee” shall consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of his bid, execute such contractual documents as may be required within the time specified.

B. A performance bond on the part of the Contractor for 100 percent of the contract price. A “performance bond” is one executed in connection with a contract to secure fulfillment to all the Contractor’s obligations under such contract.

C. A payment bond on the part of the Contractor for 100 percent of the contract price. A “payment bond” is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

D. The successful bidder, to whom the contract is awarded, will be required to carry the hereinafter listed types and amounts of insurance, which will protect the Owner, and furnish acceptable proof of payment to premiums thereon:

Comprehensive General

Liability……...$1,000,000/$1,000,000

Comprehensive Form

Premises – Operations

Explosion and Collapse Hazard

Underground Hazard

Products/Completed Operations Hazard

Contractual Insurance

Independent Contractors

Personal Injury

Property Damage…….$100,000

Builder's Risk……..……..……$ Amount of Contract

Workmen's Compensation…….……In Accordance with Statutory Requirements

Broad Form Comprehensive General Liability……..……$500,000/$500,000

Automobile Public Liability and Property Damage……....In Accordance with Statutory Requirements

20. INDEMNITY

The "Contractor agrees to and shall indemnify and hold harmless the OWNER, its officers, agents, employees and ENGINEER from and against any and all claims, losses, damages, causes of action, suits and liabilities of every kind, including all expenses of litigation, court cost, and attorney's fees, for injury to or death of any person, or for damage to any property, arising out of or in connection with the work done by the Contractor under this contract."

END OF SUPPLEMENTARY CONDITIONS

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

Except where specifically noted otherwise in the contract documents, all provisions of pertinent items of the Texas Department of Transportation 2004 Standard Specifications for Construction of Highways, Streets and Bridges shall govern all work to be done under this Contract.

All work under this contract is to be in accordance with the Standards and Specifications for the Acceptance of Public Improvements for the City of South Padre Island.

If there is a conflict between TxDOT and City Specification, the more stringent shall control unless otherwise authorized by the ENGINEER.

Any conflicts between TxDOT or City Specification and the following Technical Specifications, the project's Technical Specification shall govern.

Copies of the City's Specification are available for review at the Public Works Department, or are available for purchase for $25.00 per set.

PAYMENT

The City will pay the contractor ninety (90) percent upon completion of the work, and the remaining ten (10) percent upon final completion of all restoration and acceptance by the City of South Padre Island.

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ITEM 110
EXCAVATION

110.1. Description. Excavate areas as shown on the plans or as directed. Remove materials encountered to the lines, grades, and typical sections shown on the plans and cross-sections.

110.2. Construction. Accept ownership of unsuitable or excess material and dispose of material in accordance with local, state, and federal regulations at locations outside the right of way.
Maintain drainage in the excavated area to avoid damage to the roadway section. Correct any damage to the subgrade caused by weather, at no additional cost to the Department.
Shape slopes to avoid loosening material below or outside the proposed grades. Remove and dispose of slides as directed.

A. Rock Cuts. Excavate to finish subgrade. Manipulate and compact subgrade in accordance with Article 132.3.D, "Compaction Methods," unless excavation is to clean homogenous rock at finish subgrade elevation. If excavation extends below finish subgrade, use approved embankment material compacted in accordance with Article 132.3.D to replace undercut material at no additional cost.

B. Earth Cuts. Excavate to finish subgrade. In areas where base or pavement structure will be placed on subgrade, scarify subgrade to a uniform depth at least 6 in. below finish subgrade elevation. Manipulate and compact subgrade in accordance with Article 132.3.D, "Compaction Methods." If unsuitable material is encountered below subgrade elevations, take corrective measures as directed. Drying required deeper than 6 in. below subgrade elevation will be paid for in accordance with Article 9.4, "Payment for Extra Work." Excavation and replacement of unsuitable material below subgrade elevations will be performed and paid for in accordance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.4.

C. Subgrade Tolerances. For turnkey construction, excavate to within 1/2 in. in cross-section and 1/2 in. in 16 ft. measured longitudinally. For staged construction, excavate to within 0.1 ft. in cross-section and 0.1 ft. in 16 ft. measured longitudinally.

110.3. Measurement. This Item will be measured by the cubic yard in its original position as computed by the method of average end areas.
This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.
Limits of measurement for excavation in retaining wall areas will be as shown on the plans.
Shrinkage or swelling factors will not be considered in determining the calculated quantities.

110.4. Payment. The work performed and materials furnished in accordance with this Item will not be measured or paid for directly, but will be subsidiary to pertinent items. This price is full compensation for authorized excavation; drying; undercutting subgrade and reworking or replacing the undercut material in rock cuts; hauling; disposal of material not used elsewhere on the project; scarification and compaction; and equipment, labor, materials, tools, and incidentals.

ITEM 210
ROLLING

210.1. Description. Compact embankment, subgrade, base, surface treatments, broken concrete pavement, or asphalt pavement using rollers. Break up asphalt mats, pit run material, or base materials.

210.2. Equipment. The Contractor may use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the plans or directed. When specific types of equipment are required, use equipment that meets the requirements of this Article. The Engineer may allow the use of rollers that operate in one direction only when turning does not affect the quality of work or encroach on traffic.

Table 1
Roller Requirements[1]

Roller Type	Materials to be Compacted	Load (tons)	Contact Pressure	Roller Speed (mph)
Steel wheel	Embankment, subgrade, base, asphalt concrete	≥ 10	≥ 325 lb. per linear inch of wheel width	2-3
Tamping	Embankment, subgrade, base .	-	125.550 psi per tamping foot	2-3
Heavy Tamping	Embankment, subgrade, base	-	≤ 550 psi per	2-3
Vibratory	Embankment, subgrade, base, approved asphalt concrete	Type A < 6 Type B > 6 Type C as shown on plans	Per equipment specification and as approved	As
Light Pneumatic	Embankment, subgrade, base, surface treatment	4.5-9.0	≥ 45 psi	2-6
	Asphalt Concrete			4-12
Medium Pneumatic	Same as light pneumatic	12-25	≥ 80 psi, as directed	Same as light pneumatic
Heavy pneumatic	Embankment, subgrade, base, previously broken concrete pavement, other pavements	≥ 25	≤ 150 psi	2-6
Grid	Embankment, base, breaking up existing asphalt mats or base	5-13	-	2-3

1. Unless otherwise specified in the Contract.

A. Static Steel Wheel Rollers. Furnish single, double, or triple steel wheel, self-propelled power rollers weighing at least 10 tons capable of operating in a forward and backward motion. Ensure all wheels are flat. When static steel wheel rollers are required, vibratory rollers in the static mode may be used.

For single steel wheel rollers, pneumatic rear wheels are allowed for embankment, subgrade, and base.

For triple steel wheel rollers, provide rear wheels with a minimum diameter of 48 in., a minimum width of 20 in., and a minimum compression of 325 lb. per inch of wheel width.

B. Tamping Rollers. Furnish self-propelled rollers with at least 1 self-cleaning metal tamping drum capable of operating in a forward or backward motion with a minimum effective rolling width of 5 ft. For rollers with more than 1 drum, mount drums in a frame so that each drum moves independently of the other. Operate rollers in static or vibratory mode.

1. Tamping Roller (Minimum Requirement). For all tamping rollers except for heavy tamping rollers, provide tamping feet that exert a static load of 125 to 550 psi and project at least 3 in. from the surface of the drum.

2. Heavy Tamping Roller. Provide tamping rollers that have:

- 2 metal tamping drums, rolls, or shells, each with a 60-in. minimum diameter and a 5-ft. minimum width, or
- 1 rear and 2 forward drums, each with a 60-in. minimum diameter. Arrange drums so that the rear drum compacts the space between the 2 forward drums and the minimum overall rolling width is 10 ft.

Equip drums with tamping feet that:

- project at least 7 in. from the drum surface,
- have an area of 7 to 21 sq. in.,
- are self-cleaning,
- exert a static load of at least 550 psi, and
- are spaced at 1 tamping foot per 0.65 to 0.70 sq. ft. of drum area.

C. Vibratory Rollers. Furnish self-propelled rollers with at least 1 drum equipped to vibrate. Select and maintain amplitude and frequency settings per manufacturer.s specifications to deliver maximum compaction without material displacement or shoving, as approved. Furnish the equipment manufacturer's specifications concerning settings and controls for amplitude and frequency. Operate rollers at speeds that will produce at least 10 blows per foot unless otherwise shown on the plans or approved. Pneumatic rear wheels are allowed for embankment, subgrade, and base. Equip each vibrating drum with:

- separate frequency and amplitude controls,
- controls to manually start and stop vibration, and
- a mechanism to continuously clean the face of the drum.

For asphalt-stabilized base and asphalt concrete pavement, furnish a roller that also has the ability to:

- automatically reverse the direction of the rotating eccentric weight,
- stop vibration before the motion of the roller stops, and
- thoroughly moisten the drum with water or approved asphalt release agent.

1. Drum (Type A). Furnish a roller with a static weight less than 6 tons and a vibratory drum.

2. Drum (Type B). Furnish a roller with a minimum static weight of 6 tons and a vibratory drum.

3. Drum (Type C). Furnish a roller as shown on plans.

D. Pneumatic Tire Rollers. Pneumatic tire rollers consist of rubber tire wheels on axles mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gaps between adjacent tires of the forward group. Furnish rollers capable of forward and backward motion. Compact asphalt pavements and surface treatments with a roller equipped with smooth-tread tires. Compact without damaging the surface. When necessary, moisten the wheels with water or an approved asphalt release agent.

Select and maintain the operating load and tire air pressure within the range of the manufacturer's charts or tabulations to attain maximum compaction throughout the lift, as approved. Furnish the manufacturer's chart or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

1. Light Pneumatic Tire. Furnish a unit:

- with at least 9 pneumatic tires,

• with an effective rolling width of approximately 5 ft.,
• capable of providing a total uniform load of 4.5 to 9 tons, and
• with tires capable of maintaining a minimum ground contact pressure of 45 psi.

2. Medium Pneumatic Tire. Furnish a unit:
• with at least 7 pneumatic tires,
• with an effective rolling width of approximately 7 ft.,
• capable of providing a total uniform load of 12 to 25 tons, and
• with tires capable of maintaining a minimum ground contact pressure of 80 psi or 90 psi as directed.

3. Heavy Pneumatic Tire. Furnish a unit:
• with at least 4 pneumatic-tired wheels mounted on axles carrying at most 2 wheels,
• with wheels arranged to carry approximately equal loads on uneven surfaces,
• with a width between 8 and 10 ft. that can turn 180° in the crown width,
• capable of providing a total uniform load of at least 25 tons,
• with tires capable of maintaining a maximum ground contact pressure of 150 psi, and
• with liquid-filled tires inflated to such a level that liquid will flow from the valve stem when the stem is in the uppermost position.

E. Grid Rollers. Furnish rollers that have 2 cylindrical cages with a minimum diameter of 66 in. and a minimum width of 32 in. Mount cages in a rigid frame with weight boxes. Use a cage surface of cast or welded steel fabric grid with bars 1-1/2 in. wide, spaced on 5-in. centers in each direction, that undulate approximately 1 in. between the high and low points.

Furnish rollers capable of providing a total load of 5 to 13 tons and capable of being operated in a forward or backward motion.

F. Alternate Equipment. Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.

210.3. Construction. Perform this work in accordance with the applicable Items using equipment and roller speeds specified in Table 1. Use only rubber-tired equipment to push or pull compaction equipment on base courses. Use equipment that does not damage material being rolled.

210.4. Measurement and Payment. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

ITEM 216
PROOF ROLLING

216.1. Description. Proof-roll earthwork, base, or both to locate unstable areas.

216.2. Equipment.

A. Specified Equipment. Furnish rollers that when loaded weigh at least 25 tons. The maximum acceptable load is 50 tons. Provide rollers that meet the requirements of Section 210.2.D, "Pneumatic Tire Rollers." B. Alternative Equipment. Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results in the same period of time. Discontinue the use of the alternative equipment and furnish the specified equipment if the desired results are not achieved.

216.3. Construction. Perform proof rolling as directed. Adjust the load and tire inflation pressures within the range of the manufacturer's charts or tabulations, as directed. Make at least 2 coverages with the proof roller. Offset each trip of the roller by at most 1 tire width. Operate rollers at a speed between 2 and 6 miles per hour, as directed. If an unstable or nonuniform area is found, correct the area in accordance with the applicable Item.

216.4. Measurement and Payement. The work performed, labor, tools and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

ITEM 247

FLEXIBLE BASE

247.1. Description. Construct a foundation course composed of flexible base.

247.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance. Use Tex-100-E material definitions.

A. Aggregate. Furnish aggregate of the type and grade shown on the plans and conforming to the requirements of Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1, unless shown on the plans.

Table 1
Material Requirements

Property	Test Method	Grade 1	Grade 2	Grade 3	Grade 4
Master gradation sieve size (% retained)					
2-1/2 in.		–	0	0	
1-3/4 in.	Tex-110-E	0	0–10	0–10	As shown
7/8 in.		10–35	–	–	on the plans
3/8 in.		30–50	–	–	
No. 4		45–65	45–75	45–75	
No. 40		70–85	60–85	50–85	
Liquid limit, % max.[1]	Tex-104-E	35	40	40	As shown on the plans
Plasticity index, max.[1]		10	12	12	As shown on the plans
Plasticity index, min.[1]	Tex-106-E	As shown on the plans			
Wet ball mill, % max.[2]		40	45	–	
Wet ball mill, % max. increase passing the No. 40 sieve	Tex-116-E	20	20	–	As shown on the plans
Classification[3]		1.0	1.1–2.3	–	As shown on the plans
Min. compressive strength[3], psi lateral pressure 0 psi	Tex-117-E	45	35	–	As shown

1. Determine plastic index in accordance with Tex-107-E (linear shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
2. When a soundness value is required by the plans, test material in accordance with Tex-411-A.
3. Meet both the classification and the minimum compressive strength, unless otherwise shown on the plans.

1. Material Tolerances. The Engineer may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation.

When target grading is required by the plans, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.

The Engineer may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit. No single failing test may exceed the allowable limit by more than 2 points.

2. Material Types. Do not use fillers or binders unless approved. Furnish the type specified on the plans in accordance with the following.

a. Type A. Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.

b. Type B. Crushed or uncrushed gravel. Blending of 2 or more sources is allowed.

c. Type C. Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I. Blending of 2 or more sources is allowed.

d. Type D. Type A material or crushed concrete. Crushed concrete containing gravel will be
considered Type D material. Crushed concrete must meet the requirements in Section 247.2.A.3.b, "Recycled Material (Including Crushed Concrete) Requirements," and
be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles in order to verify compliance.

e. Type E. As shown on the plans.

3. Recycled Material. Recycled asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend 2 or more sources of recycled materials.

a. Limits on Percentage. When RAP is allowed, do not exceed 20% RAP by weight unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.

b. Recycled Material (Including Crushed Concrete) Requirements.

(1) Contractor Furnished Recycled Materials. When the Contractor furnishes the recycled materials, including crushed concrete, the final product will be subject to the requirements of Table 1 for the grade specified. Certify compliance with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines," for Contractor furnished recycled materials. In addition, recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with Tex-413-A. For RAP, do not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with Tex-406-A. Test RAP without removing the asphalt.

(2) Department Furnished Required Recycled Materials. When the Department furnishes and requires the use of recycled materials, unless otherwise shown on the plans:

- Department required recycled material will not be subject to the requirements in Table 1,
- Contractor furnished materials are subject to the requirements in Table 1 and this Item,
- the final product, blended, will be subject to the requirements in Table 1, and
- for final product, unblended (100% Department furnished required recycled material), the liquid limit, plasticity index, wet ball mill, classification, and compressive strength is waived.

Crush Department-furnished RAP so that 100% passes the 2 in. sieve. The Contractor is responsible for uniformly blending to meet the percentage required.

(3) Department Furnished and Allowed Recycled Materials. When the Department furnishes and allows the use of recycled materials or allows the Contractor to furnish recycled materials, the final blended product is subject to the requirements of Table 1 and the plans.

c. Recycled Material Sources. Department-owned recycled material is available to the Contractor only when shown on the plans. Return unused Department-owned recycled materials to the Department stockpile location designated by the Engineer unless otherwise shown on the plans.

The use of Contractor-owned recycled materials is allowed when shown on the plans. Contractor-owned surplus recycled materials remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance. Do not intermingle Contractor owned recycled material with Department-owned recycled material unless approved by the Engineer.

B. Water. Furnish water free of industrial wastes and other objectionable matter.

C. Material Sources. When non-commercial sources are used, expose the vertical faces of all strata of material proposed for use. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.

247.3. Equipment. Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216,

"Proof Rolling," when required.

247.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft. thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise shown on the plans. After construction and acceptance of the stockpile, loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile.

Do not add or remove material from temporary stockpiles that require sampling and testing before delivery unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates.

Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in accordance with the applicable Items.

A. Preparation of Subgrade or Existing Base. Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Stabilized Base and Asphalt Pavement," when shown on the plans or as directed. Shape the subgrade or existing base to conform to the typical sections shown on the plans or as directed.

When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

When shown on the plans or directed, proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying. Correct soft spots as directed.

B. Placing. Spread and shape flexible base into a uniform layer with an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed, at no additional expense to the Department.

Place successive base courses and finish courses using the same construction methods required for the first course.

C. Compaction. Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed.

When necessary, sprinkle the material in accordance with Item 204, "Sprinkling."

Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

1. Ordinary Compaction. Roll with approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

2. Density Control. Compact to at least 100% of the maximum density determined by Tex-113-E unless otherwise shown on the plans. Determine the moisture content of the material at the beginning and during compaction in accordance with Tex-103-E.

The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density

tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

D. Finishing. After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material

and dispose of it at an approved location. Seal the clipped surface immediately by rolling with a pneumatic tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed.

In areas where surfacing is to be placed, correct grade deviations greater than 1/4 in. in 16 ft. measured longitudinally or greater than 1/4 in. over the entire width of the cross-section. Correct by loosening, adding, or removing material. Reshape and recompact in accordance with Section 247.4.C, "Compaction."

E. Curing. Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

247.5. Measurement. Flexible base will be measured as follows:

- **Flexible Base (Complete In Place).** The ton, square yard, or any cubic yard method.
- **Flexible Base (Roadway Delivery).** The ton or cubic yard in vehicle.
- **Flexible Base (Stockpile Delivery).** The ton, cubic yard in vehicle, or cubic yard in stockpile.

Measurement by the cubic yard in final position and square yard is a plans quantity measurement. The quantity to be paid for is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity
Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Measurement is further defined for payment as follows.

A. Cubic Yard in Vehicle. By the cubic yard in vehicles of uniform capacity at the point of delivery.

B. Cubic Yard in Stockpile. By the cubic yard in the final stockpile position by the method of average end areas.

C. Cubic Yard in Final Position. By the cubic yard in the completed and accepted final position. The volume of base course is computed in place by the method of average end areas between the original subgrade or existing base surfaces and the lines, grades, and slopes of the accepted base course as shown on the plans.

D. Square Yard. By the square yard of surface area in the completed and accepted final position. The surface area of the base course is based on the width of flexible base as shown on the plans.

E. Ton. By the ton of dry weight in vehicles as delivered. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The Engineer will determine the moisture content in the material in accordance with Tex-103-E from samples taken at the time of weighing.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at a location approved by the Engineer. Scales must conform to the requirements of Item 520, "Weighing and Measuring Equipment."

247.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the types of work shown below. No additional payment will be made for thickness or width exceeding that shown on the typical section or provided on the plans for cubic yard in the final position or square yard measurement.

Sprinkling and rolling, except proof rolling, will not be paid for directly but will be subsidiary to this Item unless otherwise shown on the plans. When proof rolling is shown on the plans or directed, it will be paid for in accordance with Item 216, "Proof Rolling."

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this project, correction of soft spots in the subgrade will be paid in accordance with pertinent Items or Article 4.2, "Changes in the Work."

A. Flexible Base (Complete In Place). Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. For square yard measurement, a depth will be specified. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, spreading, blading, mixing, shaping, placing, compacting, reworking, finishing, correcting locations where thickness is deficient, curing, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.

B. Flexible Base (Roadway Delivery). Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" will be specified. The unit price bid will not include

processing at the roadway. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.

C. Flexible Base (Stockpile Delivery). Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" or "In Stockpile" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing and disposing of materials, preparing the stockpile area, temporary or permanent stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials to the stockpile, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.

ITEM 260
LIME TREATMENT (ROAD-MIXED)

260.1. Description. Mix and compact lime, water, and subgrade or base (with or without asphaltic concrete pavement) in the roadway.

260.2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. Obtain verification from the Engineer that the specification requirements are met before using the sources. The Engineer may sample and test project materials at any time before compaction. Use Tex-100-E for material definitions.

A. Lime. Furnish lime that meets the requirements of DMS-6350 "Lime and Lime Slurry," and DMS-6330, "Lime Sources Prequalification of Hydrated Lime and Quicklime." Use hydrated lime, commercial lime slurry, or quicklime, as shown on the plans. When furnishing quicklime, provide it in bulk.

B. Flexible Base. Furnish base material that meets the requirements of Item 247, "Flexible Base," for the type and grade shown on the plans, before the addition of lime.

C. Water. Furnish water free of industrial wastes and other objectionable material.

D. Asphalt. When asphalt or emulsion is permitted for curing purposes, furnish materials that meet the requirements of Item 300, "Asphalts, Oils, and Emulsions," as shown on the plans or as directed.

E. Mix Design. The Engineer will determine the target lime content and optimum moisture content in accordance with Tex-121-E or prior experience with the project materials. The Contractor may propose a mix design developed in accordance with Tex-121-E. The Engineer will use Tex-121-E to verify the Contractor's proposed mix design before acceptance. Reimburse the Department for subsequent mix designs or partial designs necessitated by changes in the material or requests by the Contractor. When treating existing materials, limit the amount of asphalt concrete pavement to no more than 50% of the mix unless otherwise shown on the plans or directed.

260.3. Equipment. Provide machinery, tools, and equipment necessary for proper execution of the work. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

A. Storage Facility. Store quicklime and dry hydrated lime in closed, weatherproof containers.

B. Slurry Equipment. Use slurry tanks equipped with agitation devices to slurry hydrated lime or quicklime on the project or other approved location. The Engineer may approve other slurrying methods. Provide a pump for agitating the slurry when the distributor truck is not equipped with an agitator. Equip the distributor truck with a sampling device in accordance with Tex-600-J, Part I, when using commercial lime slurry.

C. Pulverization Equipment. Provide pulverization equipment that: • cuts and pulverizes material uniformly to the proper depth with cutters that plane to a uniform surface over the entire width of the cut, • provides a visible indication of the depth of cut at all times, and • uniformly mixes the materials.

260.4. Construction. Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

A. Preparation of Subgrade or Existing Base for Treatment. Before treating, remove existing asphalt concrete pavement in accordance with Item 105, "Removing Stabilized Base and Asphalt Pavement," when shown on the plans or as directed. Shape existing material in accordance with applicable bid items to conform to typical sections shown on the plans and as directed. When shown on the plans or directed, proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying existing material. Correct soft spots as directed. When new base material is required to be mixed with existing base, deliver, place, and spread the new material in the required amount per

station. Manipulate and thoroughly mix new base with existing material to provide a uniform mixture to the specified depth before shaping.

B. Pulverization. Pulverize or scarify existing material after shaping so that 100% passes a 2-1/2-in. sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth.

C. Application of Lime. Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in Section 260.2.E, "Mix Design." Apply lime only on an area where mixing can be completed during the same working day. Start lime application only when the air temperature is at least 35°F and rising or is at least 40°F. The temperature will be taken in the shade and away from artificial heat. Suspend application when the Engineer determines that weather conditions are unsuitable. Minimize dust and scattering of lime by wind. Do not apply lime when wind conditions, in the opinion of the Engineer, cause blowing lime to become dangerous to traffic or objectionable to adjacent property owners. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application. Use of quicklime can be dangerous. Inform users of the recommended precautions for handling and storage.

1. Dry Placement. Before applying lime, bring the prepared roadway to approximately optimum moisture content. When necessary, sprinkle in accordance with Item 204, "Sprinkling." Distribute the required quantity of hydrated lime or pebble grade quicklime with approved equipment. Only hydrated lime may be distributed by bag. Do not use a motor grader to spread hydrated lime.

2. Slurry Placement. Provide slurry free of objectionable materials, at or above the approved minimum dry solids content, and with a uniform consistency that will allow ease of handling and uniform application. Deliver commercial lime slurry to the jobsite or prepare lime slurry at the jobsite or other approved location by using hydrated lime or quicklime, as specified. Distribute slurry uniformly by making successive passes over a measured section of roadway until the specified lime content is reached. Uniformly spread the residue from quicklime slurry over the length of the roadway being processed, unless otherwise directed.

D. Mixing. Begin mixing within 6 hours of application of lime. Hydrated lime exposed to the open air for 6 hours or more between application and mixing, or that experiences excessive loss due to washing or blowing, will not be accepted for payment. Thoroughly mix the material and lime using approved equipment. Allow the mixture to mellow for 1 to 4 days, as directed. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days, as directed. Sprinkle the treated materials during the mixing and mellowing operation, as directed, to achieve adequate hydration and proper moisture content. After mellowing, resume mixing until a homogeneous, friable mixture is obtained. After mixing, the Engineer will sample the mixture at roadway moisture and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements in Table 1.

Table 1
Gradation Requirements (Minimum % Passing)

Sieve Size	Base	Subgrade
1-3/4 in.	100	100
¾ in.	85	85
No. 4	-	60

E. Compaction. Compact the mixture using density control, unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the treated material in accordance with Item 204, "Sprinkling." Determine the moisture content of the mixture at the beginning and during compaction in accordance with Tex-103-E.

Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least one-half the width of the roller unit. On superelevated curves, begin rolling at the low side and progress toward the high side. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 MPH, as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish before the next course is placed or the project is accepted. Continue work until specification requirements are met. Rework in accordance with Section 260.4.F, "Reworking a Section." Perform the work at no additional expense to the Department.

1. Ordinary Compaction. Roll with approved compaction equipment, as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or 260.4 to 260.4 156 removing treated material as required, reshaping, and recompacting.

2. Density Control. The Engineer will determine roadway density of completed sections in accordance with Tex-115-E. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

a. Subgrade. Compact to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.

b. Base. Compact the bottom course to at least 95% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans. Compact subsequent courses treated under this Item to at least 98% of the maximum density determined in accordance with Tex-121-E, unless otherwise shown on the plans.

F. Reworking a Section. When a section is reworked after completion of compaction, rework the section to provide the required density. When a section is reworked more than 72 hr. after completion of compaction, add additional lime at 25% of the percentage determined in Section 260.2.E, "Mix Design." Reworking includes loosening, adding material or removing unacceptable material if necessary, mixing as directed, compacting, and finishing. When density control is specified, determine a new maximum density of the reworked material in accordance with Tex-121-E, and compact to at least 95% of this density.

G. Finishing. Immediately after completing compaction of the final course, clip, skin, or tight-blade the surface of the lime-treated material with a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of at an approved location. Roll the clipped surface immediately with a pneumatic tire roller until a smooth surface is attained. Add small amounts of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades shown on the plans or as directed.

Finish grade of constructed subgrade in accordance with Section 132.3.F.1, "Grade Tolerances." Finish grade of constructed base in accordance with Section 247.4.D, "Finishing."

H. Curing. Cure for the minimum number of days shown in Table 2 by sprinkling in accordance with Item 204, "Sprinkling," or by applying an asphalt material at a rate of 0.05 to 0.20 gal. per square yard as directed. Maintain moisture during curing. Upon completion of curing, maintain the moisture content in accordance with Article 132.3.E, "Maintenance of Moisture and Reworking" for subgrade and Article 247.4.E, "Curing" for bases prior to placing subsequent courses. Do not allow equipment on the finished course during curing except as required for sprinkling, unless otherwise approved. Apply seals or additional courses within 14 calendar days of final compaction.

Table 2
Minimum Curing Requirements Before Placing Subsequent Courses[1]

Untreated Material	Curing (Days)
PI<=35	2
PI>35	5

1. Subject to the approval of the Engineer. Proof rolling may be required as an indicator of adequate curing.

260.5. Measurement.

A. Lime. When lime is furnished in trucks, the weight of lime will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at a location approved by the Engineer. Scales must conform to the requirements of Item 520, "Weighing and Measuring Equipment."

When lime is furnished in bags, indicate the manufacturer's certified weight. Bags varying more than 5% from that weight may be rejected. The average weight of bags in any shipment, as determined by weighing 10 bags taken at random, must be at least the manufacturer's certified weight.

1. Hydrated Lime.

a. Dry. Lime will be measured by the ton (dry weight).

b. Slurry. Lime slurry will be measured by the ton (dry weight) of the hydrated lime used to prepare the slurry at the job site.

2. Commercial Lime Slurry. Lime slurry will be measured by the ton (dry weight) as calculated from the minimum percent dry solids content of the slurry, multiplied by the weight of the slurry in tons delivered.

3. Quicklime.

a. Dry. Lime will be measured by the ton (dry weight) of the quicklime.

b. Slurry. Lime slurry will be measured by the ton (dry weight) of the quicklime used to prepare the slurry multiplied by a conversion factor of 1.28 to give the quantity of equivalent hydrated lime, which will be the basis of payment.

B. Lime Treatment. Lime treatment will be measured by the square yard of surface area. The dimensions for determining the surface area are established by the widths shown on the plans and the lengths measured at placement.

260.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid in accordance with Section 260.6.A, "Lime," or Section 260.6.B, "Lime Treatment."

Furnishing and delivering new base will be paid for in accordance with Section 247.6.B, "Flexible Base (Roadway Delivery)." Mixing, spreading, blading, shaping, compacting, and finishing new or existing base material will be paid for in accordance with Section 260.6.B, "Lime Treatment." Removal and disposal of existing asphalt concrete pavement will be paid for in accordance with pertinent Items or Article 4.2, "Changes in the Work."

Sprinkling and rolling, except proof rolling, will not be paid for directly but will be subsidiary to this Item, unless otherwise shown on the plans. When proof rolling is shown on the plans or directed by the Engineer, it will be paid for in accordance with Item 216, "Proof Rolling."

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade or existing base will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade or existing base will be paid for in accordance with pertinent Items or Article 4.2, "Changes in the Work."

Asphalt used solely for curing will not be paid for directly, but will be subsidiary to this Item. Asphalt placed for curing and priming will be paid for under Item 310, "Prime Coat."

A. Lime. Lime will be paid for at the unit price bid for "Lime" of one of the following types:

- Hydrated Lime (Dry),
- Hydrated Lime (Slurry),
- Commercial Lime Slurry,
- Quicklime (Dry), or
- Quicklime (Slurry).

This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.

Lime used for reworking a section in accordance with Section 260.4.F, "Reworking a Section," will not be paid for directly but will be subsidiary to this Item.

B. Lime Treatment. Lime treatment will be paid for at the unit price bid for "Lime Treatment (Existing Material)," "Lime Treatment (New Base)," or "Lime Treatment (Mixing Existing Material and New Base)," for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans. This price is full compensation for shaping existing material, loosening, mixing, pulverizing, providing lime, spreading, applying lime, compacting, finishing, curing, curing materials, blading, shaping and maintaining, replacing, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.

ITEM 310
PRIME COAT

310.1. Description. Prepare and treat existing or newly constructed surface with a bituminous material. Apply blotter material as required.

310.2. Materials.

A. Bituminous. Use material of the type and grade shown on the plans in accordance with Item 300, "Asphalts, Oils, and Emulsions."

B. Blotter. Unless otherwise shown on the plans or approved, use either base course sweepings obtained from cleaning the base or native sand as blotter materials.

310.3. Equipment. Provide applicable equipment in accordance with Article 316.3, "Equipment."

310.4. Construction.

A. General. Apply the mixture when the air temperature is 60°F and above, or above 50°F and rising. Measure the air temperature in the shade away from artificial heat. The Engineer will determine when weather conditions are suitable for application. Do not permit traffic, hauling, or placement of subsequent courses over freshly constructed prime coats. Maintain the primed surface until placement of subsequent courses or acceptance of the work.

B. Surface Preparation. Prepare the surface by sweeping or other approved methods. When directed, before applying bituminous material, lightly sprinkle the surface with water to control dust and ensure absorption.

C. Application.

1. Bituminous. The Engineer will select the application temperature within the limits recommended in Item 300, "Asphalts, Oils, and Emulsions." Apply material within 15°F of the selected temperature. Distribute the material smoothly and evenly at the rate selected by the Engineer. When directed, roll the freshly applied prime coat with a pneumatic-tire roller to ensure penetration.

2. Blotter. Spread blotter material before allowing traffic to use a primed surface. When "Prime Coat and Blotter" is shown on the plans as a bid item, apply blotter material to primed surface at the rate shown in the plans or as directed. When "Prime Coat" is shown on the plans as a bid item, apply blotter to spot locations or as directed to accommodate traffic movement through the work area. Remove blotter material before placing the surface. Dispose of blotter material according to applicable state and federal requirements.

310.5. Measurement. This Item will be measured by the gallon of bituminous material placed and accepted.

310.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Prime Coat" or "Prime Coat and Blotter" of the type and grade of bituminous material specified. This price is full compensation for cleaning and sprinkling the area to be primed; materials, including blotter material; and rolling, equipment, labor, tools, and incidentals.

ITEM 330
LIMESTONE ROCK ASPHALT PAVEMENT

330.1. Description. Construct a base course, a surface course, a level-up course, or any combination of these courses of the types and grades shown on the plans using a cold mixed material consisting of native limestone rock asphalt (LRA) aggregate, fluxing material, water, and when specified, additives and virgin aggregates.

330.2. Materials. Type I LRA mixture consists entirely of native LRA aggregate, flux material, water, and additives. Type II LRA mixture consists of a blend of native LRA aggregate, virgin aggregates, fluxing material, additives, and water. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of all materials sources.
Notify the Engineer before changing any material source or formulation. When making a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time throughout the duration of the project to assure specification compliance.

A. Aggregate. Furnish aggregates from sources that conform to the requirements shown in Table 1, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either a coarse aggregate or fine aggregate. Supply mechanically crushed gravel or stone aggregates that 330.2 to 330.2 243 meet the definitions in Tex-100-E. The Engineer will designate the plant or the quarry as the sampling location. Samples must be from materials produced for the project. The Engineer will establish the surface aggregate classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results. The Engineer may run tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately.

1. Coarse Aggregate. Coarse aggregate stockpiles must have no more than 20% material passing the No. 10 sieve. Provide aggregates from sources listed in the Department's Bituminous Rated Source Quality Catalog (BRSQC). Provide nonlisted sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for nonlisted sources.
Provide coarse aggregate with a minimum SAC as shown on the plans. SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. The SAC for sources on the Department's Aggregate Quality Monitoring Program (AQMP) is listed in the BRSQC.
When a Type II LRA mixture is specified, Class B aggregate may be blended with Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend virgin aggregate with native LRA aggregate in the percentages shown in Table 4. When blending, do not use Class C aggregates.

a. LRA Aggregate. Native LRA aggregate consists of limestone impregnated with naturally occurring asphalt. LRA aggregates that contain less than 1% of naturally occurring asphalt are defined as white rock. Each aggregate source proposed for use will be sampled and tested to determine compliance with Table 1 requirements before the addition of fluxing material, additives, and water.

b. Virgin Aggregate. Provide virgin aggregates that meet the requirements of Table 1. Each aggregate source proposed for use will be sampled and tested to determine compliance with 330.2 to 330.2 244 Table 1 requirements before the addition of fluxing material, additives, and water.

2. Fine Aggregate. Fine aggregate stockpiles must have no more than 30% material retained on the No. 10 sieve. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify that the material is free from organic impurities. Use only fine aggregates generated by the production and handling of LRA or the virgin coarse aggregate. Use LRA fine aggregate that has a naturally impregnated bitumen content of 5.0 to 8.5% when tested in accordance with Tex-236-F.

If 10% or more of the stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for Coarse Aggregate Angularity (Tex-460-A) and Flat and Elongated Particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement	
		Native LRA Aggregate	Virgin Aggregate
Course Aggregate			
SAC	AQMP	B or C as shown on the plans	A
Deleterious Material, %, Max	Tex-217-F, Part I	1.5	1.5
Decantation, %, Max	Tex-217-F, Part II	N/A	1.5
Micro-Deval Abrasion, %, Max	Tex-461-A	Note 1	Note 1
Los Angeles Abrasion, %, Max	Tex-410-A	40	25
Magnesium Sulfate soundness, 5 cycles, %, Max	Tex-411-A	30	25
Course Aggregate angularity, 2 crushed faces, %, Min	Tex-460-A, Part 1	N/A	85[2]
Flat and elongated particles @ 5.1%, Max	Tex-280-F	N/A	10
Combined Aggregate[3]			
Naturally impregnated bitumen content, total combined gradation, % by wt.	Tex-236-F	5.0-8.5	N/A

1. Not used for acceptance purposes. Used by the Engineer as an indicator of the need for further investigation.
2. Unless otherwise shown on the plans. Only applies to crushed gravel.
3. Aggregates, without added mineral filler or additives, combined as used in the job mix formula (JMF).

B. Asphalt Material.

1. Fluxing Material. Provide fluxing material, composed of flux oil (a blend of asphalt and oil) or a blend of flux oil and aromatic oil meeting the requirements of Table 2. When required by the Engineer, provide a test report showing that the fluxing material meets the requirements of Table 2. Use fluxing material in the paving mixture to meet the workability requirements of Section 330.4.E, "Mixing."

Table 2
Fluxing Material Properties

Property	Material	Flux Oil		Aromatic Oil	
	Test Procedure	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T201	60	200	-	150
Loss on Heating, % by wt.	T47	-	10	-	12
Water, %	T55	-	0.2	-	0.2
Flash Point, C.O.C., °F	T48	200	-	135	-

2. Water. Provide water that meets the requirements of Item 204, "Sprinkling."

3. Tack Coat. Unless otherwise shown on the plans or approved, furnish CSS-1H, SS-1H, or a performance-graded (PG) binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use. If required, verify that emulsified asphalt proposed for use meets the minimum residual asphalt percentage specified in Item 300.

The Engineer will obtain at least 1 sample of the tack coat per project and test the sample for specification compliance. The Engineer will obtain the sample from the asphalt distributor, immediately before use.

C. Additives. When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved. Approved additives must be listed in the Quality Control Plan (QCP) as specified in Article 330.4, "Construction."

If lime is specified or selected for use as an antistripping agent, add only to the virgin aggregate in accordance with Item 301, "Asphalt Antistripping Agents." If a liquid antistripping agent is used, add in accordance with Item 301. Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream, unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

330.3. Equipment. Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." Use either weigh-batch or continuous mixing plants. The following requirements are modifications or additions to those in Item 320.

A. Weigh-Batch Plants.

1. Screening and Proportioning. Provide a sufficient number of bins as specified in Article 330.4, "Construction."

2. Fluxing Material Measuring System. Provide a fluxing material measuring device in the fluxing material line leading to the mixer to accurately determine the accumulated amount of fluxing material. Make permanent provisions for checking the accuracy of the meter output. Provide scales to hold and weigh flux for 1 batch. 3. Mixer. Equip the mixer with a spray bar that will distribute the fluxing material quickly and uniformly throughout the mixer.

B. Continuous Mixing Plants.

1. Screening and Proportioning. Meet the requirements of Section 330.3.A.1.a, "Screening and Proportioning." These requirements also apply to stockpiled material proposed for direct use by a continuous mixing plant without the use of plant bins.

2. Fluxing Material Measuring System. Place a fluxing material measuring device in the fluxing material line leading to the mixer to accurately determine the accumulated amount of fluxing material. Make permanent provisions for checking the accuracy of the meter output.

3. Mixer. Provide a continuous type mixer large enough to produce not less than 40 tons of mixture per hour. Equip the mixer with a spray bar that will distribute the fluxing material quickly and uniformly throughout the mixer.

330.4. Construction. Provide quality control (QC) testing as needed to meet the requirements of this Item. The Department will perform quality assurance (QA) testing.

A. QCP. Develop and follow the QCP in detail. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer. Receive the Engineer's approval of the QCP before beginning production. Include the following items in the QCP.

1. **Project Personnel.** For project personnel, include:
   • a list of individuals responsible for quality control with authority to take corrective action and
   • contact information for each individual listed.
2. **Material Delivery and Storage.** For material delivery and storage, include:

• the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;
• aggregate stockpiling procedures to avoid contamination and segregation;
• frequency, type, and timing of LRA and aggregate stockpile testing to assure conformance of material requirements before mixture production;
• flux oil for use in the LRA mixture; and
• aromatic oil for use in the LRA mixture.

3. Production. For production, include:
• loader operation procedures to avoid contamination in cold bins;
• the number of bins and the aggregate size to be placed in each bin for each type of LRA mixture produced;
• procedures for calibrating and controlling cold feeds;
• procedures to eliminate debris and oversized material;
• procedures for adding and verifying rates of each applicable mixture component (i.e., LRA, white rock, aggregates, flux oil) to minimize the formation of flux balls;
• procedures for LRA mixture testing to assure conformance of material requirements during production;
• procedures for reporting job control test results; and
• procedures to avoid segregation in the silo.

4. Loading and Transporting. For loading and transporting, include:
• type and application method for release agents and
• truck and rail car loading procedures to avoid segregation.

5. Placement and Compaction. For placement and compaction, include:
• proposed arrangements for any required prepaving meetings, including dates and locations;
• type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;
procedures for the transfer of mixture into the paver while avoiding segregation and preventing material spillage;
• process to balance production, delivery, paving, and compaction to achieve continuous placement operations;
• paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and
• procedures to construct quality longitudinal and transverse joints.

B. Stockpiling of Aggregates and LRA. Provide a smooth and welldrained area, cleared of trash, weeds, and grass. Build stockpiles in a manner that will minimize aggregate degradation and segregation. Avoid contamination and mixing of stockpiles.

Provide LRA or aggregate stockpiles for a minimum of 2 days' production before beginning plant operations. Maintain at least a 2-day aggregate supply through the course of the project unless otherwise directed.

Stockpile aggregates for each source and type separately. Do not add material to an approved stockpile unless otherwise approved. Handle and load the LRA in a manner that prevents segregation. The Engineer may reject stockpiled materials that come in contact with the earth or other objectionable material.

In addition to the requirements listed above, the material storage and stockpile requirements must be included in the approved QCP.

C. Storage and Heating of Fluxing Material. Do not heat fluxing material to a temperature more than that specified by the manufacturer. Ensure that the flux material storage capacity meets the requirements of the plant.

D. Job-Mix Formula. Provide a job-mix formula (JMF) design report for a paving mixture that meets the requirements of Tables 3, 4, and 5. Identify in the report the combined aggregate gradation, the percentage of each material component used in the mixture, and results of all applicable tests. Obtain approval of the JMF before starting production. With approval, the JMF target values may be adjusted as needed within the percentage point tolerances of Table 6 without

a laboratory redesign of the mixture. If the adjustments exceed the tolerances shown in Table 6, the Engineer may require a new mixture design. Adjustments must not exceed the master gradation for the type of mixture specified on the plans.

Determine the aggregate and asphalt correction factors from the ignition oven using Tex-236-F. Provide the Engineer with split samples of the mixtures and blank samples used to determine the correction factors. The Engineer will use the split samples provided by the Contractor to determine the aggregate and asphalt correction factors for the ignition oven in accordance with Tex-236-F.

If the aggregate mineralogy is such that Tex-236-F does not yield reliable results, the Engineer may allow alternate methods for determining the asphalt content and aggregate gradation. Unless otherwise allowed, the Engineer will require the Contractor to provide evidence that results from Tex-236-F are not reliable before permitting an alternate method. If an alternate test method is allowed, use the applicable test procedure as directed.

Table 3
Master Grading per Tex-200-F, Part I, % Retained by Weight

Sieve Size	Type I						Type II			
	Grade						Grade			
	AA Course Base	A Medium Base	B Fine Base	C Course Surface	CC Medium Surface	D Fine Surface	BS Surface	CS Medium Surface	DS Fine Surface	FS Thin Surface
1-1/2”	0	-	-	-	-	-	-	-	-	-
1-1/4”	0-10	-	-	-	-	-	-	-	-	-
1”	-	0	-	-	-	-	-	-	-	-
7/8”	15-30	0-2	-	-	-	-	-	-	-	-
¾”	-	-	-	-	-	-	0	-	-	-
5/8”	-	5-15	0	-	-	-	0-2	0	-	-
½”	-	-	0-2	0	0	-	0-10	0-2	0	-
3/8”	25-45	25-35	5-15	0-2	0-2	0	10-25	0-10	0-2	0
¼”	-	-	-	-	-	0-2	-	-	-	-
#4	45-60	50-60	45-60	35-50	35-50	10-25	40-55	35-55	10-25	0-15
#10	60-75	65-75	60-75	65-80	50-65	50-65	60-75	60-75	50-65	50-65

Table 4
Mixture Components % by Weight

Mixture Component	Type I						Type II			
	Grade						Grade			
	AA Course Base	A Medium Base	B Fine Base	C Course Surface	CC Medium Surface	D Fine Surface	BS Surface	CS Medium Surface	DS Fine Surface	FS Thin Surface
White Rock[1]	N/A	15-35	15-35	15-35	15-35	15-35	15-35	15-35	15-35	N/A
LRA	96-98	96-98	96-98	96-98	96-98	96-98	72-80.5	72-80.5	72-80.5	36.5-63.5
Virgin Aggregate	N/A	N/A	N/A	N/A	N/A	N/A	18-25	18-25	18-25	35-60
Flux Material	2.0-4.0	2.0-4.0	2.0-4.0	2.0-4.0	2.0-4.0	2.0-4.0	1.5-3.0	1.5-3.0	1.5-3.0	1.5-3.5

1. White rock values are given as a percentage of total LRA aggregate.

Table 5
Mixture Properties

Property	Test Method	Requirement
Hveem stability, min	Tex-208-F	35[1]
Laboratory-molded density, %	Tex-207-F	89.0 +/- 2
Theoretical maximum specific gravity of bituminous mixtures	Tex-227-F	N/A
Bitumen content, % by wt.	Tex-236-F	6.5 to 11.0
Water and light hydrocarbon volatiles, %, max	Tex-212-F, Part II	5.5
Boil test, %	Tex-530-C	10[2]

1. Cease operations if 2 consecutive tests fail. The Engineer may waive this requirement if other information indicates that the next material to be produced will meet the minimum value specified.
2. May be increased or eliminated when directed by the Engineer.

Table 6
Deviations from Current JMF Target Values

Material	Test Method	Tolerance
Individual % retained for #10 sieves and larger	Tex-200-F	+/- 5.0
Individual % retained for sieves smaller than #10 and larger than #200		+/- 3.0
% passing the #200 sieve		+/- 2.0
Fluxing material, %	Determined from quantity used	+/- 0.2

E. Mixing. Produce all LRA mixtures in the same mixing plant, unless otherwise approved. When needed, mix aromatic oil into the mixing chamber independently of the fluxing material. The aromatic oil may not exceed 35% of the total weight of the combined fluxing material and aromatic oil used in the paving mixture.

The Engineer will not accept mixtures produced when the LRA aggregate or virgin aggregate contains moisture above the saturated 330.4 to 330.4 252 surface dry condition. Inspect for visual surface moisture on the aggregates or any unusual quantities of fines clinging to the coarse aggregate.

Mix the materials at a central mixing plant and ship ready to use. Add water when necessary to improve workability of the mixture. Ensure that the mixture leaves the plant in a workable condition. The Engineer may reject mixtures that do not remain workable for a period that is sufficient to permit loading, unloading, hauling, placing, and compacting. Provide materials that remain workable in a stockpile for at least 6 months.

F. Hauling Operations. Transport the LRA mixture to the project or delivery point in trucks or rail cars as needed. Before use, clean all truck beds or rail cars to ensure mixture is not contaminated. When a release agent is necessary, use a release agent on the approved list maintained by the Construction Division to coat truck beds and inside rail cars. Waterproof tarpaulins are not required to cover loads.

G. Placement Operations. Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of mixture by at least 6 in. Place mixture so longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

Unless otherwise shown on the plans, the asphalt mixture may be dumped in a windrow and then placed in the finishing machine with windrow pickup equipment. Prevent the windrow pickup equipment from contaminating the mixture.

After placing the paving mixture, defer compaction, as directed by the Engineer, to allow for volatilization. When placing more than 1 pavement course, allow the previous course to dry and cure before placing the next course. Unless otherwise directed, the course will be considered cured if the hydrocarbon volatile content of the mixture is 0.4% or less by weight of the mixture when tested according to Tex-213-F.

When shown on the plans or as approved, a motor grader may be used to spread the mixture. Thoroughly aerate the mixture and spread into place with a power motor grader in a uniform layer. Placement in narrow strips or small irregular areas may require hand spreading.

1. Weather Conditions. Place the mixture when the roadway surface temperature is 60°F or higher unless otherwise approved. Place the mixture only when the weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer.

2. Tack Coat. Clean the surface before placing the tack coat. Unless otherwise approved, apply tack coat uniformly at the rate directed by the Engineer. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and joints. Prevent splattering of the tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller when directed. The Engineer may use Tex-243-F to verify that the tack coat has adequate adhesive properties. The Engineer may suspend paving operations until there is adequate adhesion.

H. Compaction. Furnish the type, size, and number or rollers required for compaction, as approved. Furnish at least 1 medium pneumatic-tire roller (minimum 12-ton weight). Use Tex-207-F, Part IV, to establish rolling patterns that achieve maximum compaction. Follow the selected rolling pattern unless changes that affect compaction occur in the mixture or placement conditions. When such changes occur, establish a new rolling pattern. Compact the pavement to the cross section of the finished paving mixture meeting the requirements of the plans and specifications. Unless otherwise directed, operate vibratory rollers in static mode when: not compacting, changing directions, or the plan depth of the pavement mat is less than 1-1/2 in. When rolling with the 3-wheel, tandem, or vibratory rollers, start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides. Proceed toward the center of the pavement, overlapping on successive trips by at least 1 ft., unless otherwise directed. Make alternate trips of the roller slightly different in length. On superelevated curves, begin rolling at the low side and progress toward the high side, unless otherwise directed. Avoid displacement of the mixture. If any displacement occurs, correct to the satisfaction of the Engineer. Ensure pavement is fully compacted before allowing rollers to stand on the pavement. Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with the rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

I. Irregularities. Immediately take corrective actions if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller

marks, tears, gouges, streaks, or uncoated aggregate particles, are detected. The Engineer may allow placement to continue for at most 1 day of production while the Contractor takes appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.

At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.

J. Ride Quality. Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

330.5. Measurement. LRA pavement will be measured by the ton of composite LRA pavement of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. Measure on scales in accordance with Item 520, "Weighing and Measuring Equipment." Keep records on tare weight, gross weight, and net weight of the LRA paving mixture for each load of the same type of mixture. All water and light hydrocarbon volatiles in the mixture, in excess of 5.5% by weight at the time of weighing, will be deducted from the net weight to determine the quantity for payment.

330.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Limestone Rock Asphalt Pavement" of the type, grade and surface aggregate classification specified. These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

Pay adjustment for ride quality, when required, will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

ITEM 420
CONCRETE STRUCTURES

420.1. Description. Construct concrete structures.

420.2. Materials.

A. Concrete. Provide concrete conforming to Item 421, "Hydraulic Cement Concrete." For each type of structure or unit, provide the class of concrete shown on the plans or in pertinent governing specifications.

B. Grout or Mortar. Provide grout or mortar conforming to Section 421.2.F, "Mortar and Grout."

C. Latex. Provide an acrylic-polymer latex admixture (acrylic resin emulsion per DMS-4640, "Chemical Admixtures for Concrete") suitable for producing polymer-modified concrete or mortar. Do not allow latex to freeze.

D. Reinforcing Steel. Provide reinforcing steel conforming to Item 440, "Reinforcing Steel."

E. Expansion Joint Material. Provide materials that conform to the requirements of DMS-6310, "Joint Sealants and Fillers":

- Provide preformed fiber expansion joint material that conforms to the dimensions shown on theplans. Provide preformed bituminous fiber material unless otherwise specified.
- Provide a Class 4, 5, or 7 low-modulus silicone sealant unless otherwise directed.
- Provide asphalt board that conforms to dimensions shown on the plans.
- Provide re-bonded neoprene filler that conforms to the dimensions shown on the plans.

F. Waterstop. Provide rubber or polyvinyl chloride (PVC) waterstops that conform to DMS-6160, "Waterstops, Nylon Reinforced Neoprene Sheet, and Elastomeric Pads," unless otherwise shown on the plans.

G. Evaporation Retardants. Provide evaporation retardants that conform to the requirements of DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

H. Curing Materials. Provide membrane curing compounds that conform to the requirements of DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

Provide cotton mats that consist of a filling material of cotton "bat" or "bats" (at least 12 oz. per square yard) completely covered with unsized cloth (at least 6 oz. per square yard) stitched longitudinally with continuous parallel rows of stitching spaced at less than 4 in., or tuft both longitudinally and transversely at intervals less than 3 in. Provide cotton mats that are free from tears and in good general condition. Provide a flap at least 6 in. wide consisting of 2 thicknesses of the covering and extending along 1 side of the mat.

Provide polyethylene sheeting that is at least 4 mils thick and free from visible defects. Provide only clear or opaque white sheeting when the ambient temperature during curing exceeds 60°F or when applicable to control temperature during mass pours.

Provide burlap-polyethylene mats made from burlap impregnated on 1 side with a film of opaque white pigmented polyethylene, free from visible defects. Provide laminated mats that have at least 1 layer of an impervious material such as polyethylene, vinyl plastic, or other acceptable material (either as a solid sheet or impregnated into another fabric) and are free of visible defects.

I. Epoxy. Unless otherwise specified, provide epoxy materials that conform to DMS-6100, "Epoxy and
Adhesives."

420.3. Equipment.

A. Fogging Equipment. Use fogging equipment that can apply water in a fine mist, not a spray. Produce the fog using equipment that pumps water or water and air under high pressure through a suitable atomizing nozzle. Use hand-held mechanical equipment portable enough to use in the direction of any prevailing wind and adaptable for intermittent use to prevent excessive wetting of the concrete.

B. Transporting and Placing Equipment. Use appropriate transporting and placing equipment such as buckets, chutes, buggies, belt conveyors, pumps, or other equipment as necessary. Do not transport or convey concrete through equipment made of aluminum. Use carts with pneumatic tires for carting or wheeling concrete over newly placed slabs.

Use tremies to control the fall of concrete or for underwater placement. Use tremies that are watertight and of large enough diameter to allow the placement of the concrete but less than 14 in. in diameter.

For underwater placements, construct the tremie so that the bottom can be sealed and opened once the tremie has been fully charged with concrete.

Use pumps with lines at least 5 in. I.D. where Grade 2 or smaller coarse aggregate is used, and at least 8 in. I.D. for Grade 1 coarse aggregate.

C. Vibrators. Use immersion-type vibrators for consolidation of concrete. Provide at least 1 standby vibrator for emergency use.

D. Screeds and Work Bridges for Bridge Slabs. For bridge slabs use a self-propelled transverse screed or a mechanical longitudinal screed. Use transverse screeds that are able to follow the skew of the bridge for skews greater than 15° unless otherwise approved. Equip transverse screeds with a pan float.

Manually operated screeding equipment may be used if approved for top slabs of culverts, small placements, or unusual conditions. Use screeds that are rigid and heavy enough to hold true to shape and have sufficient adjustments to provide for the required camber or section. Equip the screeds,

except those of the roller drum type, with metal cutting edges.

For bridge slabs, use sufficient work bridges for finishing operations. Mount a carpet drag to a work bridge or a moveable support system that can vary the area of carpet in contact with the concrete. Use carpet pieces long enough to cover the entire width of the placement. Splice or overlap the carpet as necessary. Ensure that enough carpet is in contact longitudinally with the concrete being placed to provide the desired surface finish. Use artificial grass-type carpeting having a molded polyethylene pile face with a blade length between 5/8 and 1 in. and with a minimum weight of 70 oz. per square yard. Ensure that the carpet has a strong, durable backing not subject to rot and that the facing is adequately bonded to the backing to withstand the intended use. A burlap drag, attached to the pan float on a transverse screed, may be used instead of the carpet drag.

E. Temperature Recording Equipment. For mass concrete operations or as otherwise specified, use strip chart temperature recording devices, recording maturity meters in accordance with Tex-426-A, or other approved devices that are accurate to within ±2°F within the range of 32 to 212°F.

F. Artificial Heating Equipment. Use artificial heating equipment as necessary for maintaining the concrete temperatures as specified in Section 420.4.G.11, “Placing Concrete in Cold Weather.”

G. Sawing Equipment. Use sawing equipment capable of cutting grooves in completed bridge slabs and top slabs of direct-traffic culverts. Provide grooves that are 1/8 to 3/16 in. deep and nominally 1/8 in. wide. Groove spacing may range from 5/8 to 1 in. Use sawing equipment capable of cutting grooves in hardened concrete to within 18 in. of the barrier rail or curb.

H. Spraying Equipment. Use mechanically powered pressure sprayers, either air or airless, with appropriate atomizing nozzles for the application of membrane curing. Mechanically driven spraying equipment, adaptable to the rail system used by the screeds, may be used for applying membrane curing to bridge slabs. If approved, use hand-pressurized spray equipment equipped with 2 or 3 fanspray nozzles. Ensure that the spray from each nozzle overlaps the spray from adjacent nozzles by approximately 50%.

I. Concrete Testing Equipment. Provide testing equipment for use by the Engineer in accordance with Section 421.3.C, “Testing Equipment.”

420.4. Construction. Before starting work, obtain approval for proposed construction methods. Approval of construction methods and equipment does not relieve the Contractor’s responsibility for safety or correctness of methods, adequacy of equipment, or completion of work in full accordance with the Contract.

Unless otherwise shown on the plans, it is the Contractor’s option to perform testing on structural concrete (structural classes of concrete are identified in Table 5 of Section 421.4.A, “Classification and Mix Design”) to determine the in-situ strength to address the schedule restrictions in Section 420.4.A, “Schedule Restrictions.” The Engineer may require the Contractor to perform this testing for concrete placed in cold weather. For Contractor-performed testing, make enough test specimens to ensure that strength requirements are met for the operations listed in Section 420.4.A. Make at least 1 set of test

specimens for each element cast each day. Cure these specimens under the same conditions as the portion of the structure involved for all stages of construction. Ensure safe handling, curing, and storage of all test specimens. Provide testing personnel, and sample and test the hardened concrete in accordance with Section 421.4.G, "Sampling and Testing of Concrete." The maturity method, Tex-426-A, may be used for in-situ strength determination for schedule restrictions if approved. Coring will not be allowed for in-situ strength determination for schedule restrictions. Provide the Engineer the opportunity to witness all testing operations. Report all test results to the Engineer.

If the Contractor does not wish to perform schedule restriction testing, the Engineer's 7-day lab-cured tests,

performed in accordance with Section 421.4.G.5, "Adequacy and Acceptance of Concrete," will be used for schedule restriction determinations. The Engineer may require additional time for strength gain to account for field curing conditions such as cold weather.

A. Schedule Restrictions. Unless otherwise shown on the plans, construct and open completed structures to traffic with the following limitations:

1. Setting Forms. Attain at least 2,500 psi compressive strength before erecting forms on concrete footings supported by piling or drilled shafts, or on individual drilled shafts. Erect forms on spread footings and culvert footings after the footing concrete has aged at least 2 curing days as defined in Section 420.4.J, "Curing Concrete." Place concrete only after the forms and reinforcing steel have been inspected by the Engineer.

Support tie beam or cap forms by falsework on previously placed tie beams only if the tie beam concrete has attained a compressive strength of 2,500 psi and the member is properly supported to eliminate stresses not provided for in the design. Maintain curing as required until completion of the curing period.

Place superstructure forms or falsework on the substructure only if the substructure concrete has attained a compressive strength of 3,000 psi.

2. Removal of Forms and Falsework. Keep in place weight-supporting forms and falsework for bridge components and culvert slabs until the concrete has attained a compressive strength of 2,500 psi in accordance with Section 420.4.K, "Removal of Forms and Falsework." Keep all forms for mass placements defined in Section 420.4.G.14, "Mass Placements," in place for 4 days following concrete placement.

3. Placement of Superstructure Members. Do not place superstructure members before the substructure concrete has attained a compressive strength of 3,000 psi.

4. Longitudinal Screeding of Bridge Slabs. Place a longitudinal screed directly on previously placed concrete slabs to check and grade an adjacent slab only after the previously placed slab has aged at least 24 hr. Place and screed the concrete after the previously placed slabs have aged at least 48 hr. Maintain curing of the previously placed slabs during placement.

5. Staged Placement of Bridge Slabs on Continuous Steel Units. When staged placement of a slab is required, ensure that the previously placed concrete attains a compressive strength of 3,000 psi before placing the next stage placement. Multiple stages may be placed in a single day if approved.

6. Storage of Materials on the Structure. Obtain approval to store materials on completed portions of a structure once a compressive strength of 3,000 psi has been attained. Maintain proper curing if materials will be stored on structures before completion of curing.

7. Placement of Equipment and Machinery. Do not place erection equipment or machinery on the structure until the concrete has attained the design strength specified in Section 421.4.A, "Classification and Mix Design," unless otherwise approved.

8. Carting of Concrete. Once the concrete has attained a compressive strength of 3,000 psi, it may be carted, wheeled, or pumped over completed slabs. Maintain curing during these operations. **9. Placing Bridge Rails.** Reinforcing steel and concrete for bridge rails may be placed on bridge slabs once the slab concrete has attained a compressive strength of 3,000 psi. If slipforming methods are used for railing concrete, ensure the slab concrete has attained its design strength specified in Section 421.4.A, "Classification and Mix Design," before placing railing concrete.

10. Opening to Construction Traffic. Bridges and direct-traffic culverts may be opened to all construction traffic when the design strength specified in Section 421.4.A, "Classification and Mix Design," has been attained if curing is maintained.

11. Opening to Full Traffic. Bridges and direct-traffic culverts may be opened to the traveling public when the design strength specified in Section 421.4.A, "Classification and Mix Design," has been attained for all structural elements including railing subject to impact from traffic, when curing has been completed for all slabs, and when the concrete surface treatment has been applied in accordance with Item 428, "Concrete Surface Treatment." Obtain approval before opening bridges and direct-traffic culverts to the traveling public. Other noncritical structural and nonstructural concrete may be opened for service upon the completion of curing unless otherwise specified or directed.

12. Post-Tensioned Construction. For structural elements designed to be post-tensioned ensure that strength requirements on the plans are met for stressing and staged loading of structural elements.

13. Backfilling. Backfill in accordance with Section 400.3.C, "Backfill."

B. Plans for Falsework and Forms. Submit 2 copies of plans for falsework and forms for piers, superstructure spans over 20 ft. long, bracing systems for girders when the overhang exceeds 3 ft. 6 in., and bridge widening details. Submit similar plans for other units of the structure as directed. Show all essential details of proposed forms, falsework, and bracing. Have a licensed professional engineer design, seal, and sign these plans. Department approval is not required, but the Department reserves the right to request modifications to the plans. The Contractor is responsible for the adequacy of these plans.

C. Falsework. Design and construct falsework to carry the maximum anticipated loads safely, including wind loads, and to provide the necessary rigidity. Submit details in accordance with Section 420.4.B, "Plans for Falsework and Forms."

Design job-fabricated falsework assuming a weight of 150 pcf for concrete, and include a liveload allowance of 50 psf of horizontal surface of the form. Do not exceed 125% of the allowable stresses used by the Department for the design of structures.

For commercially produced structural units used in falsework, do not exceed the manufacturer's maximum allowable working loads for moment and shear or end reaction. Include a liveload allowance of 35 psf of horizontal form surface in determining the maximum allowable working load for commercially produced structural units.

Provide timber that is sound, in good condition, and free from defects that would impair its strength.

Provide timber that meets or exceeds the species, size, and grade requirements in the submitted falsework plans.

Provide wedges made of hardwood or metal in pairs to adjust falsework to desired elevations to ensure even bearing. Do not use wedges to compensate for incorrectly cut bearing surfaces.

Use sills or grillages that are large enough to support the superimposed load without settlement. Take precautions to prevent settling of the supporting material unless the sills or grillages are founded on solid rock, shale, or other hard materials.

Place falsework that cannot be founded on a satisfactory spread footing on piling or drilled shafts with enough bearing capacity to support the superimposed load without settlement. Drive falsework piling to the required resistance determined by the applicable formula in Item 404, "Driving Piling." Design drilled shafts for falsework to carry the superimposed load using both skin friction and point bearing.

Weld in conformance with Item 448, "Structural Field Welding." Securely brace each falsework bent to provide the stiffness required, and securely fasten the bracing to each pile or column it crosses.

Remove falsework when it is no longer required or as indicated on the submitted falsework plan. Pull or cut off foundations for falsework at least 2 ft. below finished ground level. Completely remove falsework, piling, or drilled shafts in a stream, lake, or bay to the approved limits to prevent obstruction to the waterway.

D. Forms. Submit formwork plans in accordance with Section 420.4.B, "Plans for Falsework and Forms."

1. General. Except where otherwise specified or permitted, provide forms of either timber or metal. Design forms for the pressure exerted by a liquid weighing 150 pcf. Take the rate of concrete placement into consideration in determining the depth of the equivalent liquid. Include a liveload allowance of 50 psf of horizontal surface for job-fabricated forms. Do not exceed 125% of the allowable stresses used by the Department for the design of structures.

For commercially produced structural units used for forms, do not exceed the manufacturer's maximum allowable working loads for moment and shear or end reaction. Include a liveload allowance of 35 psf of horizontal form surface in determining the maximum allowable working load for commercially produced structural units.

Provide steel forms for round columns unless otherwise approved. Refer to Item 427, "Surface Finishes for Concrete," for additional requirements for off-the-form finishes.

Provide commercial form liners for imprinting a pattern or texture on the concrete surface as shown on the plans and specified in Section 427.4.B.2.d, "Form Liner Finish."

Provide forming systems that are practically mortar-tight, rigidly braced, and strong enough to prevent bulging between supports, and maintain them to the proper line and grade during concrete placement. Maintain forms in a manner that prevents warping and shrinkage. Do not allow offsets at form joints to exceed 1/16 in.

For forms to be left in place, use only material that is inert, nonbiodegradable, and nonabsorptive.

Attachment of forms or screed supports for bridge slabs to steel I-beams or girders may be by welding subject to the following requirements:

- Do not weld to tension flanges or to areas indicated on the plans.
- Weld in accordance with Item 448, "Structural Field Welding."

Take into account:

- deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram in the setting of slab forms,
- differential beam or girder deflections due to skew angles and the use of certain stay-in- place slab forming systems, and
- deflection of the forming system due to the wet concrete.

For bridge approach slabs, securely stake forms to line and grade and maintain in position. Rigidly attach inside forms for curbs to the outside forms.

Construct all forms to permit their removal without marring or damaging the concrete.

Clean all forms and footing areas of any extraneous matter before placing concrete.

Provide openings in forms if needed for the removal of laitance or foreign matter

Treat the facing of all forms with bond-breaking coating of composition that will not discolor or injuriously affect the concrete surface. Take care to prevent coating of the reinforcing steel.

Complete all preparatory work before requesting permission to place concrete.

If the forms show signs of bulging or sagging at any stage of the placement, cease placement and remove the portion of the concrete causing this condition immediately if necessary. Reset the forms and securely brace them against further movement before continuing the placement.

2. Timber Forms. Provide properly seasoned good-quality lumber that is free from imperfections that would affect its strength or impair the finished surface of the concrete. Provide timber or lumber that meets or exceeds the requirements for species and grade in the submitted formwork plans.

Maintain forms or form lumber that will be reused so that it stays clean and in good condition. Do not use any lumber that is split, warped, bulged, or marred or that has defects that will produce inferior work, and promptly remove such lumber from the work.

Provide form lining for all formed surfaces except:

- the inside of culvert barrels, inlets, manholes, and box girders;
- the bottom of bridge slabs between beams or girders;
- surfaces that are subsequently covered by backfill material or are completely enclosed; and
- any surface formed by a single finished board or by plywood.

Provide form lining of an approved type such as masonite or plywood. Do not provide thin membrane sheeting such as polyethylene sheets for form lining.

Use plywood at least 3/4 in. thick. Place the grain of the face plies on plywood forms parallel to the span between the supporting studs or joists unless otherwise indicated on the submitted form drawings.

Use plywood for forming surfaces that remain exposed that meets the requirements for B-B Plyform Class I or Class II Exterior of the U.S. Department of Commerce Voluntary Product Standard PS 1.

Space studs and joists so that the facing form material remains in true alignment under the imposed loads.

Space wales closely enough to hold forms securely to the designated lines, scabbed at least 4 ft. on each side of joints to provide continuity. Place a row of wales near the bottom of each placement.

Place facing material with parallel and square joints, securely fastened to supporting studs.

For surfaces exposed to view and receiving only an ordinary surface finish as defined in Section 420.4.M, "Ordinary Surface Finish," place forms with the form panels symmetrical (long dimensions set in the same direction). Make horizontal joints continuous.

Make molding for chamfer strips or other uses of materials of a grade that will not split when nailed and that can be maintained to a true line without warping. Dress wood molding on all faces.

Unless otherwise shown on the plans, fill forms at all sharp corners and edges with triangular chamfer strips measuring 3/4 in. on the sides.

To hold forms in place, use metal form ties of an approved type or a satisfactory substitute of a
type that permits ease of removal of the metal. Cut back wire ties at least 1/2 in. from the face of the concrete.

Use devices to hold metal ties in place that are able to develop the strength of the tie and adjust to allow for proper alignment.

Entirely remove metal and wooden spreaders that separate the forms as the concrete is being placed.

Provide adequate clean-out openings for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

3. Metal Forms. Requirements for timber forms regarding design, mortar-tightness, filleted corners,
beveled projections, bracing, alignment, removal, reuse, and wetting also apply to metal forms except that metal forms do not require lining unless specifically noted on the plans.

Use form metal thick enough to maintain the true shape without warping or bulging. Countersink all bolt and rivet heads on the facing sides. Design clamps, pins, or other connecting devices to hold the forms rigidly together and to allow removal without damage to the concrete. Use metal forms that present a smooth surface and that line up properly. Keep metal free from rust, grease, and other foreign materials.

4. Form Supports for Overhang Slabs. Form supports that transmit a horizontal force to a steel girder or beam or to a prestressed concrete beam are permitted provided a satisfactory structural analysis has been made of the effect on the girder or beam as indicated in the submitted formwork plans.

When overhang brackets are used on prestressed concrete beam spans with slab overhangs not exceeding 3 ft 6 in., use beam bracing as indicated in the plans. For spans with overhangs exceeding this amount, use additional support for the outside beams regardless of the type of beam used. Submit details of the proposed bracing system in accordance with Section 420.4.B, "Plans for Falsework and Forms."

Punch or drill holes full size in the webs of steel members for support of overhang brackets, or torch-cut them to 1/4 in. under size and ream them full size. Do not burn the holes full size. Leave the holes open unless otherwise shown on the plans. Never fill the holes by welding.

E. Drains. Install and construct weep holes and roadway drains as shown on the plans.

F. Placing Reinforcement. Place reinforcement as provided in Item 440, "Reinforcing Steel." Do not weld reinforcing steel supports to I-beams or girders or to reinforcing steel except where shown on the plans.

Place post-tensioning ducts in accordance with the approved prestressing details and in accordance with Item 426, "Prestressing." Keep ducts free of obstructions until all post-tensioning operations are complete.

G. Placing Concrete. Give the Engineer sufficient advance notice before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement, and other preparations.

Follow the sequence of placing concrete shown on the plans or specified.

Do not place concrete when impending weather conditions would impair the quality of the finished work. If conditions of wind, humidity, and temperature are such that concrete cannot be placed without the potential for shrinkage cracking, place concrete in early morning or at night or adjust the placement schedule for more favorable weather. Consult the evaporation rate nomograph in the Portland Cement Association's *Design and Control of Concrete Mixtures* for shrinkage cracking potential. When mixing, placing, and finishing concrete in non-daylight hours, adequately illuminate the entire placement site as approved.

If changes in weather conditions require protective measures after work starts, furnish adequate shelter to protect the concrete against damage from rainfall or from freezing temperatures as outlined in this Item. Continue operations during rainfall only if approved. Use protective coverings for the material stockpiles. Cover aggregate stockpiles only to the extent necessary to control the moisture conditions in the aggregates.

Allow at least 1 curing day after the concrete has achieved initial set before placing strain on projecting reinforcement to prevent damage to the concrete.

1. Placing Temperature. Place concrete according to the following temperature limits for the classes of concrete defined in Section 421.4.A, "Classification and Mix Design":

- Place Class C, F, H, K, or SS concrete only when its temperature at time of placement is between 50 and 95°F. Increase the minimum placement temperature to 60°F if groundgranulated blast furnace (GGBF) slag is used in the concrete.
- When used in a bridge slab or in the top slab of a direct-traffic culvert, place Class CO, DC, or S concrete only when its temperature at the time of placement is between 50 and 85°F. Increase the minimum placement temperature to 60°F if GGBF slag is used in the concrete. The maximum temperature increases to 95°F if these classes are used for other applications.
- Place Class A, B, and D concrete only when its temperature at the time of placement is greater than 50°F.
- Place mass concrete, defined by Section 420.4.G.14, "Mass Placements," only when its temperature at the time of placement is between 50 and 75°F.

2. Transporting Time. Place concrete delivered in agitating trucks within 60 min. after batching.

Place concrete delivered in non-agitating equipment within 45 min. after batching.

Revise the concrete mix design as necessary for hot weather or other conditions that contribute to quick setting of the concrete. Submit for approval a plan to demonstrate that these time limitations can be extended while ensuring the concrete can be properly placed, consolidated, and finished without the use of additional water.

3. Workability of Concrete. Place concrete with a slump as specified in Section 421.4.A.5, "Slump." Concrete that exceeds the maximum slump will be rejected. Water may be added to the concrete before discharging any concrete from the truck to adjust for low slump provided that the maximum mix design water–cement ratio is not exceeded. After introduction of any additional water or chemical admixtures, mix concrete in accordance with Section 421.4.E, "Mixing and Delivering Concrete." Do not add water or chemical admixtures after any concrete has been discharged.

4. Transporting Concrete. Use a method and equipment capable of maintaining the rate of placement shown on the plans or required by this Item to transport concrete to the forms. Transport concrete by buckets, chutes, buggies, belt conveyors, pumps, or other methods. Protect concrete transported by conveyors from sun and wind to prevent loss of slump and workability. Shade or wrap with wet burlap pipes through which concrete is pumped as necessary to prevent loss of slump and workability.

Arrange and use chutes, troughs, conveyors, or pipes so that the concrete ingredients will not be separated. When necessary to prevent segregation, terminate such equipment in

vertical downspouts. Extend open troughs and chutes, if necessary, down inside the forms or through holes left in the forms.
Keep all transporting equipment clean and free from hardened concrete coatings. Discharge water used for cleaning clear of the concrete.
5. Preparation of Surfaces. Thoroughly wet all forms, prestressed concrete panels, T-beams, and concrete box beams on which concrete is to be placed before placing concrete on them. Remove any remaining puddles of excess water before placing concrete. Provide surfaces that are in a moist, saturated surface-dry condition when concrete is placed on them.
Ensure that the subgrade or foundation is moist before placing concrete for bridge approach slabs or other concrete placed on grade. Lightly sprinkle the subgrade if dry.
6. Expansion Joints. Construct joints and devices to provide for expansion and contraction in accordance with plan details and the requirements of this Section and Item 454, "Bridge Expansion Joints."
Prevent bridging of concrete or mortar around expansion joint material in bearings and expansion joints.
Use forms adaptable to loosening or early removal in construction of all open joints and joints to be filled with expansion joint material. To avoid expansion or contraction damage to the adjacent concrete, loosen these forms as soon as possible after final concrete set to permit free movement of the span without requiring full form removal.
When the plans show a Type A joint, provide preformed fiber joint material in the vertical joints of the roadway slab, curb, median, or sidewalk, and fill the top 1 in. with the specified joint sealing material unless noted otherwise. Install the sealer in accordance with Item 438, "Cleaning and Sealing Joints and Cracks (Rigid Pavement and Bridge Decks)," and the manufacturer's recommendations.
Use light wire or nails to anchor any preformed fiber joint material to the concrete on 1 side of the joint.
Ensure that finished joints conform to the plan details with the concrete sections completely separated by the specified opening or joint material.
Remove all concrete within the joint opening soon after form removal and again where necessary after surface finishing to ensure full effectiveness of the expansion joint.
7. Construction Joints. A construction joint is the joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set. Monolithic placement means that the manner and sequence of concrete placing does not create a construction joint.
Make construction joints of the type and at the locations shown on the plans. Do not make joints in bridge slabs not shown on the plans unless approved. Additional joints in other members are not permitted without approval. Place authorized additional joints using details equivalent to those shown on the plans for joints in similar locations.
Unless otherwise required, make construction joints square and normal to the forms. Use
bulkheads in the forms for all vertical joints.
Thoroughly roughen the top surface of a concrete placement terminating at a horizontal construction joint as soon as practical after initial set is attained.
Thoroughly clean the hardened concrete surface of all loose material, laitance, dirt, and foreign matter, and saturate it with water. Remove all free water and moisten the surface before concrete or bonding grout is placed against it.
Draw forms tight against the existing concrete to avoid mortar loss and offsets at joints.
Coat the joint surface with bonding mortar, grout, epoxy, or other material as indicated in the plans or other Items. Provide Type V epoxy per DMS-6100, "Epoxies and Adhesives," for bonding fresh concrete to hardened concrete. Place the bonding epoxy on a clean, dry surface, and place the fresh concrete while the epoxy is still tacky. Place bonding mortar or grout on a surface that is saturated surface-dry, and place the concrete before the bonding mortar or grout dries. Place other bonding agents in accordance with the manufacturer's recommendations.
8. Handling and Placing. Minimize segregation of the concrete and displacement of the reinforcement when handling and placing concrete. Produce a uniform dense compact mass.

Do not allow concrete to free-fall more than 5 ft. except in the case of drilled shafts, thin walls such as in culverts, or as allowed by other Items. Remove any hardened concrete splatter ahead of the plastic concrete.

Fill each part of the forms by depositing concrete as near its final position as possible. Do not deposit large quantities at 1 point and run or work the concrete along the forms. Deposit concrete in the forms in layers of suitable depth but not more than 36 in. deep unless otherwise permitted.

Avoid cold joints in a monolithic placement. Sequence successive layers or adjacent portions of concrete so that they can be vibrated into a homogeneous mass with the previously placed concrete before it sets. When re-vibration of the concrete is shown on the plans, allow at most 1 hr. to elapse between adjacent or successive placements of concrete except as otherwise allowed by an approved placing procedure. This time limit may be extended by 1/2 hr. if the concrete contains at least a normal dosage of retarding admixture.

Use an approved retarding agent to control stress cracks and cold joints in placements where differential settlement and setting time may induce cracking.

9. Consolidation. Carefully consolidate concrete and flush mortar to the form surfaces with immersion type vibrators. Do not use vibrators that operate by attachment to forms or reinforcement except where approved on steel forms.

Vibrate the concrete immediately after deposit. Systematically space points of vibration to ensure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. Insert the vibrator vertically where possible except for slabs where it may be inserted in a sloping or horizontal position. Vibrate the entire depth of each lift, allowing the vibrator to penetrate several inches into the preceding lift. Do not use the vibrator to move the concrete to other locations in the forms. Do not drag the vibrator through the concrete. Thoroughly consolidate concrete along construction joints by operating the vibrator along and close to but not against the joint surface. Continue the vibration until the concrete surrounding reinforcements and fixtures is completely consolidated. Hand-spade or rod the concrete if necessary to ensure flushing of mortar to the surface of all forms.

10. Installation of Dowels and Anchor Bolts. Install dowels and anchor bolts by casting them inplace or by grouting with grout, epoxy, or epoxy mortar unless noted otherwise. Form or drill holes for grouting.

Drill holes for anchor bolts to accommodate the bolt embedment required by the plans. Make holes for dowels at least 12 in. deep unless otherwise shown on the plans. When using grout or epoxy mortar, make the diameter of the hole at least twice the dowel or bolt diameter, but the hole need not exceed the dowel or bolt diameter plus 1-1/2 in. When using epoxy, make the hole diameter 1/16 to 1/4 in. greater than the dowel or bolt diameter.

Thoroughly clean holes of all loose material, oil, grease, or other bond-breaking substance, and blow them clean with filtered compressed air. Ensure that holes are in a surface dry condition when epoxy type material is used and in a surface moist condition when hydraulic cement grout is used. Develop and demonstrate for approval a procedure for cleaning and preparing the holes for installation of the dowels and anchor bolts. Completely fill the void between the hole and dowel or bolt with grouting material. Follow exactly the requirements for cleaning outlined in the product specifications for prepackaged systems.

For cast-in-place or grouted systems, provide hydraulic cement grout in accordance with Section 421.2.F, “Mortar and Grout,” epoxy, epoxy mortar, or other prepackaged grouts as approved. Provide a Type III epoxy per DMS-6100, “Epoxies and Adhesives,” when neat epoxy is used for anchor bolts or dowels. Provide Type VIII epoxy per DMS-6100 when an epoxy grout is used. Provide grout, epoxy, or epoxy mortar as the binding agent unless otherwise indicated on the plans.

Provide other anchor systems as required in the plans.

11. Placing Concrete in Cold Weather. Protect concrete placed under weather conditions where weather may adversely affect results. Permission given by the Engineer for placing during cold weather does not relieve the Contractor of

responsibility for producing concrete equal in quality to that placed under normal conditions. If concrete placed under poor conditions is unsatisfactory, remove and replace it as directed at Contractor's expense.

Do not place concrete in contact with any material coated with frost or having a temperature of 32°F or lower. Do not place concrete when the ambient temperature in the shade is below 40°F and falling unless approved. Concrete may be placed when the ambient temperature in the shade is 35°F and rising or above 40°F.

Provide and install recording thermometers, maturity meters, or other suitable temperature measuring devices to verify that all concrete is effectively protected as follows:

- Maintain the temperature of the top surface of bridge slabs and top slabs of direct-traffic culverts at 50°F or above for 72 hr. from the time of placement and above 40°F for an additional 72 hr.
- Maintain the temperature at all surfaces of concrete in bents, piers, culvert walls, retaining walls, parapets, wingwalls, bottoms of bridge slab or culvert top slabs, and other similar formed concrete at 40°F or above for 72 hr. from the time of placement.
- Maintain the temperature of all other concrete, including the bottom slabs (footings) of culverts, placed on or in the ground above 32°F for 72 hr. from the time of placement.

Use additional covering, insulated forms, or other means and, if necessary, supplement the covering with artificial heating. Avoid applying heat directly to concrete surfaces. Cure as specified in Section 420.4.J, "Curing Concrete," during this period until all requirements for curing have been satisfied.

When impending weather conditions indicate the possible need for temperature protection, have on hand all necessary heating and covering material, ready for use, before permission is granted to begin placement.

12. Placing Concrete in Hot Weather. Use an approved retarding agent in all concrete for superstructures and top slabs of direct-traffic culverts, except concrete containing GGBF slag, when the temperature of the air is above 85°F unless otherwise directed. Keep the concrete at or below the maximum temperature at time of placement as specified in Section 420.4.G.1, "Placing Temperature." Sprinkle and shade aggregate stockpiles or use ice, liquid nitrogen systems, or other approved methods as necessary to control the concrete temperature.

13. Placing Concrete in Water. Deposit concrete in water only when shown on the plans or with approval. Make forms or cofferdams tight enough to prevent any water current passing through the space in which the concrete is being deposited. Do not pump water during the concrete placing or until the concrete has set for at least 36 hr.

Place the concrete with a tremie or pump, or use another approved method, and do not allow it to fall freely through the water or disturb it after it is placed. Keep the concrete surface approximately level during placement.

Support the tremie or operate the pump so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow. Submerge the lower end of the tremie or pump hose in the concrete at all times. Use continuous placing operations until the work is complete.

For concrete to be placed under water, design the concrete mix in accordance with Item 421, "Hydraulic Cement Concrete," with a minimum cement content of 650 lb. per cubic yard. Include an anti-washout admixture in the mix design as necessary to produce a satisfactory finished product.

14. Mass Placements. Mass placements are defined as placements with a least dimension greater than or equal to 5 ft., or designated on the plans. For monolithic mass placements, develop and obtain approval for a plan to ensure the following during the heat dissipation period:

- the temperature differential between the central core of the placement and the exposedconcrete surface does not exceed 35°F and
- the temperature at the central core of the placement does not exceed 160°F.

Base this plan on the equations given in the Portland Cement Association's *Design and Control of Concrete Mixtures*. Cease all mass placement operations and revise the plan as necessary if either of the above limitations is exceeded.

Include a combination of the following elements in this plan:

- selection of concrete ingredients including aggregates, gradation, and cement types, to minimize heat of hydration;
- use of ice or other concrete cooling ingredients;
- use of liquid nitrogen dosing systems;
- controlling rate or time of concrete placement;
- use of insulation or supplemental external heat to control heat loss;
- use of supplementary cementing materials; or
- use of a cooling system to control the core temperature.

Furnish and install 2 sets of temperature recording devices, maturity meters, or other approved equivalent devices at designated locations. Use these devices to simultaneously measure the temperature of the concrete at the core and the surface. Maintain temperature control methods for 4 days unless otherwise approved. Maturity meters may not be used to predict strength of mass concrete.

15. Placing Concrete in Foundation and Substructure. Do not place concrete in footings until the depth and character of the foundation has been inspected and permission has been given to proceed.

Placing of concrete footings upon seal concrete is permitted after the cofferdams are free from water and the seal concrete cleaned. Perform any necessary pumping or bailing during the concreting from a suitable sump located outside the forms.

Construct or adjust all temporary wales or braces inside cofferdams as the work proceeds to prevent unauthorized construction joints.

When footings can be placed in a dry excavation without the use of cofferdams, omit forms if approved, and fill the entire excavation with concrete to the elevation of the top of footing.

Place concrete in columns monolithically between construction joints unless otherwise directed.

Columns and caps or tie beams supported on them may be placed in the same operation or separately. If placed in the same operation, allow for settlement and shrinkage of the column concrete by placing it to the lower level of the cap or tie beam, and delay placement between 1 and 2 hr. before proceeding with the cap or tie beam placement.

16. Placing Concrete in Box Culverts. Where the top slab and walls are placed monolithically in

culverts more than 4 ft. in clear height, allow between 1 and 2 hr. to elapse before placing the top slab to allow for settlement and shrinkage in the wall concrete. Accurately finish the footing slab at the proper time to provide a smooth uniform surface. Finish top slabs that carry direct-traffic as specified in this Item. Give top slabs of fill type culverts a float finish.

17. Placing Concrete in Superstructure. Unless otherwise shown on the plans, place simple span bridge slabs without transverse construction joints by using either a self-propelled transverse finishing machine or a mechanical longitudinal screed. For small placements or for unusual conditions such as narrow widening, variable cross-slopes, or transitions, use of manually operated screeding equipment may be permitted. Support the screed adequately on a header or rail system stable enough to withstand the longitudinal or lateral thrust of the equipment. Adjust the profile grade line as necessary to account for variations in beam camber and other factors to obtain the required slab thickness and concrete cover over the slab reinforcement. Set beams and verify their surface elevations in a sufficient number of spans so that when adjustment is necessary, the profile grade line can be adjusted over suitable increments to produce a smooth riding surface. Take dead load deflection into account in setting the grades of headers and rail systems. Use construction joints, when required or permitted for slab placements on steel or prestressed concrete beams, as shown on the plans. Before placing concrete on steel girder or truss spans, release falsework under the spans and swing the spans free on their permanent supports.

Make 1 or more passes with the screed over the bridge slab segment before placing concrete on it to ensure proper operation and maintenance of grades and clearances. Use an approved system of checking to detect any vertical movement of the forms or falsework. Maintain forms for the bottom surface of concrete slabs, girders, and overhangs to the required vertical alignment during concrete placing.

Fog unformed surfaces of slab concrete in bridge slabs and in top slabs of direct-traffic culverts from the time of initial strikeoff of the concrete until finishing is completed and required interim curing is in place. Do not use fogging as a means to add finishing water, and do not work moisture from the fog spray into the fresh concrete.

For simple spans, retard the concrete only if necessary to complete finishing operations or as required by this Section. When filling curb forms, bring the top of curb and sidewalk section to the correct camber and alignment, and finish them as described in this Item.

a. Transverse Screeding. Install rails for transverse finishing machines that are supported from the beams or girders so that the supports may be removed without damage to the slab. Prevent bonding between removable supports and the concrete in an acceptable manner. Do not allow rail support parts that remain embedded in the slab to project above the upper mat of reinforcing steel. Rail or screed supports attached to I-beams or girders are subject to the requirements of this Item. Unless otherwise shown on the plans, for transverse screeding the minimum rate of concrete placement is 30 linear feet of bridge slab per hour. Deposit concrete parallel to the skew of the bridge so that all girders are loaded uniformly along their length.

Deposit slab concrete between the exterior beam and the adjacent beam before placing concrete in the overhang portion of the slab. Furnish personnel and equipment capable of placing, finishing, and curing the slab at an acceptable rate to ensure compliance with the specifications. Place concrete in transverse strips. On profile grades greater than 1-1/2%, start placement at the lowest end.

b. Longitudinal Screeding. Unless otherwise shown on the plans, use of temporary intermediate headers will be permitted for placements over 50 ft. long if the rate of placement is rapid enough to prevent a cold joint and if these headers are designed for easy removal to permit satisfactory consolidation and finish of the concrete at their locations. Deposit slab concrete between the exterior beam and the adjacent beam before placing concrete in the overhang portion of the slab. Place concrete in longitudinal strips starting at a point in the center of the segment adjacent to 1 side except as this Section indicates, and complete the strip by placing uniformly in both directions toward the ends. For spans on a profile grade of 1-1/2% or more, start placing at the lowest end. Use strips wide enough that the concrete within each strip remains plastic until placement of the adjacent strip. Where monolithic curb construction is specified, place the concrete in proper sequence to be monolithic with the adjacent longitudinal strips of the slabs.

c. Placements on Continuous Steel Units. Unless otherwise shown on the plans, place slabs on continuous steel units in a single continuous operation without transverse construction joints using a self-propelled transverse finishing machine or a mechanical longitudinal screed. Retard the initial set of the concrete sufficiently to ensure that concrete remains plastic in at least 3 spans immediately preceding the slab being placed. Use construction joints, when required for slab placements on steel beams or girders, as shown on the plans. When staged placement of a slab is required in the plans, ensure that the previously placed concrete attains a compressive strength of 3,000 psi before placing the next stage concrete. Multiple stages may be placed in a single day if approved. Where plans permit staged placing without specifying a particular order of placement, use an approved placing sequence that will not overstress of any of the supporting members.

d. Slab and Girder Units. Unless otherwise shown on the plans, place girders, slab, and curbs of slab and girder spans monolithically. Fill concrete girder stems first, and place the slab concrete within the time limits specified in this

Item. If using a transverse screed, place concrete in the stems for a short distance and then place the concrete in transverse strips. If using a longitudinal screed, fill the outside girder stem first, beginning at the low end or side, and continue placement in longitudinal strips.

H. Treatment and Finishing of Horizontal Surfaces Other Than Bridge Slabs. Strike off to grade and finish all unformed upper surfaces. Do not use mortar topping for surfaces constructed under this Section.

After the concrete has been struck off, float the surface with a suitable float. Give bridge sidewalks a wood float or broom finish, or stripe them with a brush.

Slightly slope the tops of caps and piers between bearing areas from the center toward the edge, and slope the tops of abutment and transition bent caps from the backwall to the edge, as directed, so that water drains from the surface. Give the concrete a smooth trowel finish. Construct bearing areas for steel units in accordance with Section 441.3.K.5, "Bearing and Anchorage Devices."

Give the bearing area under the expansion ends of concrete slabs and slab and girder spans a steel-trowel finish to the exact grades required. Give bearing areas under elastomeric bearing pads or non-reinforced bearing seat buildups a textured, wood float finish. Do not allow the bearing area to vary from a level plane more than 1/16 in. in all directions.

Cast bearing seat buildups or pedestals for concrete units integrally with the cap or with a construction joint. Provide a latex-based mortar, an epoxy mortar, or an approved proprietary bearing mortar for bearing seat buildups cast with a construction joint. Mix mortars in accordance with the manufacturer's recommendations. Construct pedestals of Class C concrete, reinforced as shown on the plans or as indicated in Figure 1 and Figure 2.

Figure 1
Section through bearing seat buildups.

Figure 2
Plan view of bearing seat buildups.

I. Finish of Bridge Slabs. Provide camber for specified vertical curvature and transverse slopes. For concrete flat slab and concrete slab and girder spans cast in place on falsework, provide additional camber to offset the initial and final deflections of the span as indicated in the plans. For concrete slab and girder spans using pan forms, provide camber of approximately 3/8 in. for 30-ft. spans and 1/2 in. for 40-ft. spans to offset initial and final deflections unless otherwise directed. For concrete flat slab and concrete slab and girder spans not using pan forms, when dead load deflection is not shown on the plans, provide a camber of 1/8 in. per 10 ft. of span length but no more than 1/2 in.

Provide a camber of 1/4 in. in addition to deflection for slabs without vertical curvature on steel or
prestressed concrete beams.

Use work bridges or other suitable facilities to perform all finishing operations and to provide access, if necessary, for the Engineer to check measurements for slab thickness and reinforcement cover.

As soon as the concrete has been placed and vibrated in a section wide enough to permit working, level, strike off, and screed the surface, carrying a slight excess of concrete ahead of the screed to fill all low spots.

Move longitudinal screeds across the concrete with a saw-like motion while their ends rest on headers or templates set true to the roadway grade or on the adjacent finished slab. Move transverse screeds longitudinally approximately 1/5 of the drum length for each complete out-and-back pass of the carriage.

Screed the surface of the concrete enough times and at intervals to produce a uniform surface true to grade and free of voids.

Work the screeded surface to a smooth finish with a long-handled wood or metal float or hand-float it from work bridges over the slab. Floating may not be necessary if the pan float attached to a transverse screed produces an acceptable finish. Avoid overworking the surface of the concrete. Avoid overuse of finish water.

Perform sufficient checks, witnessed by the Engineer, with a long-handled 16-ft. straightedge on the plastic concrete to ensure that the final surface will be within specified tolerances. Make the check with the straightedge parallel to the centerline. Lap each pass half over the preceding pass. Remove all high spots, and fill and float all depressions over 1/16 in. deep with fresh concrete. Continue checking and floating until the surface is true to grade and free of depressions, high spots, voids, or rough spots.

Fill screed-rail support holes with concrete, and finish them to match the top of the slab.

Finish the concrete surface to a uniform texture using a carpet drag, burlap drag, or broom finish. Finish the surface to a smooth sandy texture without blemishes, marks, or scratches deeper than 1/16 in. Apply the surface texturing using a work bridge or platform immediately after completing the straightedge checks. Draw the carpet or burlap drag longitudinally along the concrete surface,
adjusting the surface contact area or pressure to provide a satisfactory coarsely textured surface. A
broom finish may be performed using a fine bristle broom transversely.

Coat the concrete surface immediately after the carpet or burlap drag, or broom finish with a single application of evaporation retardant at a rate recommended by the manufacturer. Do not allow more than 10 min. to elapse between the texturing at any location and application of evaporation retardant.

The evaporation retardant may be applied using the same work bridge used for surface texturing. Do not work the concrete surface once the evaporation retardant has been applied.

Apply interim and final curing in accordance with Section 420.4.J, "Curing Concrete."

The Contractor is responsible for the ride quality of the finished bridge slab. The Engineer will use a 10-ft. straightedge (1/8 in. in 10 ft.) to verify ride quality and to determine locations where corrections are needed. If the Engineer determines that the ride quality is unacceptable, submit a plan for approval to produce a ride of acceptable quality. Make all corrections for ride before saw-cutting grooves.

Saw-cut grooves in the hardened concrete of bridge slabs, bridge approach slabs, and direct-traffic culverts to produce the final texturing after completion of the required curing period. Cut grooves perpendicular to the structure centerline. Cut grooves continuously across the slab to within 18 in. of the barrier rail, curb, or median divider. At skewed metal expansion joints in bridge slabs, adjust groove cutting by using narrow-width cutting heads so that all grooves end within 6 in. of the joint, measured perpendicular to the centerline of the metal joint. Leave no ungrooved surface wider than 6 in. adjacent to either side of the joint. Ensure that the minimum distance to the first groove, measured perpendicular to the edge of the concrete joint or from the junction between the concrete and the metal leg of the joint, is 1 in. Cut grooves continuously across construction joints or other joints in the concrete that are less than 1/2 in. wide. Apply the same procedure described above where barrier rails, curbs, or median dividers are not parallel to the structure centerline to maintain the 18-in. maximum dimension from the end of the grooves to the gutter line. Cut grooves continuously across formed concrete joints.

When the plans call for a concrete overlay to be placed on the slab (new construction) or on prestressed concrete box beams or other precast elements, give a carpet drag, burlap drag, or broom finish to all concrete surfaces to be overlaid. Saw-grooving is not required in this case. Provide an average texture depth for the finish of approximately 0.035 in. with no individual test falling below 0.020 in., unless otherwise shown on the plans, when tested in accordance with Tex-436-A. If the texture depth falls below what is intended, revise finishing procedures to produce the desired texture.

When the plans require an asphalt seal, with or without overlay, on the slab (new construction), on prestressed concrete box beams, or on other precast elements, give all concrete surfaces to be covered a lightly textured broom or carpet drag finish. Provide an average texture depth of approximately 0.025 in. when tested in accordance with Tex-436-A.

J. Curing Concrete. Obtain approval of the proposed curing methods, equipment, and materials before placing concrete. The Engineer may require the same curing methods for like portions of a single structure. Inadequate curing or facilities may delay all concrete placement on the job until remedial action is taken.

A curing day is a calendar day when the temperature, taken in the shade away from artificial heat, is above 50°F for at least 19 hr. or, on colder days if the temperature of all surfaces of the concrete is maintained above 40°F, for the entire 24 hr. The required curing period begins when all concrete has attained its initial set. Tex-440-A may be used to determine when the concrete has attained its initial set. Cure all concrete for 4 consecutive days except as noted in Table 1.

Table 1
Exceptions to 4-Day Curing

Description	Type of Cement	Required Curing Days
Upper surfaces of bridge slabs, top slab of direct-traffic culverts, and concrete overlays.	I or III	8
	II- or I/II	10
	All types with supplementary cementing materials	10
Concrete piling buildups	All	6

For upper surfaces of bridge slabs, bridge approach slabs, median and sidewalk slabs, and culvert top slabs constructed using Class S concrete, apply interim curing using a Type 1-D curing compound as soon as possible after application of the evaporation retardant and after the water sheen has disappeared, but no more than 45 min. after application of the evaporation retardant. Apply membrane interim curing using a work bridge or other approved apparatus to ensure a

uniform application. Watercure for final curing in accordance with this Section, starting as soon as possible without damaging the surface finish. Maintain the water curing for the duration noted in Table 1. Place polyethylene sheeting, burlap-polyethylene blankets, laminated mats, or insulating curing mats in direct contact with the slab when the air temperature is expected to drop below 40°F during the first 72 hr. of the curing period. Weigh down these curing materials with dry mats to maintain direct contact with the concrete and to provide insulation against cold weather. Supplemental heating or insulation may be required in cold and wet weather if the insulating cotton mats become wet or if the concrete drops below the specified curing temperature. Avoid applying heat directly to concrete surfaces.

For the top surface of any concrete unit upon which concrete is to be placed and bonded at a later interval (stub walls, risers, etc.) and other superstructure concrete (curbs, wingwalls, parapet walls, etc.), use only water curing in accordance with this Section.

Cure all other concrete as specified in the pertinent Items. Use the following methods for curing concrete, subject to the requirements of this Item.

1. Form Curing. When forms are left in intimate contact with the concrete, other curing methods are not required except for exposed surfaces and for cold weather protection. If forms are removed before the 4-day required curing period, use another approved curing method.

2. Water Curing. Keep all exposed surfaces of the concrete wet continuously for the required curing time. Use water curing that meets the requirements for concrete mixing water in Section 421.2.D, "Water." Do not use seawater or water that stains or leaves an unsightly residue.

a. Wet Mats. Keep the concrete continuously wet by maintaining wet cotton mats in direct contact with the concrete for the required curing time. If needed, place damp burlap blankets made from 9-oz. stock on the damp concrete surface for temporary protection before applying cotton mats. Then place the dry mats and wet them immediately after they are placed. Weight the mats adequately to provide continuous contact with all concrete. Cover surfaces that cannot be cured by direct contact with mats, forming an enclosure well anchored to the forms or ground so that outside air cannot enter the enclosure. Provide sufficient moisture inside the enclosure to keep all surfaces of the concrete wet.

b. Water Spray. Overlap sprays or sprinklers to keep all unformed surfaces continuously wet.

c. Ponding. Cover the surfaces with at least 2 in. of clean granular material, kept wet at all times, or at least 1 in. deep water. Use a dam to retain the water or saturated granular material.

3. Membrane Curing. Unless otherwise shown on the plans, choose either Type 1-D or Type 2 membrane-curing compound when membrane curing is permitted. Type 1-D (Resin Base Only) is required for interim curing bridge slabs and top slabs of direct-traffic culverts and all other surfaces that require a higher grade of surface finish. For substructure concrete provide only 1 type of curing compound on any 1 structure.

Apply membrane curing just after free moisture has disappeared at a rate of approximately 180 sq. ft. per gallon. Do not spray curing compound on projecting reinforcing steel or concrete that will later form a construction joint. Do not apply membrane curing to dry surfaces. Dampen formed surfaces and surfaces that have been given a first rub so that they are moist at the time of application of the membrane.

When membrane is used for complete curing, leave the film unbroken for the minimum curing period specified. Correct damaged membrane immediately by reapplication of membrane.

Polyethylene sheeting, burlap-polyethylene mats, or laminated mats in close contact with the concrete surfaces are equivalent to membrane curing.

K. Removal of Forms and Falsework. Unless otherwise directed, forms for vertical surfaces may be removed after the concrete has aged 12 hr. after initial set provided the removal can be done without damage to the concrete. Keep forms for mass placements, defined in Section 420.4.G.14, "Mass Placements," in place for 4 days following concrete placement.

Remove forms for inside curb faces and for bridge rails whenever removal can be done without damage to the curb or railing.

Leave in place weight-supporting forms and falsework spanning more than 1 ft. for all bridge components and culvert slabs except as directed otherwise until the concrete has attained a compressive strength of 2,500 psi. Remove forms for other structural components as necessary. Remove inside forms (walls and top slabs) for box culverts and sewers after concrete has attained a compressive strength of 1,800 psi if an approved overhead support system is used to transfer the weight of the top slab to the walls of the box culvert or sewer before removal of the support provided by the forms.

Forms or parts of forms may be removed only if constructed to permit removal without disturbing forms or falsework required to be left in place for a longer period on other portions of the structure.

Remove all metal appliances used inside forms for alignment to a depth of at least 1/2 in. from the concrete surface. Make the appliances so that metal may be removed without undue chipping or spalling of the concrete, and so that it leaves a smooth opening in the concrete surface when removed. Do not burn off rods, bolts, or ties.

Remove all forms and falsework unless otherwise directed.

L. Defective Work. Repair defective work as soon as possible. Remove and replace at the expense of the Contractor any defect that cannot be repaired to the satisfaction of the Engineer.

M. Ordinary Surface Finish. Apply an ordinary surface finish to all concrete surfaces as follows:

- Chip away all loose or broken material to sound concrete where porous, spalled, or honeycombed areas are visible after form removal.
- Repair spalls by saw-cutting and chipping at least 1/2 in. deep, perpendicular to the surface to eliminate feather edges. Repair shallow cavities using a latex adhesive grout, cement mortar, or epoxy mortar as approved. Repair large areas using concrete as directed or approved.
- Clean and fill holes or spalls caused by the removal of form ties, etc., with latex grout, cement grout, or epoxy grout as approved. Fill only the holes. Do not blend the patch with the surrounding concrete. On surfaces to receive a rub finish in accordance with Item 427, "Surface Finishes for Concrete," chip out exposed parts of metals chairs to a depth of 1/2 in. and repair the surface.
- Remove all fins, runs, drips, or mortar from surfaces that will be exposed. Smooth all form marks and chamfer edges by grinding or dry-rubbing.
- Ensure that all repairs are dense, well bonded, and properly cured. Finish exposed large repairs to blend with the surrounding concrete where a higher class of finish is not specified.

Unless noted otherwise, apply an ordinary surface finish as the final finish to the following exposed surfaces:

- inside and top of inlets,
- inside and top of manholes,
- inside of sewer appurtenances,
- inside of culvert barrels,
- bottom of bridge slabs between girders or beams, and
- vertical and bottom surfaces of interior concrete beams or girders.

Form marks and chamfer edges do not need to be smoothed for the inside of culvert barrels and the bottom of bridge slabs between girders or beams.

420.5. Measurement. This Item will be measured by the cubic yard, square yard, foot, square foot, or by each structure.

A. General. Concrete quantities will be based on the dimensions shown on the plans or those established in writing by the Engineer.

In determining quantities, no deductions will be made for chamfers less than 2 in. or for embedded portions of steel or prestressed concrete beams, piling, anchor bolts, reinforcing steel, drains, weep holes, junction boxes, electrical or telephone conduit, ducts and voids for prestressed tendons, or embedded portions of light fixtures.

For slab and girder spans using pan forms, a quantity will be included for the screed setting required to provide proper camber in the roadway surface after form removal.

For slabs on steel or prestressed concrete beams, an estimated quantity for the haunch between the slab and beams will be included. No measurement will be made during construction for variation in the amount of haunch concrete due to variations in camber of the beams.

For cast-in-place slabs on slab beams, double-T beams, or box beams, the combination of span length, theoretical camber in beams, computed deflections, and plan vertical curve will be taken into account in determining the quantity for the slab.
Additional concrete that may be required by an adjustment of the profile grade line during construction, to insure proper slab thickness, will not be measured for payment.
Variation in concrete headwall quantity incurred when an alternate bid for pipe is permitted will not be cause for payment adjustment.
Mass placements may be either a plans quantity item or measured in place as indicated.
Quantities revised by a change in design, measured as specified, will be increased or decreased and included for payment.

B. Plans Quantity. Structure elements designated in Table 2 and measured by the cubic yard are plans quantity measurement items. The quantity to be paid for plans quantity items is the quantity shown in the proposal unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.
No adjustment will be made for footings or other in-ground elements where the Contractor has been allowed to place concrete in an excavation without forms.

Table 2
Plans Quantity Payment
(Cubic Yard Measurement Only)

Culverts and culvert wing walls	Abutments
Headwalls for pipe	Slab and girder spans (pan form)
Retaining walls	Footings
Inlets and manholes	Pile bent caps
Shear key concrete for box and slab beams	Concrete wearing surface on pre-cast box beams, slab beams or double-T beams
Bridge approach slabs	Cast-in-place concrete slab spans

Note: Other structure elements, including pier and bent concrete, may be paid for as "plans quantity" when shown on the plans.

C. Measured in Place. Items not paid for as "plans quantity" will be measured in place.

420.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the various structure elements specified of the various classes of concrete. Mass placements, as defined in Section 420.4.G.14, "Mass Placements," will be paid for separately for the various classes of concrete. This price is full compensation for furnishing, hauling, and mixing concrete materials; furnishing, bending, fabricating, splicing, welding and placing the required reinforcement; clips, blocks, metal spacers, ties, wire, or other materials used for fastening reinforcement in place; placing, finishing, curing, and grooving concrete; applying ordinary surface finish; furnishing and placing drains, metal flashing strips, and expansion-joint material; excavation, subgrade preparation, and disposal of excavated material for bridge approach slabs; and forms and falsework, equipment, labor, tools, and incidentals.
Diaphragm concrete will not be paid for directly but is subsidiary to the slab unless otherwise shown on the
plans.
Design and installation of foundations for falsework is at the Contractor's expense.
The following procedure will be used to evaluate concrete where 1 or more project acceptance test specimens fail to meet the required design strength specified in Item 421, "Hydraulic Cement Concrete," or
in the plans:

- The concrete for a given placement will be considered structurally adequate and accepted at full price if the average of all test results for specimens made at the time of placement meets the required design strength provided that no single test result is less than 85% of the required design strength.
- The Engineer will perform a structural review of the concrete to determine its adequacy to remain in service if the average of all test results for specimens made at the time of placement is less than the required design strength or if any test results are less than 85% of the required design

strength. If cores are required to determine the strength of the in-situ concrete, take cores at locations designated by the Engineer in accordance with Tex-424-A. The coring and testing of the cores will be at the Contractor's expense. The Engineer will test the cores.

- If all of the tested cores meet the required design strength, the concrete will be paid for at the full price.
- If any of the tested cores do not meet the required design strength but the average strength attained is determined to be structurally adequate, the Engineer will determine the limits of the pay adjustment. The average strength of the cores tested will be used in the pay adjustment formula.
- Remove concrete that is not structurally adequate.
- Concrete that has been determined to be structurally adequate may be accepted at an adjusted price based on the following formula:

$A = 0.10Bp + 0.75(Sa/Ss)_2\, Bp$

where:

A = Amount to be paid per unit of measure for the entire placement in question
Sa = Actual strength from cylinders or cores. Use values from cores, if taken.
Ss = Minimum required strength (specified)
Bp = Unit bid price.

- The decision to reject structurally inadequate concrete or to apply the pay adjustment will be made nolater than 56 days after placement.

ITEM 421

HYDRAULIC CEMENT CONCRETE

421.1. Description. Furnish hydraulic cement concrete for concrete pavements, concrete structures, and other concrete construction.

421.2. Materials.

A. Cement. Furnish cement conforming to DMS-4600, "Hydraulic Cement".

B. Supplementary Cementing Materials (SCM).

1. Fly Ash. Furnish fly ash conforming to DMS-4610, "Fly Ash".

2. Ultra-Fine Fly Ash (UFFA). Furnish UFFA conforming to DMS-4610, "Fly Ash".

3. Ground Granulated Blast-Furnace Slag (GGBFS). Furnish GGBFS conforming to DMS-4620, "Ground Granulated Blast-Furnace Slag," Grade 100 or 120.

4. Silica Fume. Furnish silica fume conforming to DMS-4630, "Silica Fume".

5. Metakaolin. Furnish metakaolin conforming to DMS-4635, "Metakaolin".

C. Chemical Admixtures. Furnish admixtures conforming to DMS-4640, "Chemical Admixtures for Concrete". Do not use calcium chloride.

D. Water. Furnish mixing and curing water that is free from oils, acids, organic matter, or other deleterious substances. Water from municipal supplies approved by the Texas Department of Health will not require testing. When using water from other sources, provide test reports showing compliance with Table 1 before use.

Water that is a blend of concrete wash water and other acceptable water sources, certified by the concrete producer as complying with the requirements of both Table 1 and Table 2, may be used as mix water. Test the blended water weekly for 4 weeks for compliance with Table 1 and Table 2 or provide previous test results. Then test every month for compliance. Provide water test results upon request.

Table 1
Chemical Limits for Mix Water

Contaminant	Test Method	Maximum Concentration (ppm)
Chloride (Cl) Prestressed concrete Bridge decks & superstructure All other concrete	ASTM D 512	500 500 1,000
Sulfate (SO_4)	ASTM D 516	1,000
Alkalies ($Na_2O + 0.658K_2O$)	ASTM D 4191 & ASTM D 4192	600
Total solids	AASHTO T 26	50,000

Table 2
Acceptance Criteria for Questionable Water Supplies

Property	Test Method	Limits
Compressive strength, min % control at 7 days	ASTM C 109[1]	90
Time of set, deviation from control, Min.	ASTM C 191[1]	from 60 early to 90 later

1. Base comparisons on fixed proportions and the same volume of test water compared to the control mix using city water or distilled water.

Do not use mix water that has an adverse effect on the air-entraining agent, on any other chemical admixture, or on strength or time of set of the concrete. When using white hydraulic cement, use mixing and curing water free of iron and other impurities that may cause staining or discoloration.

E. Aggregate. Supply aggregates that meet the definitions in Tex-100-E. Provide coarse and fine aggregates from sources listed in the Department.s Concrete Rated Source Quality Catalog (CRSQC). Provide aggregate from non-listed sources only when tested and approved by the Engineer before use.

Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources. Do not combine approved material with unapproved material.

1. Coarse Aggregate. Provide coarse aggregate consisting of durable particles of gravel, crushed blast furnace slag, recycled crushed hydraulic cement concrete, crushed stone, or combinations thereof that are free from frozen material and from injurious amounts of salt, alkali, vegetable matter, or other objectionable material, either free or as an adherent coating. Provide coarse aggregate of uniform quality throughout.

Provide coarse aggregate that, when tested in accordance with Tex-413-A, has:

- at most 0.25% by weight of clay lumps,
- at most 1.0% by weight of shale, and
- at most 5.0% by weight of laminated and friable particles.

Wear must not be more than 40% when tested in accordance with Tex-410-A.

Unless otherwise shown on the plans, provide coarse aggregate with a 5-cycle magnesium sulfate soundness of not more than 18% when tested in accordance with Tex-411-A. Crushed recycled hydraulic cement concrete is not subject to the 5-cycle soundness test.

The loss by decantation as tested in accordance with Tex-406-A, plus the allowable weight of clay lumps, must not exceed 1.0% or the value shown on the plans, whichever is smaller. In the case of aggregates made primarily from crushing stone, if the material finer than the No. 200 sieve is established to be the dust of fracture and essentially free from clay or shale as established by Tex-406-A, Part III, the limit may be increased to 1.5%. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1.0% but not more than 3.0% if the material finer than the No. 200 sieve is determined to be at least 67% calcium carbonate in accordance with Tex-406-A, Part III.

Unless otherwise specified, provide aggregate conforming to the gradation requirements shown in Table 3 when tested in accordance with Tex-401-A.

Table 3
Coarse Aggregate Gradation Chart

Percent Passing on Each Sieve

Grade	Aggregate Nominal Size	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8
No.[1]										
1	2"	100	80-100	50-85		20-40			0-5	
2 (467)	1.1/2"		100	95-100		35-70		10-30	0-5	
3	1.1/2"		100	95-100		60-90	25-60		0-5	
4 (57)	1"			100	95-100		25-60		0-10	0-5
5 (67)	3/4"				100	90-100		20-55	0-10	0-5
6 (7)	1/2"					100	90-100	40-70	0-15	0-5
7 3/8"							100	70-95	0-25	
8 3/8"							100	95-100	20-65	0-10

1. Corresponding ASTM C 33 gradation shown in parentheses.

2. Fine Aggregate. Provide fine aggregate consisting of clean, hard, durable particles of natural or manufactured sand or a combination thereof with or without mineral filler. Provide fine aggregate free from frozen material and from injurious amounts of salt, alkali, vegetable matter, or other objectionable material, and containing no more than 0.5% clay lumps by weight in accordance with Tex-413-A.

Provide fine aggregate that does not show a color darker than standard when subjected to the color test for organic impurities in accordance with Tex-408-A.

Unless otherwise shown on the plans, use fine aggregate with an acid insoluble residue of at least 60% by weight when tested in accordance with Tex-612-J in all concrete subject to direct traffic. Unless otherwise shown on the plans, when necessary, blend the fine aggregate to meet the acid insoluble residue requirement. When blending, use the following equation:

Acid Insoluble (%) = $\{(A1)(P1)+(A2)(P2)\}/100$

where:

$A1$ = acid insoluble (%) of aggregate 1

A2 = acid insoluble (%) of aggregate 2
P1 = percent by weight of *A1* of the fine aggregate blend
P2 = percent by weight of *A2* of the fine aggregate blend
Provide fine aggregate or combinations of aggregates, including mineral filler, conforming to the gradation requirements shown in Table 4 when tested in accordance with Tex-401-A unless otherwise specified.

Table 4
Fine Aggregate Gradation Chart (Grade 1)

Sieve Size	Percent Passing
3/8 in.	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-65
No. 50	10-35[1]
No. 100	0-10
No. 200	0-3[2]

1. 6.35 when sand equivalent value is greater than 85.
2. 0.6 for manufactured sand.

Unless otherwise shown on the plans, provide fine aggregate with a sand equivalent of at least 80 in accordance with Tex-203-F.
For all classes of concrete except Class K, provide fine aggregate with a fineness modulus between 2.30 and 3.10 as determined by Tex-402-A. For Class K concrete, provide a fine aggregate with a fineness modulus between 2.60 to 2.80 unless otherwise shown on the plans.
3. Mineral Filler. Provide mineral filler consisting of stone dust, clean crushed sand, or other approved inert material with 100% passing the No. 30 sieve and 65 to 100% passing the No. 200 sieve when tested in accordance with Tex-401-A.
F. Mortar and Grout. When required or shown on the plans, provide mortar and grout consisting of 1 part hydraulic cement, 2 parts sand, and sufficient water to provide the desired consistency. Provide mortar with a consistency such that the mortar can be easily handled and spread by trowel. Provide grout of a consistency that will flow into and completely fill all voids.
421.3. Equipment.
A. Concrete Plants and Mixing Equipment. Except for volumetric mixers (auger/mixer), each plant and truck mixer must be currently certified by the National Ready Mixed Concrete Association (NRMCA) or have an inspection report signed and sealed by a licensed professional engineer showing that concrete measuring, mixing, and delivery equipment meets all requirements of ASTM C 94. A new certification or signed and sealed report is required every time a plant is moved. Plants with a licensed engineer.s inspection require reinspection every 2 years. Provide a copy of the certification or the signed and sealed inspection report to the Engineer. When equipment or facilities fail to meet specification requirements, remove them from service until corrected.
1. Scales. Check all scales prior to beginning of operations, after each move, or whenever their accuracy or adequacy is questioned, and at least once every 6 mo. Immediately correct deficiencies, and recalibrate. Provide a record of calibration showing scales in compliance with

Unless otherwise shown on the plans, use fine aggregate with an acid insoluble residue of at least 60% by weight when tested in accordance with Tex-612-J in all concrete subject to direct traffic. Unless otherwise shown on the plans, when necessary, blend the fine aggregate to meet the acid insoluble residue requirement. When blending, use the following equation:

Acid Insoluble (%) = {(*A1*)(*P1*)+(*A2*)(*P2*)}/100
where:
A1 = acid insoluble (%) of aggregate 1
A2 = acid insoluble (%) of aggregate 2
P1 = percent by weight of *A1* of the fine aggregate blend
P2 = percent by weight of *A2* of the fine aggregate blend
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otherwise specified.

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No. 50	10-35[1]
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1. 6.35 when sand equivalent value is greater than 85.
2. 0.6 for manufactured sand.

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F. Mortar and Grout. When required or shown on the plans, provide mortar and grout consisting of 1 part hydraulic cement, 2 parts sand, and sufficient water to provide the desired consistency. Provide mortar with a consistency such that the mortar can be easily handled and spread by trowel. Provide grout of a consistency that will flow into and completely fill all voids.

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1. Scales. Check all scales prior to beginning of operations, after each move, or whenever their accuracy or adequacy is questioned, and at least once every 6 mo. Immediately correct deficiencies, and recalibrate. Provide a record of calibration showing scales in compliance with ASTM C 94 requirements. Check batching accuracy of volumetric water batching devices and admixture dispensing devices at least every 90 days. Perform daily checks as necessary to ensure measuring accuracy.

2. Volumetric Mixers. Provide volumetric mixers with rating plates defining the capacity and the

performance of the mixer in accordance with the Volumetric Mixer Manufacturers Bureau or equivalent. Provide volumetric mixers that comply with ASTM C 685. Provide test data showing mixers meet the uniformity test requirements of Tex-472-A.
3. Agitators and Truck and Stationary Mixers. Inspect and furnish inspection reports on truck mixers and agitators annually. If an inspection within 12 mo. is not practical, a 2-mo. grace period (for a maximum of 14 mo. between inspections) is permitted. Include in the report the condition of blades and fins and their percent wear from the original manufacturer.s design. Repair mixing equipment exhibiting 10% or more wear before use. Provide truck mixers and agitators equipped with means to readily verify the number of revolutions of the drum, blades, or paddles.
Provide stationary and truck mixers capable of combining the ingredients of the concrete within

the specified time or the number of revolutions specified into a thoroughly mixed and uniform mass and capable of discharging the concrete so that at least 5 of the 6 requirements of Tex-472-A are met.
As directed, to resolve issues of mix uniformity and mixer performance, perform concrete uniformity tests on mixers or agitators in accordance with Tex-472-A.
Perform the mixer or agitator uniformity test at the full rated capacity of the equipment and within the maximum mixing time or maximum number of revolutions. Remove from service all equipment that fails the uniformity test.
Inspect and maintain mixers and agitators. Keep them reasonably free of concrete buildup, and repair or replace worn or damaged blades or fins.
Ensure all mixers have a plate affixed showing manufacturer.s recommended operating speed and rated capacity for mixing and agitating.
B. Hauling Equipment. Provide hauling equipment capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.
When using non-agitating equipment for transporting concrete, provide equipment with smooth, mortar-tight metal containers equipped with gates that prevent accidental discharge of the concrete.
C. Testing Equipment. Unless otherwise shown on the plans or specified, in accordance with the pertinent test procedure, furnish and maintain:
• test molds,
• curing facilities,
• maturity meters if used, and
• wheelbarrow or other container acceptable for the sampling of the concrete.
Provide strength-testing equipment in accordance with the Contract controlling test unless shown otherwise.

421.4. Construction.
A. Classification and Mix Design. Furnish mix designs using ACI 211, .Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete,. or other approved procedures for the classes of concrete required in accordance with Table 5. Do not exceed the maximum water-tocementitious-material ratio.
A higher-strength class of concrete with equal or lower water-to-cementitious-material ratio may be substituted for the specified class of concrete.
To account for production variability and ensure minimum compressive strength requirements are met, over-design the mix in accordance with Table 6.
1. Cementitious Materials. Use cementitious materials from prequalified sources; otherwise, request sampling and testing for approval before use. Unless otherwise specified or approved, limit cementitious material content to no more than 700 lb. per cubic yard. When supplementary cementing materials are used, “cement. is defined as .cement plus supplementary cementing material.”

Use Type III cement only in precast concrete or when specified or permitted.

For monolithic placements, use cement of the same type and from the same source.
When sulfate-resistant concrete is required, use mix design options 1, 2, 3, or 4 given in Section 421.4.A.6, .Mix Design Options,. using Type I/II, II, V, IP, or IS cement. Do not use Class C fly ash in sulfate-resistant concrete.
Do not use supplementary cementing materials when white hydraulic cement is specified.

Table 5
Concrete Classes

Class of Concrete Min. 28-day f'_c (psi)	Design Strength,	Maximum W/C Ratio[1] Grades[2,3]	Coarse Aggregate	General Usage[4]
A	3,000	0.60	1.4, 8	Inlets, manholes, curb, gutter, curb &

				gutter, conc. retards, sidewalks, driveways, backup walls, anchors
B	2,000	0.60	2.7	Riprap, small roadside signs, and anchors
C[5]	3,600	0.45	1.6	Drilled shafts, bridge substructure, bridge railing, culverts except top slab of direct traffic culverts, headwalls, wing walls, approach slabs, concrete traffic barrier (cast-in-place)
D	1,500	0.60	2.7	Riprap
E	3,000	0.50	2.5	Seal concrete
F[5]	Note 6	0.45	2.5	Railroad structures; occasionally for Bridge piers, columns, or bents
H[5]	Note 6	0.45	3.6	Prestressed concrete beams, boxes, piling, and concrete traffic barrier (precast)
S[5]	4,000	0.45	2.5	Bridge slabs, top slabs of direct traffic culverts
P	See Item 360	0.45	2.3	Concrete pavement
DC[5]	5,500	0.40	6	Dense conc. overlay
CO[5]	4,600	0.40	6	Conc. overlay
LMC[5]	4,000	0.40	6.8	Latex-modified concrete overlay
SS[5]	Note 7	0.45	4.6	Slurry displacement shafts, underwater drilled shafts
K[5]	Note 6	0.45	Note 6	Note 6
HES	Note 6	0.45	Note 6	Note 6

1. Maximum water-cement or water-cementitious ratio by weight.
2. Unless otherwise permitted, do not use Grade 1 coarse aggregate except in massive foundations with 4-in. minimum clear spacing between reinforcing steel bars. Do not use Grade 1 aggregate in drilled shafts.
3. Unless otherwise approved, use Grade 8 aggregate in extruded curbs.
4. For information only.
5. Structural concrete classes.
6. As shown on the plans or specified.
7. Cementitious material content shall be minimum 658 lb/cy of concrete.

Table 6
Over Design to Meet Compressive Strength Requirements[1]

No. of Tests[2,3]	**Standard Deviation, psi**				
	300	**400**	**500**	**600**	**700**
15	470	620	850	1,120	1,390
20	430	580	760	1,010	1,260
30 or more	400	530	670	900	1,130

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5.
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,000 psi for specified strength less than 3,000 psi, 1,200 psi for specified strengths from 3,000 to 5,000 psi and 1,400 psi for specified strengths greater than 5,000 psi.

2. Aggregates. Limit the use of recycled crushed hydraulic cement concrete as a coarse or fine aggregate to Class A, B, D, E, and P concrete. Limit recycled crushed concrete fine aggregate to a maximum of 20% of the fine aggregate.

When white hydraulic cement is specified, use light-colored aggregates.

3. Chemical Admixtures. Use only preapproved concrete chemical admixtures from the list of prequalified concrete admixtures maintained by the Construction Division. Submit non-preapproved admixtures for testing to the Engineer for approval. Do not use high-range waterreducing admixtures (Type F or G) or accelerating admixtures (Type C or E) in bridge deck concrete.

4. Air Entrainment. Air-entrain all concrete except for Class B in accordance with Table 7 unlessotherwise shown on the plans. Use moderate exposure values unless otherwise specified. If the air content is more than 1-1/2 percentage points below or 3 percentage points above the

required air, the load of concrete will be rejected. If the air content is more than 1-1/2 but less than 3 percentage points above the required air, the concrete may be accepted based on strength tests.

Table 7
Air Entrainment

Nominal Maximum Aggregate Size, in.	% Air[1] Moderate Exposure	Severe Exposure
3/8 (Grades 7 & 8)	6	7-1/2
1/2 (Grade 6)	5-1/2	7
3/4 (Grade 5)	5	6
1 (Grade 4)	4-1/2	6
1-1/2 (Grades 2 & 3)	4-1/2	5-1/2
2 (Grade 1)	4	5

1. For specified concrete strengths above 5,000 psi a reduction of 1 percentage point is permitted.

5. Slump. Unless otherwise specified, provide concrete slump in accordance with Table 8 using the lowest slump possible that can be placed and finished efficiently without segregation or honeycombing.

Concrete that exceeds the maximum acceptable placement slump at time of delivery will be rejected.

When approved, the slump of a given concrete mix may be increased above the values shown in Table 8 using chemical admixtures, provided that the admixture-treated concrete has the same or lower water-cement or water-cementitious-material ratio and does not exhibit segregation or excessive bleeding. Request approval for the mix design sufficiently in advance for proper evaluation by the Engineer.

Table 8
Slump Requirements

Concrete Designation	Recommended Design and Placement Slump, in.	Maximum Acceptable Placement Slump, in.
Drilled shafts	See Item 416	See Item 416
Thin walled section (9 in. or less)	4	6-1/2
Approach slabs, concrete overlays, caps, columns, piers, wall sections (over 9 in.)	3	5
Bridge slabs	4	5-1/2
Prestressed concrete members[1]	4	6-1/2
Concrete traffic barrier, concrete bridge railing	4	6-1/2
Dense concrete overlay	3/4	2
Latex-modified conc. for bridge deck overlays	3	7-1/2
Concrete placed underwater	6	8-1/2
Concrete pavement (slipformed)	1-1/2	3
Concrete pavement (formed)	4	6-1/2
Riprap, curb, gutter, slipformed, and extruded concrete	As approved	As approved

1. If a high-range water reducer (HRWR) is used, maximum acceptable placement slump will be 9 in.

6. Mix Design Options. For structural concrete identified in Table 5 and any other class of concrete designed using more than 520 lb. of cementitious material per cubic yard, use one of the mix design Options 1.8 shown below.

For concrete classes not identified as structural concrete and designed using less than 520 lb. of cementitious material per cubic yard, use one of the mix design Options 1.8 shown in Table 5, except that Class C fly ash may be used instead of Class F fly ash for Options 1, 3, and 4 unless sulfate-resistant concrete is required.

a. Option 1. Replace 20 to 35% of the cement with Class F fly ash.
b. Option 2. Replace 35 to 50% of the cement with GGBFS.
c. Option 3. Replace 35 to 50% of the cement with a combination of Class F fly ash, GGBFS, or silica fume. However, no more than 35% may be fly ash, and no more than 10% may be silica fume.
d. Option 4. Use Type IP or Type IS cement. (Up to 10% of a Type IP or Type IS cement may be replaced with Class F fly ash, GGBFS, or silica fume.)
e. Option 5. Replace 35 to 50% of the cement with a combination of Class C fly ash and at least 6% of silica fume, UFFA, or metakaolin. However, no more than 35% may be Class C fly ash, and no more than 10% may be silica fume.
f. Option 6. Use a lithium nitrate admixture at a minimum dosage of 0.55 gal. of 30% lithium nitrate solution per pound of alkalis present in the hydraulic cement.
g. Option 7. When using hydraulic cement only, ensure that the total alkali contribution from the cement in the concrete does not exceed 4.00 lb. per cubic yard. of concrete when calculated as follows:

$$\text{lb. alkali per cu. yd.} = \frac{(\text{lb. cement per cu. yd.}) \times (\%\ Na_2O \text{ equivalent in cement})}{100}$$

In the above calculation, use the maximum cement alkali content reported on the cement mill certificate.
h. Option 8. For any deviations from Options 1.7, perform the following:

• Test both coarse and fine aggregate separately in accordance with ASTM C 1260, using 440 g of the proposed cementitious material in the same proportions of hydraulic cement to supplementary cementing material to be used in the mix.
• Before use of the mix, provide the certified test report signed and sealed by a licensed professional engineer demonstrating that the ASTM C 1260 test result for each aggregate does not exceed 0.10% expansion.
B. Trial Batches. Perform all preliminary trial batches and testing necessary to substantiate the proposed mix designs, and provide documentation including mix design, material proportions, and test results substantiating that the mix design conforms to specification requirements.
Make all final trial batches using the proposed ingredients in a mixer that is representative of the mixers to be used on the job. Make the batch size at least 50% of the mixer's rated capacity. Perform fresh concrete tests for air and slump, and make, cure, and test strength specimens for compliance with specification requirements. Test at least 3 sets of design strength specimens with 2 specimens per set in accordance with Tex-418-A or Tex-448-A for each test age. Before placing, provide the Engineer the option of witnessing final trial batches, including the testing of the concrete. If not provided this option, the Engineer may require additional trial batches, including testing, before the concrete is placed.
Establish 7-day compressive strength target values using the following formula for each concrete mix to be used:

$$\text{Target value} = \text{Minimum design strength} \times \frac{\text{7 - day avg. trial batch strength}}{\text{28 - day avg. trial batch strength}}$$

When there are changes in aggregates or in type, brand, or source of cement, SCM, or chemical admixtures, reevaluate the mix as a new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, new trial batches may be waived by the Engineer.
When the maturity method is specified or permitted, establish the strength-maturity relationship in accordance with Tex-426-A. When using the maturity method any changes in any of the ingredients, including changes in proportions, will require the development of a new strength-maturity relationship for the mix.
C. Storage of Materials.
1. Cement, Supplementary Cementing Materials, and Mineral Filler. Store all cement, supplementary cementing materials, and mineral filler in weatherproof enclosures that will protect them from dampness or absorption of moisture.

When permitted, small quantities of sacked cement may be stored in the open, on a raised platform, and under waterproof covering for up to 48 hours.

2. Aggregates. Handle and store concrete aggregates in a manner that prevents contamination with foreign materials. If the aggregates are stored on the ground, clear the sites for the stockpiles of all vegetation, level the sites, and do not use the bottom 6-in. layer of aggregate without cleaning the aggregate before use.

When conditions require the use of 2 or more grades of coarse aggregates, maintain separate stockpiles and prevent intermixing. Where space is limited, separate the stockpiles using physical barriers. Store aggregates from different sources in different stockpiles unless the Engineer authorizes pre-blending of the aggregates. Minimize segregation in stockpiles. Remix and test stockpiles when segregation is apparent.

Sprinkle stockpiles to control moisture and temperature as necessary. Maintain reasonably uniform moisture content in aggregate stockpiles.

3. Admixtures. Store admixtures in accordance with manufacturer's recommendations and prevent admixtures from freezing.

D. Measurement of Materials. Except for volumetric mixers, measure concrete materials by weight.

Measure mixing water, consisting of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures, by volume or weight. Measure ice by weight. Measure cement and supplementary cementing materials in a weigh hopper and on a separate scale from those used for other materials. Measure the cement first when measuring the cumulative weight. Measure concrete chemical admixtures in powdered form by weight.

Measure concrete chemical admixtures in liquid form by weight or volume. Measure batch materials within the tolerances of Table 9.

Table 9
Measurement Tolerances . Non-Volumetric Mixers

Material	Tolerance (%)
Cement, wt.	±1
Mineral admixture, wt.	±1
Cement + SCM (cumulative weighing), wt.	±1
Water, wt. or volume	±3
Fine aggregate, wt.	±2
Coarse aggregate, wt.	±2
Fine + coarse aggregate (cumulative weighing), wt.	±1
Chemical admixtures, wt. or volume	±3

When measuring cementitious materials at less than 30% of scale capacity, ensure that the quantity measured is accurate to not less than the required amount and not more than 4% in excess. When measuring aggregates in a cumulative weigh batcher at less than 30% of the scale capacity, ensure that the cumulative quantity is measured accurate to ±0.3% of scale capacity or ±3% of the required cumulative weight, whichever is less.

For volumetric mixers, base tolerances on volume-weight relationship established by calibration, and measure the various ingredients within the tolerances of Table 10.

Correct batch weight measurements for moisture.

When approved, under special circumstances, measure cement in bags of standard weight. Weighing of sacked cement is not required. Do not use fractional bags except for small hand-mixed batches of approximately 5 cu. ft. or less and when an approved method of volumetric or weight measurement is used.

Table 10
Measurement Tolerances . Volumetric Mixers

Material	Tolerance
Cement, wt. % 0 to	+4
SCM, wt. % 0 to	+4
Fine aggregate, wt. %	±2
Coarse aggregate, wt. %	±2

Admixtures, wt. or volume %	±3
Water, wt. or volume %	±1

E. Mixing and Delivering Concrete. Mix and deliver concrete by means of one of the following operations:

- central-mixed,
- shrink-mixed,
- truck-mixed,
- volumetric mixer-mixed, or
- hand-mixed.

Operate mixers and agitators within the limits of the rated capacity and speed of rotation for mixing and agitation as designated by the manufacturer of the equipment.

For shrink-mixed and truck-mixed concrete, when there is a reason to suspect the uniformity of concrete delivered using a truck mixer or truck agitator, conduct slump tests of 2 individual samples taken after discharging approximately 15% and 85% of the load as a quick check of the probable degree of uniformity. Take the 2 samples within an elapsed time of at most 15 min. If the slumps of the 2 samples differ by more than the values shown in Table 11, investigate the causes and take corrective actions including adjusting the batching sequence at the plant and the mixing time and number of revolutions. Delivery vehicles that fail to meet the mixing uniformity requirements must not be used until the condition is corrected.

Table 11
Slump Tolerance[1]

Average Slump	Slump Tolerance[2]
4 in. or less	1.0 in.
4 to 6 in.	1.5 in.

1. Do not apply these tolerances to the required slumps in Table 8.
2. Maximum permissible difference in results of test of samples from 2 locations in the concrete batch.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Do not add water after the introduction of mixing water at the batch plant except on arrival at the job site, with approval, to adjust the slump of the concrete. When this water is added, do not exceed the mix design water-cementitious-material ratio. Turn the drum or blades at least 30 additional revolutions at mixing speed to ensure thorough and uniform mixing of the concrete.

Do not add water or chemical admixtures to the batch after any concrete has been discharged. Maintain concrete delivery and placement rates sufficient to prevent cold joints.

Before unloading, furnish the delivery ticket for the batch of concrete containing the information required on Department Form 596, .Concrete Batch Ticket..

When the concrete contains silica fume, adjust mixing times and batching operations as necessary to ensure the material is completely and uniformly dispersed in the mix. The dispersion of the silica fume within the mix will be verified by the Construction Division, Materials and Pavements Section, using cylinders made from trial batches. If uniform dispersion is not achieved, make necessary changes to the batching operations until uniform and complete dispersion of the silica fume is achieved.

1. Central-Mixed Concrete. Provide concrete that is mixed completely in a stationary mixer. Mix concrete for a period of 1 min. for 1 cu. yd. and 15 sec. for each additional cu. yd. of rated capacity of the mixer unless mixer performance test data demonstrate that shorter mixing times can be used to obtain a uniform mix in accordance with Tex-472-A. Count the mixing time from the time all the solid materials are in the drum. Charge the mixer so that some water will enter before the cement and aggregate. Ensure that all water is in the drum by the end of the first 1/4 of the specified mixing time. Adjust the mixing time if necessary to achieve a uniform mix. Concrete mixed completely in a stationary mixer must be delivered to the project in a truck mixer, truck agitator, or non-agitating delivery vehicle. When a truck mixer or truck agitator is used for transporting concrete, use the manufacturer's designated agitating speed for any turning during transportation. Non-agitating delivery vehicles must be clean and free of built-up concrete with adequate means to control concrete discharge. Deliver the concrete to the project in a thoroughly mixed and uniform mass, and discharge the concrete with a satisfactory degree of uniformity.

Resolve questions regarding the uniformity of the concrete by testing when directed by the Engineer in accordance with Tex-472-A.

2. Shrink-Mixed Concrete. Provide concrete that is first partially mixed in a stationary mixer and then mixed completely in a truck mixer. Partially mix for the minimum time required to intermingle the ingredients in the stationary mixer, and then transfer to a truck mixer and mix the concrete at the manufacturer's designated mixing speed for an adequate amount of time to produce thoroughly mixed concrete. Deliver the concrete to the project in a thoroughly mixed and uniform mass, and discharge the concrete with a satisfactory degree of uniformity.

3. Truck-Mixed Concrete. Mix the concrete in a truck mixer from 70 to 100 revolutions at the mixing speed designated by the manufacturer to produce a uniform concrete mix. Deliver the concrete to the project in a thoroughly mixed and uniform mass and discharge the concrete with a satisfactory degree of uniformity. Additional mixing at the job site at the mixing speed designated by the manufacturer is allowed as long as concrete is discharged before the drum has revolved a total of 300 revolutions after the introduction of the mixing water to the cement and the aggregates.

4. Volumetric Mixer-Mixed Concrete. Unless otherwise specified or permitted, perform all mixing operations in accordance with manufacturer's recommended procedures. Provide an accurate method of measuring all ingredients by volume, and calibrate equipment to assure correct measurement of materials within the specified tolerances.

5. Hand-Mixed Concrete. When permitted, for small placements of less than 2 cu. yd., mix up to a 2-sack batch of concrete by hand methods or in a small motor-driven mixer. For such placements, proportion the mix by volume or weight.

F. Placing, Finishing, and Curing Concrete. Place, finish, and cure concrete in accordance with the pertinent Items.

G. Sampling and Testing of Concrete. Unless otherwise specified, all fresh and hardened concrete is subject to testing as follows:

1. Sampling Fresh Concrete. Provide all material to be tested. Fresh concrete will be sampled for testing at the discharge end if using belt conveyors or pumps. When it is impractical to sample at the discharge end, a sample will be taken at the time of discharge from the delivery equipment and correlation testing will be performed and documented to ensure specification requirements are met at the discharge end.

2. Testing of Fresh Concrete.

a. Air Content. Tex-414-A or Tex-416-A.

b. Slump. Tex-415-A.

c. Temperature. Tex-422-A.

d. Making and Curing Strength Specimens. Tex-447-A.

3. Testing of Hardened Concrete. Only compressive strength testing will be used unless otherwise specified or shown on the plans.

a. Compressive Strength. Tex-418-A.

b. Flexural Strength. Tex-448-A.

c. Maturity. Tex-426-a.

4. Certification of Testing Personnel. Contractor personnel performing testing must be either ACI certified or qualified by a Department-recognized equivalent written and performance testing program for the tests being performed. Personnel performing these tests are subject to Department approval. Use of a commercial laboratory is permitted. All personnel performing testing using the maturity method must be qualified by a training program recognized by the Department before using this method on the job.

5. Adequacy and Acceptance of Concrete. The Engineer will sample and test the fresh and hardened concrete for acceptance. The test results will be reported to the Contractor and the concrete supplier. For any concrete that fails to meet the required strengths as outlined below, investigate the quality of the materials, the concrete production operations, and other possible problem areas to determine the cause. Take necessary actions to correct the problem including redesign of the concrete mix. The Engineer may suspend all concrete operations under the pertinent Items if the Contractor is unable to identify, document, and correct the cause of the low strengths in a timely manner. Resume concrete operations only after obtaining approval for any proposed corrective actions.

a. Structural Concrete. For concrete classes identified as structural concrete in Table 5, the Engineer will make and test 7-day and 28-day specimens. Acceptance will be based on the design strength given in Table 5.

The Engineer will evaluate the adequacy of the concrete by comparing 7-day test results to the target value established in accordance with Section 421.4.B, .Trial Batches..

b. All Other Concrete. For concrete classes not identified as structural concrete in Table 5, the Engineer will make and test 7-day specimens. The Engineer will base acceptance on the 7-day target value established in accordance with Section 421.4.B, "Trial Batches".

6. Test Sample Handling. Unless otherwise shown on the plans or directed, remove forms and deliver department test specimens to curing facilities, in accordance with pertinent test procedures. Clean and prepare forms for reuse.

421.5. Measurement and Payment. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

ITEM 427
SURFACE FINISHES FOR CONCRETE

427.1. Description. Finish concrete surface as specified.

427.2. Materials. Furnish materials in accordance with this Article for the type of surface finish specified.

A. Coatings.

1. Adhesive Grout and Concrete Paint. Provide coatings in accordance with DMS-8110, "Coatings for Concrete." Match color of coating with Federal Standard 595B color 35630, concrete gray, unless otherwise shown on the plans.

2. Opaque Sealer. Provide penetrating-type sealer in accordance with DMS-8110, "Coatings for Concrete." Match color of coating with Federal Standard 595B color 35630, concrete gray, unless otherwise shown on the plans.

3. 742 Appearance Coating. Provide #742 gray appearance coating (Federal Standard 595B color 35630) in accordance with DMS-8100, "Structural Steel Paints-Formula."

4. Epoxy Paint. Provide Type X epoxy coating in accordance with DMS-6100, "Epoxies and Adhesives."

B. Exposed Aggregate Finish. Provide approved aggregates meeting the grading requirements shown on the plans. Unless otherwise shown on the plans, provide gravel consisting of predominantly rounded particles. When a bush-hammered finish is desired, use crushed stone. Provide a concrete surface retardant. Provide clear acrylic resin sealer in accordance with DMS-8110, "Coatings for Concrete," or clear Type II permanent anti-graffiti coating in accordance with DMS-8111, "Anti-Graffiti Coatings."

427.3. Equipment. The Engineer may require demonstration of the equipment's capabilities.

A. Low-Pressure Water Blasting. Use equipment capable of supplying a minimum pressure at the nozzle end of 3,000 psi at a minimum flow rate of 3 gpm. Use a 0° rotary, vibratory, or wobble-type nozzle. Use equipment capable of including abrasives in the water stream when specified on the plans.

B. Abrasive Blasting. Use equipment equipped with filters to produce oil-free air and also water-free air when dry air is required.

C. Slurry Blasting. Use equipment capable of combining air and abrasives with water to form a wet blast media capable of cleaning and preparing surface without creating dust.

D. Spraying. For spray applications, use equipment with fluid and air pressure regulators and gauges to allow for adjustment to produce a uniform spray pattern.

E. Off-the-Form Finish Forms. Use nonstaining, nonporous, high-quality forming materials (e.g., steel or medium-density and high-density overlaid plywood forms). Use steel or high-density overlaid plywood forms when the same form will be used more than twice.

F. Form Liners. Provide form liners capable of producing a patterned finish as shown on the plans. Use form liners that provide a clean release from the concrete surface without pulling or breaking the textured concrete.

427.4. Construction. Provide the finish specified on the plans for the specific surface areas.

A. Surface Areas of Finish. "Surface area of finish" designates the areas where the specified surface is to be applied.

1. Surface Area I. Surface Area I includes:

- surfaces of railing;
- exterior vertical faces of fascia beams, slabs, slab spans, arches, and box girders;
- the outside bottom surface of fascia beams and girders;
- the underside of overhanging slabs to the point of juncture of the supporting beam;
- the entire underside of slab spans when shown on the plans;
- vertical and underside surfaces of bents and piers;
- all surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and embankment is placed; and
- all other exposed surfaces shown in the plans to require surface treatment.

2. Surface Area II. Surface Area II includes surfaces of railing, all wingwalls, and the exterior

vertical faces of slabs.

3. Surface Area III. Surface Area III includes only the top and roadway faces of all concrete railing and bridge wingwalls.

4. Surface Area IV. Surface Area IV includes areas designated on the plans.

B. Surface Finishes. Apply the coating or special finish from Table 1 as specified on the plans.

Table 1
Surface Finishes

Coatings	Special Surface Finishes
Adhesive grout	Blast
Concrete paint	Rub
Opaque sealer	Off-the-form
742 appearance coating	Form liner
Epoxy paint	Exposed aggregate

1. Application of Coatings.

a. Preparation. Before applying a coating, thoroughly clean the surface by chemical cleaning, if required, and by blast cleaning.

(1) Chemical Cleaning. Clean surfaces contaminated with oil, grease, or other contaminants by scrubbing the area with an approved detergent or other concrete cleaning material before blast cleaning. Do not use a solvent that will stain the surface or inhibit coating adhesion. Perform the following test to check for surface contamination of oil type materials:

- Spray the surface with a fine mist of potable water.
- Examine the area to see if water beads up.
- If beading is found, clean the surface.

(2) Blast Cleaning. Before applying a specified coating, blast-clean the designated surface to remove weak surface material, curing compound, and other contaminants, leaving a lightly etched uniformly textured surface. Use an approved abrasive propelled by oil-free air with or without the addition of potable water, or blast with potable water with or without the addition of an approved abrasive at sufficient pressure to effectively clean and prepare the surface. When water-blasting, maintain the stand-off-distance of the nozzle to a maximum of 12 in. from the surface being cleaned.

Do not damage concrete surface by gouging, spalling, or exposing coarse aggregate by the blasting operation.

Immediately before application of any coating, blow clean oil- and moisture-free air on all surfaces with sufficient pressure to remove loose particles.

Perform the following test to check for surface cleanliness as directed:

- Press a 10 in. long strip of 2 in. wide clear packing tape on the surface by rubbing with moderate pressure times.
- Grasp the free end of the tape, and remove the tape from the surface with a sharp jerk.
- Examine the surface of the tape for clinging particles.

Continue cleaning the concrete surface until there are no particles clinging to the tape surface for subsequent tests. An additional test that can be used to check the surface for dust is to wipe the surface with a dark cloth and then examine the cloth for discoloration.

b. Application. Mix coating materials thoroughly with a mechanical mixer at a speed that

causes the mixture to rotate entirely in the container. Ensure complete mixing by probing the container with a stirring device searching for non-dispersed or settled material.

Do not apply coatings before the new concrete aging a minimum of 28 days unless approved otherwise. Do not apply coatings when weather conditions will be detrimental to the final surface finish as determined by the Engineer. Do not apply coatings when surface temperature of the concrete exceeds 110°F.

Apply coatings to obtain a consistent color and texture.

(1) Adhesive Grout. Apply coating on a moistened surface to a uniform minimum thickness of 1/16 in. Do not apply when ambient temperature is less than 50°F.

(2) Concrete Paint. Apply the coating on a dry surface in 2 coats for a total maximum application rate of 150 sq. ft. per gallon. Match the color of the applied coating with the color standard shown on the plans. Do not thin material unless approved. Apply when ambient temperature is between 50°F and 100°F.

(3) Opaque Sealer. Apply the coating to a dry surface in 2 coats for a total maximum application rate of 200 sq. ft. per gallon. Match the color of the applied coating with the approved color standard shown on the plans. Do not thin the material unless approved.

Apply when ambient temperature is between 40°F and 95°F.

(4) 742 Appearance Coating. Apply the coating on a dry surface at a rate of at most 400 sq. ft. per gallon. Apply when ambient temperature is above 40°F.

(5) Epoxy Paint. Apply the coating on a dry surface at a maximum application rate of 100 sq. ft. per gallon. Apply when ambient temperature is above 50°F.

Repair surface finish where coating has been applied that exhibits peeling, flaking, or discoloration or that has been damaged during construction. Remove defective or damaged coating. Clean and recoat repair area in accordance with the requirements of this Item.

2. Special Surface Finishes. Submit a work plan to the Engineer for any special finish shown on the plans. Include in the work plan the type of aggregates, materials, variation of panel or pattern arrangement, dimensions, construction methods, and other features affecting the work as is necessary for the "Special Surface Finish" specified.

a. Blast Finish. Provide surface profile as shown in the plans, or meet the minimum requirements of Section 427.4.B.1.a, "Preparation." Construct a 4-ft. by 4-ft. sample panel using the same concrete used in construction of the member to receive the blast finish.

Prepare the surface of the sample panel to meet the specified finish, and obtain approval of the sample finish. Use the approved sample panel finish as the standard for surfaces requiring a blast finish.

b. Rub Finish. Provide a finish to the surface by rubbing the surface with a carborundum stone or other approved material. Begin rubbing the surface immediately after forms have been removed. If rubbing surface is delayed to the point where the surface is dry and unable to be rubbed to produce an acceptable finish, provide blast finish or other finish as directed at no additional cost to the Department. Perform the requirements to obtain the ordinary surface finish specified in Section 420.4.M, "Ordinary Surface Finish," concurrently with rubbing the surface. Where concrete patching is performed, rub these areas after the patch material has thoroughly set and blend the patch in with the surrounding area to produce a surface with uniform color and texture.

After form removal, keep the surface continuously wet until the rubbing is complete. Rub the surface sufficiently to bring the wetted concrete surface to a paste producing a smooth dense surface without pits, form marks, or other irregularities. Do not use cement grout to form the paste on the surface. Stripe the surface with a brush to conceal the rubbing pattern and allow the paste to reset. Wash the concrete with potable water after the paste has sufficiently set to leave it with a neat and uniform appearance and texture. If required, apply membrane curing in accordance with Item 420, "Concrete Structures," after rubbing is complete.

c. Off-the-Form Finish. Provide a finish with minimal surface defects and uniform color and texture by using non-staining, non-porous, high-quality forming materials. Use the same type of forming materials for like elements for the entire structure.

Use mortar-tight forms to prevent leakage and discoloration. If necessary, seal joints with

compressible gasket material, caulk, tape or by other suitable means that are not detrimental to the concrete finish. Use one brand and type of form release agents for all surfaces unless another product produces a similar concrete surface appearance. Do not use barrier-type (wax, fuel oil, carrier oil, etc.) release agents. Use form release agents containing a rust inhibitor on steel forms. Clean rust off steel forms before use. Do not use plywood that will cause discoloration of the concrete surface.

Direct special attention to consolidation and vibration of the concrete around the form surfaces to minimize bug holes. Modify concrete placement and vibration techniques if surface contains an excessive amount of bug holes. Remove all forms without interruption
once form removal begins to prevent discoloration due to differing form curing times. Do not use membrane curing on surfaces with off-the-form finish.
Repair honeycombed and spall areas with least dimension larger than 2 in. in accordance with the concrete surface repair procedures outlined in Item 420, “Concrete Structures,” to obtain an ordinary surface finish as defined in Section 420.4.M, “Ordinary Surface Finish.” For honeycombed and spall areas with least dimension greater than 3/4 in. but smaller than 2 in., patch by filling defect with repair material omitting the chipping operation. Do not patch honeycombed and spall areas with least dimension smaller than 3/4 in. Perform required repairs as soon as forms are removed. Match repair material color and texture with surrounding concrete surfaces. Minimize the area of repair by not smearing the repair material over acceptable concrete surfaces in an attempt to blend the repair with the surrounding concrete. Cut out form ties at least 1/2 in. below the surface, and patch accordingly. Perform repair work as soon as possible after removing forms so that concrete and repair material have similar ages. Replace or refurbish the forms when the Engineer determines that defective formwork is causing an excessive amount of repair work.

d. Form Liner Finish. Provide patterned finish as shown on the plans. Do not splice form liner panels in a way that causes a noticeable transition or line between pieces. Wash and clean form liners after each use when the forms can be re-used. Replace form liners that have become damaged or worn.
Construct a sample panel for each form liner finish. Approval is required to verify that the
sample panel meets the requirements of the plans and specifications before beginning work.
Upon approval, the sample panel becomes the model panel that all other work will be compared against. Deviation in color, grade, or depth from the model panel is grounds for rejection of the form liner finish. Removal of defective work may be necessary as determined by the Engineer and in accordance with the surface finish requirements outlined in Item 420, “Concrete Structures,” to obtain an ordinary surface finish as defined in Section 420.4.M, “Ordinary Surface Finish.”
Seal all form liner joints in a manner acceptable to the Engineer to prevent leakage at the surface.

e. Exposed Aggregate Finish. Provide exposed aggregate finish as indicated on the plans.
Provide a depth of finish between 3/8 in. and 1/2 in. unless directed otherwise.
Apply a concrete surface retarder that penetrates approximately 1/4 in. into the forms or concrete surface to help achieve the desired finish. Apply 2 or 3 coats to wood forms to account for absorption if necessary. Tape or caulk form joints to prevent escape of the retarder during the placing operations. Protect the form surfaces from sun and rain while exposed to the atmosphere. Re-treat form surfaces with retarder if disturbed. Protect adjacent areas of concrete not requiring exposed aggregate finish from the retarder.
Remove forms 12 to 15 hr. after concrete placement but not before concrete has gained sufficient strength to support the self-weight of the member unless directed otherwise.
Expose the aggregate for the finish immediately after form removal. Remove the grout paste covering the aggregate to be exposed by an approved method. Do not loosen the aggregate by the grout removal operation. Maintain required curing on all surfaces except for the time while the aggregate is being exposed. Cure using wet mats or membrane after the aggregate is exposed.
Repair defective areas as determined by the Engineer.
Re-clean exposed aggregate surfaces by an approved method. Apply a coat of acrylic resin sealer or clear Type II permanent anti-graffiti coating to cleaned exposed aggregate surface.
Apply a single coat or multiple coats for a total maximum application rate of 250 sq. ft. per gallon.

427.5. Measurement. When surface finishes for concrete is shown on the plans to be a pay item, measurement will be by the square foot of the type of surface finish specified.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2, "Plans Quantity Measurement." Additional measurement or calculations will be made if adjustments of quantities are required.

427.6. Payment. Unless otherwise specified on the plans, the work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly, but will be considered subsidiary to pertinent Items.

When a surface finish for concrete is specified as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adhesive Grout Finish," "Concrete Paint Finish," "Opaque Sealer Finish," "742 Appearance Coating Finish," "Epoxy Paint Finish," "Blast Finish," or "Rub Finish." This price is full compensation for materials; cleaning and preparing surfaces; application of materials; and equipment, labor, tools, and incidentals.

Off-the-form, form liner, or exposed aggregate finishes (including anti-graffiti coating) will not be paid for under this Item but are subsidiary to other pertinent Items.

ITEM 438
CLEANING AND SEALING JOINTS AND CRACKS (RIGID PAVEMENT AND BRIDGE DECKS)

438.1. Description. Clean and seal joints and cracks in new or existing rigid concrete pavements and bridge decks.

438.2. Materials. Use sealants of the class specified on the plans that meet the requirements of DMS-6310, "Joint Sealants and Fillers." If required, use primers recommended by the manufacturer of the sealant. Use backer rods compatible with the sealant that do not react or bond together.

438.3. Equipment. Use equipment that meets sealant manufacturer's recommendations. Use air compressors equipped with appropriate filters for removing oil and water from the air. For grooving cracks, use devices such as diamond-blade random-cut saws or random-crack grinders, capable of following the path of the crack without causing excessive spalling or other damage to the concrete.

438.4. Construction. Before starting work, submit information from the sealant manufacturer showing recommended equipment and installation procedures. All equipment and procedures will be subject to approval. If the equipment causes damage to dowels, reinforcing steel, concrete, base, subbase, or subgrade, repair the damage and change the procedure and equipment to prevent further damage.

A. Preparation. Remove all debris, dirt, dust, saw cuttings, and other foreign material from the crack or joint by an approved method. Collect and dispose of all the removed material.

1. Joints. Remove existing preformed bituminous fiber board material or other spacer material the full depth of the joint along with all other debris in the joint opening. Resize the joint sealant space by sawing to the width and depth shown on the plans to accommodate the type of sealant specified.

On concrete slab and girder bridges, clean debris from the diaphragm windows below the joints.

Abrasive blast clean the vertical faces of joints armored with steel to remove all visible rust, paint, mill scale, and other forms of contamination, leaving a white metal appearance. Clean concrete and other surfaces by method approved and in accordance with the manufacturer's specifications before placing sealant. After cleaning, air-blast the joint to remove all dust.

2. Cracks. Unless otherwise specified, groove the crack at the surface so that a reservoir with a rectangular cross section is provided for the sealant. Cut grooves to the dimensions shown on the plans.

B. Sealing. Place the sealant in accordance with the manufacturer's recommended procedures. Apply the primer, when required, at the specified rate and time interval before applying the sealant. Apply the sealant to dry joint and crack surfaces unless otherwise recommended by the sealant manufacturer. Tool any sealant material that is not self-leveling to force the sealant against the joint surfaces.

1. Joints. For concrete pavement, place approved support spacers into joints as shown on the plans. Place a backer rod in the joint opening to prevent the sealant from flowing through the joint and to hold the sealant at its required elevation unless directed otherwise. Set the top of the sealant and thickness of sealant as shown on the plans. Do not place sealant in an expansion-type joint if surface temperature is below 55°F or above 90°F.

2. Cracks. Do not place the sealant when the surface temperature is less than 40°F. Set the top of the sealant 1/8 in. to 1/4 in. below the pavement surface, with a minimum depth of sealant of 1/2 in. unless otherwise recommended by the sealant manufacturer.

438.5. Measurement. When specified on the plans to be a pay item, this Item will be measured by the foot or gallon of sealant placed. If measurement is by the gallon, the volume of sealant placed in the joints and cracks will be measured during progress of work.

438.6. Payment. Unless otherwise specified on the plans, the work performed and materials furnished as required by this Item will not be paid for directly but will be subsidiary to bid items of the Contract.

When shown as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Cleaning and Sealing of Existing Joints," "Cleaning and Sealing Joints," and "Cleaning and Sealing Cracks." This price is full compensation for furnishing all materials; sawing, routing, and cleaning and installing; disposing of debris; and equipment, labor, tools, and incidentals.

ITEM 440

REINFORCING STEEL

440.1. Description. Furnish and place reinforcing steel of the sizes and details shown on the plans.

440.2. Materials.

A. Approved Mills. Before furnishing steel, producing mills of reinforcing steel for the Department must be pre-approved in accordance with DMS-7320, .Qualification Procedure for Reinforcing Steel Mills,.

by the Construction Division, which maintains a list of approved producing mills. Reinforcing steel obtained from unapproved sources will not be accepted.

B. Deformed Bar and Wire Reinforcement. Unless otherwise shown on the plans, reinforcing steel must be Grade 60, and bar reinforcement must be deformed. Reinforcing steel must conform to one of the following:

- ASTM A 615, Grades 40 or 60;
- ASTM A 996, Type A, Grades 40 or 60;
- ASTM A 996, Type R, Grade 60, permitted in concrete pavement only (Furnish ASTM A 996, Type R bars as straight bars only and do not bend them. Bend tests are not required.); or
- ASTM A 706.

The provisions of this Item take precedence over ASTM provisions.

The nominal size, area, and weight of reinforcing steel bars covered by this Item are shown in Table 1.

Designate smooth bars up to No. 4 by size number and above No. 4 by diameter in inches.

Table 1

Size, Area, and Weight of Reinforcing Steel Bars

Bar Size Number (in.)	Bar Size Number (mm)	Diameter (in.)	Area (Sq.in)	Weight per Ft.
3	10	0.375	0.11	0.376
4	13	0.500	0.20	0.668
5	16	0.625	0.31	1.043
6	19	0.750	0.44	1.502
7	22	0.875	0.60	2.044
8	25	1.000	0.79	2.670
9	29	1.128	1.00	3.400
10	32	1.270	1.27	4.303
11	36	1.410	1.56	5.313
14	43	1.693	2.25	7.650
18	57	2.257	4.00	13.60

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

C. Smooth Bar and Spiral Reinforcement. Smooth bars and dowels for concrete pavement must have a minimum yield strength of 60 ksi and meet ASTM A 615. For smooth bars that are larger than No. 3, provide steel conforming to ASTM A 615 or meet the physical requirements of ASTM A 36.

Spiral reinforcement may be smooth or deformed bars or wire of the minimum size or gauge shown on the plans. Bars for spiral reinforcement must comply with ASTM A 615, Grade 40; ASTM A 996,

Type A, Grade 40; or ASTM A 675, Grade 80, meeting dimensional requirements of ASTM A 615.

Smooth wire must comply with ASTM A 82, and deformed wire must comply with ASTM A 496.

D. Weldable Reinforcing Steel. Reinforcing steel to be welded must comply with ASTM A 706 or have a carbon equivalent (C.E.) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish C.E. is required for reinforcing steel that does not meet ASTM A 706to be structurally welded. These requirements do not

pertain to miscellaneous welds on reinforcing steel as defined in Section 448.4.B.1.a, "Miscellaneous Welding Applications."
Calculate C.E. using the following formula:

$$C.E. = \%C + \frac{\%Mn}{6} + \frac{\%Cu}{40} + \frac{\%Ni}{20} + \frac{\%Cr}{10} - \frac{\%Mo}{50} - \frac{\%V}{10}$$

E. Welded Wire Fabric. For fabric reinforcement, use wire that conforms to ASTM A 82 or A 496. Use wire fabric that conforms to ASTM A 185 or A 497. Observe the relations shown in Table 2 among size number, diameter in inches, and area when ordering wire by size numbers, unless otherwise specified. Precede the size number for deformed wire with "D" and for smooth wire with "W".
Designate welded wire fabric as shown in the following example: 6 × 12 . W16 × W8 (indicating 6-in. longitudinal wire spacing and 12-in. transverse wire spacing with smooth No. 16 wire longitudinally and smooth No. 8 wire transversely).

Table 2
Wire Size Number, Diameter, and Area

Size Number (in.) (in.)	Size Number (mm)	Diameter (in.)	Area (sq. in.)
31	200	0.628	0.310
30	194	0.618	0.300
28	181	0.597	0.280
26	168	0.575	0.260
24	155	0.553	0.240
22	142	0.529	0.220
20	129	0.505	0.200
18	116	0.479	0.180
16	103	0.451	0.160
14	90	0.422	0.140
12	77	0.391	0.120
10	65	0.357	0.100
8	52	0.319	0.080
7	45	0.299	0.070
6	39	0.276	0.060
5.5	35	0.265	0.055
5	32	0.252	0.050
4.5	29	0.239	0.045
4	26	0.226	0.040
3.5	23	0.211	0.035
2.9	19	0.192	0.035
2.5	16	0.178	0.025
2	13	0.160	0.020
1.4	9	0.134	0.014
1.2	8	0.124	0.012
0.5	3	0.080	0.005

Note: Size numbers (in.) are the nominal cross-sectional area of the wire in hundredths of a square inch. Size numbers (mm) are the nominal cross-sectional area of the wire in square millimeters. Fractional sizes between the sizes listed above are also available and acceptable for use.

F. Epoxy Coating. Epoxy coating will be required as shown on the plans. Before furnishing epoxycoated reinforcing steel, an epoxy applicator must be pre-approved in accordance with DMS-7330, "Qualification Procedure for Reinforcing Steel Epoxy Coating Applicators". The Construction Division maintains a list of approved applicators.
Coat reinforcing steel in accordance with Table 3.

Table 3
Epoxy Coating Requirements for Reinforcing Steel

Material	Specification
Bar	ASTM A 775 or A 934
Wire or fabric	ASTM A 884 Class A or B
Mechanical couplers	As shown on the plans
Hardware	As shown on the plans

Use epoxy coating material and coating repair material that complies with DMS-8130, "Epoxy Powder Coating for Reinforcing Steel". Do not patch more than 1/4 in. total length in any foot at the applicator's plant.

Epoxy-coated reinforcement will be sampled and tested in accordance with Tex-739-I. Maintain identification of all reinforcing throughout the coating and fabrication and until delivery to the project site.

Furnish 1 copy of a written certification that the coated reinforcing steel meets the requirements of this Item and 1 copy of the manufacturer's control tests.

G. Mechanical Couplers. When mechanical splices in reinforcing steel bars are shown on the plans, use the following types of coupler:

- sleeve-filler,
- sleeve-threaded,
- sleeve-swaged, or
- sleeve-wedge.

Furnish only couplers that have been produced by a manufacturer that has been prequalified in accordance with DMS-4510, .Mechanical Couplers.. Sleeve-wedge type couplers will not be permitted on coated reinforcing. Couplers for use on individual projects must be sampled and tested in accordance with DMS-4510. Furnish couplers only at locations shown on the plans.

440.3. Construction.

A. Bending. Cold-bend the reinforcement accurately to the shapes and dimensions shown on the plans. Fabricate in the shop if possible. Field-fabricate, if permitted, using a method approved by the Engineer. Replace improperly fabricated, damaged, or broken bars at no additional expense to the Department. Repair damaged or broken bars embedded in a previous concrete placement using a method approved by the Engineer.

Unless otherwise shown on the plans, the inside diameter of bar bends, in terms of the nominal bar diameter (d), must be as shown in Table 4.

Table 4
Minimum Inside Diameter of Bar Bends

Bend	Bar Size Number (in.)	Bar Size Number (mm)	Diameter
Bends of 90° and greater in stirrups, ties, and other secondary bars that enclose another bar in the bend	3, 4, 5	10, 13, 16	4d
	6, 7, 8	19, 22, 25	6d
Bends in main bars and in secondary bars not covered above	3 through 8	10 through 25	6d
	9, 10, 11	29, 32, 36	8d
	14, 18	43, 57	10d

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

Where bending No. 14 or No. 18 Grade 60 bars is required, bend-test representative specimens as described for smaller bars in the applicable ASTM specification. Make the

required 90° bend around a pin with a diameter of 10 times the nominal diameter of the bar.

B. Tolerances. Fabrication tolerances for bars are shown in Figure 1.

Figure 1
Fabrication tolerances for bars.

C. Storage. Store steel reinforcement above the ground on platforms, skids, or other supports, and protect it from damage and deterioration. Ensure that reinforcement is free from dirt, paint, grease, oil, and other foreign materials when it is placed in the work. Use reinforcement free from defects such as cracks and delaminations. Rust, surface seams, surface irregularities, or mill scale will not be cause for rejection if the minimum cross-sectional area of a hand wire-brushed specimen meets the requirements for the size of steel specified.

D. Splices. Lap-splice, weld-splice, or mechanically splice bars as shown on the plans. Additional splices not shown on the plans will require approval. Splices not shown on the plans will be permitted in slabs 15 in. or less in thickness, columns, walls, and parapets.

- Unless otherwise approved, splices will not be permitted in bars 30 ft. or less in plan length. For bars exceeding 30 ft. in plan length, the distance center-to-center of splices must be at least 30 ft.minus 1 splice length, with no more than 1 individual bar length less than 10 ft. Make lap splicesnot shown on the plans, but otherwise permitted, in accordance with Table 5. Maintain the specified concrete cover and spacing at splices, and place the lap-spliced bars in contact, securely tied together.

Table 5
Minimum Lap Requirements for Bar Sizes through No. 11

Bar Size Number (in.)	Bar Size Number (mm)	Uncoated Lap Length	Coated Lap Length
3	10	1 ft. 4 in.	2 ft. 0 in.
4	13	1 ft. 9 in.	2 ft. 8 in.
5	16	2 ft. 2 in.	3 ft. 3 in.
6	19	2 ft. 7 in.	3 ft. 11 in.
7	22	3 ft. 5 in.	5 ft. 2 in.
8	25	4 ft. 6 in.	6 ft. 9 in.
9	29	5 ft. 8 in.	8 ft. 6 in.
10	32	7 ft. 3 in.	10 ft. 11 in.
11	36	8 ft. 11 in.	13 ft. 5 in.

Note: Bar size numbers (in.) are based on the number of eighths of an inch included in the

nominal diameter of the bar. Bar size numbers (mm) approximate the number of millimeters included in the nominal diameter of the bar.

- Do not lap No. 14 or No. 18 bars.
- Lap spiral steel at least 1 turn.
- Splice welded wire fabric using a lap length that includes the overlap of at least 2 cross wires plus 2 in. on each sheet or roll. Splices using bars that develop equivalent strength and are lapped in accordance with Table 5 are permitted.
- For box culvert extensions with less than 1 ft. of fill, lap the existing longitudinal bars with the new bars as shown in Table 3. For extensions with more than 1 ft. of fill, lap at least 1 ft. 0 in.
- Ensure that welded splices conform to the requirements of the plans and of Item 448, .Structural Field Welding.. Field-prepare ends of reinforcing bars if they will be butt-welded. Delivered bars must be long enough to permit weld preparation.
- Install mechanical coupling devices in accordance with the manufacturer.s recommendations at locations shown on the plans. Protect threaded male or female connections, and make sure the threaded connections are clean when making the connection. Do not repair damaged threads.
- Mechanical coupler alternate equivalent strength arrangements, to be accomplished by substituting larger bar sizes or more bars, will be considered if approved in writing before fabrication of the systems.

E. Placing. Unless otherwise shown on the plans, dimensions shown for reinforcement are to the centers of the bars. Place reinforcement as near as possible to the position shown on the plans. In the plane of the steel parallel to the nearest surface of concrete, bars must not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars must not vary from plan placement by more than 1/4 in. Cover of concrete to the nearest surface of steel must be at least 1 in. unless otherwise shown on the plans.

For bridge slabs, the clear cover tolerance for the top mat of reinforcement is −0, +1/2 in.

Locate the reinforcement accurately in the forms, and hold it firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the proper distance from the forms. Support bars by standard bar supports with plastic tips, approved plastic bar supports, or precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Use bright basic bar supports to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade must be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in. thick and extend
upward on the wire to a point at least 1/2 in. above the formwork.

All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement must be of steel, fully coated with epoxy or plastic. Plastic supports approved by the Engineer may also be used with epoxy-coated reinforcement.

Cast mortar or concrete blocks to uniform dimensions with adequate bearing area. Provide a suitable tie wire in each block for anchoring to the steel. Cast the blocks to the thickness required in approved molds. The surface placed adjacent to the form must be a true plane, free of surface imperfections.

Cure the blocks by covering them with wet burlap or mats for a period of 72 hr. Mortar for blocks
should contain approximately 1 part hydraulic cement to 3 parts sand. Concrete for blocks should
contain 850 lb. of hydraulic cement per cubic yard of concrete.

Place individual bar supports in rows at 4-ft. maximum spacing in each direction. Place continuous type bar supports at 4-ft. maximum spacing. Use continuous bar supports with permanent metal deck forms.

The exposure of the ends of longitudinals, stirrups, and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not cause for rejection.

Tie reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of prestressed box beams at all intersections, except tie only alternate intersections where spacing is less than 1 ft. in each direction. For reinforcing steel cages for other structural members, tie the steel at enough intersections to provide a rigid cage of steel. Fasten mats of wire fabric securely at the ends and edges.

Before concrete placement, clean mortar, mud, dirt, debris, oil, and other foreign material from the reinforcement. Do not place concrete until authorized.

If reinforcement is not adequately supported or tied to resist settlement, reinforcement is floating upward, truss bars are overturning, or movement is detected in any direction during concrete

placement, stop placement until corrective measures are taken.

F. Handling, Placement, and Repair of Epoxy-Coated Reinforcing Steel.

1. Handling. Provide systems for handling coated reinforcement with padded contact areas. Pad bundling bands or use suitable banding to prevent damage to the coating. Lift bundles of coated reinforcement with a strongback, spreader bar, multiple supports, or a platform bridge. Transport the bundled reinforcement carefully, and store it on protective cribbing. Do not drop or drag the coated reinforcement.

2. Construction Methods. Do not flame-cut coated reinforcement. Saw or shear-cut only when approved. Coat cut ends as specified in Section 440.3.F.3, "Repair of Coating".

Do not weld or mechanically couple coated reinforcing steel except where specifically shown on the plans. Remove the epoxy coating at least 6 in. beyond the weld limits before welding and 2 in. beyond the limits of the coupler before assembly. After welding or coupling, clean the steel of oil, grease, moisture, dirt, welding contamination (slag or acid residue), and rust to a near-white finish.

Check the existing epoxy for damage. Remove any damaged or loose epoxy back to sound epoxy coating.

After cleaning, coat the splice area with epoxy repair material to a thickness of 7 to 17 mils after curing. Apply a second application of repair material to the bar and coupler interface to ensure complete sealing of the joint.

3. Repair of Coating. For repair of the coating, use material that complies with the requirements of this Item and ASTM D 3963. Make repairs in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, apply at least the same coating thickness as required for the original coating. Repair all visible damage to the coating.

Repair sawed and sheared ends, cuts, breaks, and other damage promptly before additional oxidation occurs. Clean areas to be repaired to ensure that they are free from surface contaminants.

Make repairs in the shop or in the field as required.

440.4. Measurement and Payment. The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be considered subsidiary to pertinent Items.

ITEM 529
CONCRETE CURB, GUTTER, AND COMBINED CURBAND GUTTER

529.1. Description. Construct hydraulic cement concrete curb, gutter, and combined curb and gutter.

529.2. Materials. Furnish materials conforming to:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

Use Class A concrete or material specified in the plans. Use Grade 8 coarse aggregate for extruded Class A
concrete. Use other grades if approved by the Engineer.

529.3. Construction. Provide finished work with a well-compacted mass and a surface free from voids and honeycomb, in the required shape, line, and grade. Round exposed edges with an edging tool of the radius shown on the plans. Mix, place, and cure concrete in accordance with Item 420, "Concrete Structures." Construct joints at locations shown on the plans. Cure for at least 72 hr.
Furnish and place reinforcing steel in accordance with Item 440, "Reinforcing Steel."
Set and maintain a guideline that conforms to alignment data shown on the plans, with an outline that conforms to the details shown on the plans.

A. Conventionally Formed Concrete. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement.
Pour concrete into forms, and strike off with a template 1/4 to 3/8 in. less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate.
Brush exposed surfaces to a uniform texture.
Place curbs, gutters, and combined curb and gutters in 50-ft. maximum sections unless otherwise approved.

B. Extruded or Slipformed Concrete. Hand-tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment.
The forming tube of the extrusion machine or the form of the slipform machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established gradeline.
Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slipform work and the grade guideline. Other methods may be used when approved.
Finish surfaces immediately after extrusion or slipforming.

529.4. Measurement. This Item will be measured by the foot.

529.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Curb," "Concrete Curb (Mono)," or "Concrete Curb and Gutter" of the type specified. This price is full compensation for surface preparation of base, equipment, labor, materials, tools, and incidentals.

ITEM 531
SIDEWALKS

531.1. Description. Construct hydraulic cement concrete sidewalks.

531.2. Materials. Furnish materials conforming to the following:

- Item 360, "Concrete Pavement"
- Item 420, "Concrete Structures"
- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcing Steel."

Use Class A concrete or other concrete as specified. Use Grade 8 course aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.

531.3. Construction. Shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross-section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Hand-tamp and sprinkle foundation when placement is directly on subgrade or foundation materials. Remove and dispose of existing concrete in accordance with Item 104, "Removing Concrete." Provide a clean surface for concrete placement directly on the surface material or pavement. Mix and place concrete in accordance with the pertinent Items. Handfinishing is allowed for any method of construction. Finish exposed surfaces 531.4 to 531.5 852 to a uniform transverse broom finish surface. Curb ramps must include a detectable warning surface and conform to details shown on the plans. Install joints as shown on the plans. Brush all exposed surfaces to a smooth and uniform surface. Ensure that abrupt changes in sidewalk elevation do not exceed 1/4 inch, sidewalk cross slope does not exceed 2%, curb ramp grade does not exceed 8.3%, and flares adjacent to the ramp do not exceed 10% slope. Where a sidewalk crosses a concrete driveway, ensure that the sidewalk depth and reinforcement are not less than the driveway crosssectional details shown on the plans. Provide finished work with a well-compacted mass, a surface free from voids and honeycomb, and the required true-to-line shape and grade. Cure for at least 72 hr. in accordance with Item 420, "Concrete Structures."

A. Conventionally Formed Concrete. Provide sidewalk sections separated by premold or board joint of the thickness shown on the plans in lengths greater than 8 ft. but less than 40 ft., unless otherwise directed. Terminate workday production at an expansion joint.

B. Extruded or Slipformed Concrete. Provide any additional surface finishing immediately after extrusion or slipforming as required on the plans. Construct joints at locations as shown on the plans or as directed.

531.4. Measurement. Sidewalks will be measured by the foot or by the square yard of surface area. Curb ramps will be measured by each unit. The unit will consist of the curb ramp, landing, adjacent flares or side curb, and detectable warning surface as shown on the plans.

531.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Sidewalks" of the width (for foot measurement) and of the depth specified or "Curb Ramps" of the type specified. This price is full compensation for surface preparation of base; materials; removal and disposal of existing concrete; excavation, hauling and disposal of excavated material; drilling and doweling into existing concrete curb, sidewalk, and pavement; repair of adjacent street or pavement structure damaged by these operations; and equipment, labor, materials, tools, and incidentals. Sidewalks that cross and connect to concrete driveways or turnouts will be measured and paid for in accordance with Item 530, "Intersections, Driveways, and Turnouts."

ADJUSTING MANHOLES CLEANOUTS, INLETS & WATER VALVE RISERS

A. DESCRIPTION. This item shall govern for the furnishing of materials and for adjusting manholes, cleanouts inlets or water valve risers where required by the plans. Manholes, cleanouts, inlets and water valve risers shall be adjusted to position and/or elevation as shown on the plans, or as ordered by the Department of Public Works and the ENGINEER and in accordance with these specifications.

B. MATERIALS. Manhole, cleanout, and inlet covers, water valve risers, and brick in good condition, removed in the process of adjustment, may be re-used. Additional materials needed shall be provided as needed.

Mortar for brick work shall be composed of one part Portland Cement and two parts clean, sharp mortar sand suitably graded for the purpose. Lime may be added to the mix but in no case shall it exceed 10% by weight of the total dry mix.

Concrete for inlets shall be 4000 psi (28 day compressive strength) concrete containing a minimum of 6 sacks of cement per cubic yard.

Reinforcing steel shall be deformed and shall conform to ASTM Designation A-615.

When prefabricated steel extension rings are furnished, the material shall be ASTM A36 or equal.

C. CONSTRUCTION. Existing manholes, cleanouts and water valve risers located within areas of base and sub-base construction shall be located and referenced; covers, and risers shall be removed carefully and stored by the Contractor. Rings, covers, plates, or grates broken in the process of removal and cleaning lost or stolen shall be replaced in kind by the Contractor at his expense. Manholes shall be broken down below subgrade elevation and covered with hatch covers prior to beginning excavation and subgrade preparation. If manholes are to be lowered the brick work shall be removed to a point where the corbell will not exceed 1" per course of brick, in order to obtain the proper diameter at the top for resetting the ring and cover. Upon completion of the flexible base, the manholes, and the water valves shall be located from the reference points and the top portion of the manhole rebuilt, and water valve risers reset so that they will be within ½ inch of the proposed asphalt surfacing.

When manholes are located within pavement areas to be overlaid with hot mix asphaltic concrete, the Contractor may, upon removal of the cast iron ring and adding concrete adjustment rings, provide prefabricated steel extension rings. They shall be either of the one-piece or two-piece type as necessary for the amount of adjustment. They will be installed in accordance with the manufacturer's instructions.

Inlets to be adjusted shall be broken down as necessary and rebuilt to the elevations as shown on the plans.

D. MEASUREMENT & PAYMENT. This item; "ADJUSTING MANHOLES CLEANOUTS, INLETS & WATER VALVE RISERS", will NOT be paid as a separate pay item. This work is considered incidental to the placement of the concrete sidewalk.

DETOUR, BARRICADE AND WARNING SIGNS

The Contractor shall place and maintain in good condition, standard barricades and warning signs at each end of the project and at other locations to maintain the safety of the public and employees in conformance with the Manual on Uniform Traffic Control Devices (MUTCD).

All barricades and signs remaining in place at night and all points of hazard to traffic shall be illuminated by flares, flashers or both, as determined by the Department of Public Works and the ENGINEER.

Upon completion of the work, all signs and evidence thereof shall be removed by the Contractor.

All materials furnished and work performed under these provisions will not be paid for directly, but shall be considered as subsidiary work pertaining to the various bid items of the contract.

No direct payment shall be made to the Contractor for any temporary detours which may be needed during the construction of this project.

GEOGRID BASE REINFORCEMENT

1. Description. Furnish and place geogrid base reinforcement in accordance with the lines and grades shown on the plans or as directed.

2. Materials. Provide geogrid base reinforcement, of the type shown on the plans, meeting the requirements of DMS-6240 "Geogrid for Base/Embankment Reinforcement." Use roll widths and lengths shown on the plans or as approved.

3. Construction. Prepare the subgrade as indicated on the plans or as directed. Set string lines for alignment if directed. Install geogrid in accordance with the lines and grades as shown on the plans. Place base material in lift thicknesses and compact as shown on the plans or as directed. Do not operate tracked construction equipment on the geogrid until a minimum fill cover of 6 in. is achieved. Rubber tire construction equipment may operate directly on the geogrid at speeds of less than 5 mph if the underlying material will support the loads. Where excessive substructure deformation is apparent, correct grid placement operations as recommended by the manufacturer or as directed

A. Geogrid Placement. Orient the geogrid length as unrolled parallel to the direction of roadway. Overlap geogrid sections as shown on the plans or as directed. Use plastic ties at overlap joints or as directed. Placement of geogrid around corners may require cutting and diagonal lapping. Pin geogrid at the beginning of the backfill section as directed. Keep geogrid taut at the beginning of the backfilling section but not restrained from stretching or flattening.

1. Longitudinal Joints. Overlap longitudinal joints by a minimum of 1 ft. Space longitudinal ties 10 ft. to 20 ft. or as directed.

2. Transverse Joints. Overlap transverse joints by a minimum of 1 ft. Space transverse ties 4 ft. to 5 ft. or as directed.

B. Damage Repair. As directed, remove and replace contractor damaged or excessively deformed areas without additional compensation. Lap repair areas a minimum of 3 ft in all directions. Tie each side of repair grid in at least 3 locations but do not exceed normal construction spacing; tie spacing for odd shapes will be as directed. Repair excessively deformed materials underlying the grid as directed.

4. Measurement. Geogrid base reinforcement will be measured by the square yard of roadway placement as shown in the plans with no allowance for overlapping at transverse and longitudinal joints.

5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are paid for at the unit bid price for "Geogrid Base Reinforcement" of the type specified. This price is full compensation for furnishing, preparing, hauling and placing materials including labor, materials, freight, tools, equipment and incidentals.

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