

Reference:

DACW09-90-B-XXXX

S P E C I F I C A T I O N S

for

ARIZONA CANAL DIVERSION CHANNEL

REACH 4

Maricopa County, Arizona

Property of  
Flood Control District of MC Library  
Please Return to  
2801 W. Durango  
Phoenix, AZ 85009

Authority:

Public Law 89-298,  
Flood Control Act of 1965

Appropriation:

Construction General  
Contributed Funds, Other

US Army Corps  
of Engineers

Los Angeles District

FLOOD CONTROL DISTRICT RECEIVED	
JAN 05 1990	
CH ENG	P & PM
DEP	HYDRO
ADMIN	LMGT
FINANCE	FILE
C & D	
ENGR	
REMARKS	

A118.501

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BIDDING SCHEDULE

<u>Item No.</u>	<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Estimated Amount</u>
1.	DIVERSION AND CONTROL OF WATER	1	Job	L.S.	\$ _____
2.	CLEAR SITE AND REMOVING OBSTRUCTIONS	1	Job	L.S.	_____
3.	EXCAVATION	1,690,320	Cu.Yd.	\$ _____	_____
4.	COMPACTED FILL, CHANNEL	476,000	Cu.Yd.	_____	_____
5.	COMPACTED FILL, BACKFILL TOE	3,940	Cu.Yd.	_____	_____
6.	COMPACTED FILL, LEVEE	1,320	Cu.Yd.	_____	_____
7.	COMPACTED FILL, MISCELLANEOUS	43,400	Cu.Yd.	_____	_____
8.	OVERFLOW SPILLWAYS	1	Job	L.S.	_____
9.	CONCRETE, TOP SLAB	27,465	Cu.Yd.	_____	_____
10.	CONCRETE, INVERT	80,570	Cu.Yd.	_____	_____
11.	CONCRETE, WALLS	73,405	Cu.Yd.	_____	_____
12.	CONCRETE, RETAINING WALLS AND CONDUIT HEADWALL	7	Cu.Yd.	_____	_____
13.	COLOR ADMIXTURE FOR CONCRETE	1	Job	L.S.	_____
14.	STEEL REINFORCEMENT	13,450	Ton	_____	_____
15.	ASPHALT CONCRETE PAVING	6,150	Ton	_____	_____
16.	STEEL PICKET FENCE	1	Job	L.S.	_____
17.	SIDE DRAINS	1	Job	L.S.	_____
18.	MISCELLANEOUS HARDWARE	1	Job	L.S.	_____
19.	DRIVEWAY ENTRANCE	1	Job	L.S.	_____

BIDDING SCHEDULE (Cont'd)

20.	STATION MARKINGS	1	Job	L.S.	\$ _____
21.	GAGING STATION	1	Job	L.S.	_____
22.	CONDUITS	1	Job	L.S.	_____
23.	INTAKE BOX	1	Job	L.S.	_____
24.	SHOTCRETE	1	Job	L.S.	_____
25.	MISCELLANEOUS ITEMS OF WORK	1	Job	L.S.	_____
26.	DETOURS AND STREET RECONSTRUCTION	1	Job	L.S.	_____
27.	16TH STREET UNDERPASS RAMPS	1	Job	L.S.	_____
28.	STONE	14,200	Ton	\$ _____	_____
29.	GROUT	3,560	Cu.Yd.	_____	_____
30.	CURB AND GUTTER	19,300	Lin.Ft.	_____	_____
31.	LANDSCAPING	1	Job	L.S.	_____
32.	IRRIGATION	1	Job	L.S.	_____
33.	DRAINAGE SYSTEM	1	Job	L.S.	_____
34.	CONCRETE, DENTAL	500	Cu.Yd.	_____	_____
35.	BILTMORE HOTEL FACILITIES RESTORATION	1	Job	L.S.	_____
36.	35TH STREET SIDE DRAINS	1	Job	L.S.	_____

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TOTAL ESTIMATED AMOUNT: \$ \_\_\_\_\_

NOTES: All extensions of the unit prices shown will be subject to verification by the Government. In case of variation between the unit price and the extension, the unit price will be considered to be the bid.

Amounts and prices shall be indicated in either figures or words, not both.

If a modification to a bid based on unit prices is submitted which provides for a lump sum adjustment to the total estimated amount, the application of the lump sum adjustment to each unit price in the Bidding Schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro-rata basis to every unit price in the Bidding Schedule.

Bids shall be submitted on all items of the Bidding Schedule.

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SPECIAL CLAUSES

Index

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| 1. Commencement, Prosecution, and Completion of Work   | 13. Performance of Work by the Contractor                      |
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| 5. Physical Data                                       | 17. Environmental Litigation                                   |
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| 12. Equipment Ownership and Operating Expense Schedule |  |

1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (1984 APR) FAR 52.212-3. The Contractor shall be required to (a) commence work under this contract within 5 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 630 calendar days after the date of receipt of notice to proceed, except for seeding and planting. Seeding and planting shall be completed as soon as practicable and within the time limits stated in the Technical Provisions or as directed by the Contracting Officer. The time stated for completion shall include final cleanup of the premises.

2. LIQUIDATED DAMAGES-CONSTRUCTION (APR 1984) FAR 52.212-5.

2.1 If the Contractor fails to complete the work within the time(s) specified in the contract, or any extensions, the Contractor shall pay to the Government as liquidated damages, the following sums separately for each day of delay.

2.1.1 Completion of the entire work as specified in paragraph 1, above: \$\_\_\_.

2.2 If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

2.3 If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

3. CONTRACT DRAWINGS AND SPECIFICATIONS. (SEP 1987) DFARS 252.236-7002.

3.1 Ten sets of large scale contract drawings and specifications will be furnished the Contractor without charge except applicable publications incorporated into the technical provisions by reference. Additional sets will

be furnished on request at the cost of reproduction. The work shall conform to the following contract drawings all of which form a part of these specifications and are available in the office of the U.S. Army Engineer District, Los Angeles, 300 North Los Angeles Street, Los Angeles, California.

3.2 The work shall conform to the following contract drawings which form a part of these specifications and are available in the office of the U.S. Army Engineer District, Los Angeles, 300 North Los Angeles Street, Los Angeles, California. The list of drawings set out in the following drawing is hereby incorporated by reference into the contract.

ARIZONA CANAL DIVERSION CHANNEL  
(DREAMY DRAW TO CAVE CREEK)

District File No.

Title

XXX/XXX

Index to Contract Drawings

3.3 Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

3.4 The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

4. SUBMITTALS (ER 415-1-10).

4.1 General. Reference is made to the CONTRACT CLAUSE: SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION. The Contractor shall submit for approval all shop drawings, certificates of compliance, equipment data, and/or material samples called for by these specifications.

4.2 Submittal Register. Within 15 days after receipt of notice to proceed, the Contractor shall complete and submit to the Contracting Officer, in duplicate, Submittal Register, ENG FORM 4288, listing all submittals required under the Contract (including the Contract Clauses, the Special Clauses and the Technical Provisions) and dates of submittals. In addition to these items listed on ENG Form 4288, the Contractor shall furnish submittals for any proposed deviations from the plans or specifications. The scheduled need dates shall be recorded on the Register for each item for control purposes. In preparing the Register, adequate time (a minimum of 30 days) will be allowed for review, approval and possible resubmittal. Scheduling shall be coordinated with the approved progress schedule. The Contractor's Quality Control Representative shall review the Register at least every 30 days and take appropriate action to maintain an

effective system. Copies of updated or corrected Registers shall be submitted to the Contracting Officer at least every 30 days in the quantity specified. Payment will not be made for any material, equipment, or service which does not comply with contract requirements.

4.2.1 The attached submittal register is a minimum listing of the submittals that the Contractor shall submit to the Contracting Officer. The Contractor shall complete those columns in the submittal register (ENG Form 4288) entitled "NAS Activity Code," "Submittal Identification Number," and "Contractor Schedule Dates." The Contractor shall coordinate the submittal register with the specific detailed requirements of the Technical Provisions of the contract. In the case of conflict between the Submittal Register and the Technical Provisions of this contract, the requirements of the SPECIAL CLAUSES will govern.

4.2.2 The listing of submittals in the Submittal Register shall not relieve the Contractor from providing additional submittals required by the Contracting Officer under the Provisions of the CONTRACT CLAUSES.

4.3 Transmittals. The Contractor shall complete ENG FORM 4025, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance" with each set of shop drawings, certificates, equipment data or samples submitted. Blank ENG FORM 4025 will be furnished by the Contracting Officer on request. Six (6) copies of each submittal will be required.

4.4 Shop Drawings. The Contractor shall submit to the Contracting Officer for approval 6 copies of all shop drawings called for by these specifications. One set will be returned to the Contractor.

4.5 Certificates of Compliance. Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in 6 copies. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

4.6 Resubmittals. If a submittal is returned for correction or is not satisfactory and is disapproved by the Contracting Officer, the Contractor shall resubmit the corrected material, in the same quantity, as specified for the original submittal, for approval within 14 days after receipt of the disapproved material.

5. PHYSICAL DATA (APR 1984) FAR 52.236-4. Data and Information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

5.1 The indications of physical conditions on the drawings and in the specifications are the result of site investigations by surveys.

5.2 Weather Conditions. The Contractor shall satisfy himself as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any U.S. Weather Bureau Office.

5.3 Transportation Facilities. The Contractor shall make his own investigation of the condition of available public and private roads, railroads, and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the site work. It shall be the Contractor's responsibility to construct and maintain at his own expense, any haul roads required for construction operations.

5.4 Additional Information, including but not necessarily limited to, results of laboratory tests of material encountered in test holes or other explorations and field logs, is available for inspection and study in the office of District Engineer, Geotechnical Branch, 300 North Los Angeles Street, Los Angeles, California.

6. SALVAGE MATERIALS AND EQUIPMENT (JAN 1965) DFARS 252.236-7005. The Contractor shall maintain adequate property control records for all materials or equipment specified to be salvaged. These records may be in accordance with the Contractor's system of property control, if approved by the property administrator. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvaged materials and equipment which are broken or damaged during salvage operations as the result of his negligence, or while in his care.

#### 7. LAYOUT OF WORK.

7.1 The Government has established bench marks and horizontal control points at the site of the work. These are described and indicated on contract drawings.

7.2 From these control points the Contractor shall layout the work by establishing all lines and grades at the site necessary to control the work and shall be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on the contract drawings. The Contractor shall place and establish additional stakes and markers as may be necessary for control and guidance of his construction operations. All survey data shall be recorded in accordance with standard and approved methods. All field notes, sketches, recordings, and computations made by the Contractor in establishing above horizontal and vertical control points, shall be available at all times during the progress of the work for ready examination by the Contracting Officer or his duly authorized representative.

7.3 The Contractor shall furnish, at his own expense all such stakes, spikes, steel pins, templates, platforms, equipment, tools, and materials and all labor as may be required in laying out any part of the work from the control points established by the Government. It shall be the responsibility of the Contractor

to maintain and preserve all stakes and other markers established by him until authorized to remove them. If any of the control points established at the site by the Government are destroyed by or through the negligence of the Contractor prior to their authorized removal, they may be replaced by the Contracting Officer, and the expense of replacement will be deducted from any amount due or which may become due the Contractor. The Contracting Officer may require that work be suspended at any time when horizontal and vertical control points established at the site by the Contractor are not reasonably adequate to permit checking the work. Such suspension will be withdrawn upon proper replacement of the control points.

8. QUANTITY SURVEYS (APR 1984) FAR 52.236-16.

8.1 Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.

8.2 The Government shall conduct the original and final surveys and make the computations based on them. The Contractor shall conduct the surveys for any periods for which progress payments are requested and shall make the computations based on these surveys. All surveys conducted by the Contractor shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance.

8.3 Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

9. DAMAGE TO WORK. The responsibility for damage to any part of the permanent work shall be as set forth in the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. However, if, in the judgment of the Contracting Officer, any part of the permanent work performed by the Contractor is damaged by flood or earthquake, which damage is not due to the failure of the Contractor to take reasonable precautions or to exercise sound engineering and construction practices in the conduct of the work, the Contractor will make the repairs as ordered by the Contracting Officer and full compensation for such repairs will be made at the applicable contract unit or lump sum prices as fixed and established in the contract. If, in the opinion of the Contracting Officer, there are no contract unit or lump sum prices applicable to any part of such work an equitable adjustment pursuant to CONTRACT CLAUSE: CHANGES, will be made as full compensation for the repairs of that part of the permanent work for which there are no applicable contract unit or lump sum prices. Except as herein provided, damage to all work (including temporary construction), utilities, materials, equipment and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

10. CONCRETE AGGREGATE SOURCES.

10.1 Concrete aggregates can be produced from existing commercial sources along the Salt River and Cave Creek and on the Agua Fria River.

10.2 Concrete aggregates may be furnished from any of the above listed sources or at the option of the Contractor may be furnished from any other source designated by the Contractor and approved by the Contracting Officer, subject to the conditions hereinafter stated.

10.3 After the award of the contract, the Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish aggregates. If the Contractor proposed to furnish aggregates from a source of from sources not listed above, he may designate only a single source or single combination of sources for aggregates. Samples for acceptance testing shall be provided as required by SECTION: CONCRETE of the "Technical Provisions". If a source for coarse or fine aggregate so designated by the Contractor is not approved for use by the Contracting Officer, the Contractor may not submit for approval other sources but shall furnish the coarse or fine aggregate, as the case may be, from an approved source listed above at no additional cost to the Government.

10.4 Listing of a concrete aggregate source is not to be construed as approval of all materials from the source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels when such materials are unsuitable for concrete aggregate as determined by the Contracting Officer. Materials produced from an approved source shall meet all the requirements of SECTION: CONCRETE of the Technical Provisions of these specifications.

#### 11. TIME EXTENSIONS (APR 1984) FAR 52.212-6.

Use this clause if there are more than one completion dates listed in Clause 2.

11.1 Notwithstanding any other provisions of this contract, it is mutually understood that the time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements so delayed and that the remaining contract completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages under the new completion schedule.

#### 12. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE. EFARS 31.105 (JUL 1989).

12.1 Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region VII. Working conditions shall be considered

to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

12.2 Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36 substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

12.3 When actual equipment costs are proposed and the total amount of the pricing action is over \$25,000, cost or pricing data shall be submitted on Standard Form 1411, "Contract Pricing Proposal Cover Sheet." By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

12.4 This does not apply to terminations. See 49.113(100) and FAR Part 4.9.

### 13. PERFORMANCE OF WORK BY THE CONTRACTOR (1984 APR) FAR 52.236-1.

13.1 The Contractor shall perform on the site, and with its own organization, work equivalent to at least thirty-five (35) percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement of this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

### 14. PERFORMANCE EVALUATION OF CONTRACTOR.

14.1 As a minimum, the Contractor's performance will be evaluated upon final acceptance of the work. However, interim evaluation may be prepared at any time during contract performance when determined to be in the best interest of the Government.

14.2 The format for the evaluation will be SF 1421, and the Contractor will be rated either outstanding, satisfactory, or unsatisfactory in the areas of Contractor Quality Control, Timely Performance, Effectiveness of Management, Compliance with Labor Standards, and Compliance with Safety Standards. The Contractor will be advised of any unsatisfactory rating either in an individual element or in the overall rating, prior to completing the evaluation, and all Contractor comments will be made a part of the official record. Performance

Evaluation Reports will be available to all DOD Contracting offices for their future use in determining Contractor responsibility, in compliance with DFARS 236.201(C)(1).

15. HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (AUG 1987) FAR 52.223-3.

15.1 The Contractor agrees to submit a Material Safety Data Sheet (Department of Labor Form OSHA-20), as prescribed in Federal Standard No. 313B, for all hazardous material 5 days before delivery of the material, whether or not listed in Appendix A of the Standard. This obligation applies to all materials delivered under this contract which will involve exposure to hazardous materials or items containing these materials.

15.2 "Hazardous material," as used in this clause is as defined in Federal Standard No. 313B, in effect on the date of this contract.

15.3 Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

15.4 The Contractor shall comply with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

15.5 The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

15.5.1 To use, duplicate, and disclose any data to which this clause is applicable. The purposes of this right are to (i) apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials; (ii) obtain medical treatment for those affected by the material; and (iii) have others use, duplicate, and disclose the data for the Government for these purposes.

15.5.2 To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph 15.5.1 above, in precedence over any other clause of this contract providing for rights in data.

15.5.3 That the Government is not precluded from using similar or identical data acquired from other sources.

15.5.4 That the data shall not be duplicated, disclosed, or released outside the Government, in whole or in part for any acquisition of manufacturing purpose, if the following legend is marked on each piece of data to which this clause applies-

"This is furnished under United States Government Contract No. \_\_\_\_\_ and shall not be used, duplicated, or disclosed for any acquisition or manufacturing purpose without the permission of \_\_\_\_\_. This legend shall be marked on any reproduction of this data."

15.5.5 That the Contractor shall not place the legend or any other restrictive legend or any data which (i) the Contractor or any subcontractor previously delivered to the Government without limitations or (ii) should be delivered without limitations under the conditions specified in the Federal Acquisition Regulation in the clause at 52.227-18, Rights in Data.

15.6 The Contractor shall insert this clause, including this paragraph, with appropriate changes in the designation of the parties, in subcontracts at any tier (including purchase designations or purchase orders) under this contract involving hazardous material.

16. AS-BUILT DRAWINGS (ER 415-345-38).

16.1 General. The Contractor shall furnish 3 full size sets of as-built blue-line prints for use in preparation of as-built drawings by the Government. The as-built prints shall be a record of the construction as installed and completed by the Contractor. They shall include all the information shown on the contract set of drawings and a record of all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, all additional work not appearing on the contract drawings, and all changes which are made after final inspection of the contract work. In event the Contractor accomplishes additional work which changes the as-built conditions of the facility after submission of the as-built drawings, the Contractor shall furnish revised and/or additional drawings as required to depict as-built conditions. The requirements for these additional drawings will be the same as for the as-built drawings included in the original submission. The prints shall show the following information, but not be limited thereto:

16.1.1 The location and description of any utility lines or other installations of any kind or description known to exist within the construction area. The location includes dimensions to permanent features.

16.1.2 The location and dimensions of any changes within the building or structure.

16.1.3 Correct grade or alignment of roads, structures or utilities if any changes were made from contract plans.

16.1.4 Correct elevations if changes were made in site grading.

16.1.5 Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

16.1.6 The topography and grades of all drainage installed or affected as a part of the project construction.

16.1.7 All changes or modifications which result from the final inspection.

16.1.8 Options. Where contract drawings or specifications allow options, only the option selected for construction shall be shown on the as-built drawings.

16.1.9 Submittal to Contracting Officer for review and approval. Not later than 2 weeks after acceptance of the project by the Government, the Contractor shall deliver to the Contracting Officer 3 full size sets of blue-line prints marked up to depict as-built conditions. If upon review, the drawings are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. The Contractor shall complete the corrections and return the drawings to the Contracting Officer within ten (10) calendar days.

16.2 Preliminary As-Built Prints. The Contractor shall maintain one set of paper prints to show the as-built conditions. These as-built marked prints shall be kept current and available on the jobsite at all times. All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. The as-built marked prints will be jointly inspected for accuracy and completeness by the Contracting Officer's representative and responsible representative of the construction Contractor prior to submission of each monthly pay estimate. Information to be included on the preliminary prints shall conform to the requirements of final as-built prints.

#### 17. ENVIRONMENTAL LITIGATION.

17.1 If the performance of all or part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the CONTRACT CLAUSE: SUSPENSION OF WORK. The period of such suspension, delay or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof.

17.2 The term "environmental litigation", as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

#### 18. TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (DAEN-ECC-Q LTR 3 APR 84).

18.1 This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSE: DEFAULT. The listing below defines the monthly anticipated adverse weather for

the contract period and is based upon NOAA or similar data for the geographical location of the project.

MONTHLY ANTICIPATED ADVERSE WEATHER CALENDAR DAYS

ELEMENT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Precipitn .10"	2	2	2	1	0	0	2	3	2	2	1	2
Temp 320F	8	5	1	0	0	0	0	0	0	0	2	6
Total days*	10	7	3	1	0	0	2	3	2	2	3	8

\*Total number of adverse weather days per month (anticipated average) is based upon precipitation .10 inch, and temperature 32 degrees F. The concurrence factor is approximately 10 percent between precipitation and temperature during January and 5 percent during November, December, February, and March.

Winds 40-50 mph are relatively uncommon, although wind gusts associated with a summer thunderstorms can exceed 45 mph on relatively rare occasions.

The site can experience light snowfall on rare occasions between late November and early March.

18.2 Determination.

18.2.1 The above schedule of anticipated adverse weather will constitute the base line for monthly (or portion thereof) weather time evaluations. Upon acknowledgment of the notice to proceed and continuing throughout the contract on a monthly basis, actual adverse weather days will be recorded on a calendar day basis (including weekends and holidays) and compared to the monthly anticipated adverse weather in subparagraph 18.1 above. For purposes of subparagraph 18.2, the term actual adverse weather days shall include days impacted by actual adverse weather days.

18.2.2 The number of actual adverse weather days shall be calculated chronologically from the first to the last day in each month. Once the number of actual adverse weather days anticipated in subparagraph 18.1 above have been incurred, the Contracting Officer will examine any subsequently occurring adverse weather days to determine whether a Contractor is entitled to a time extension. These subsequently occurring adverse weather days must prevent work for 50 percent or more of the Contractor's work day and delay work critical to the timely completion of the project. The Contracting Office will convert any delays to meeting the above requirements to calendar days and issue a modification in accordance with the CONTRACT CLAUSE: DEFAULT.

18.3 The Contractor's schedule must clearly define the above anticipated adverse weather delays on all weather dependent activities.

19. CONTRACTOR SAFETY PERSONNEL REQUIREMENT.

19.1 The Contractor shall employ at the project site to cover all of work hours of work at least one Safety and Occupational Health person to manage the Contractor's accident program. Duties which are not germane to the safety program shall not be assigned to the Safety and Health person(s). The principal safety person shall report to and work directly for the Contractor's on-site top manager, higher level official, or corporate safety office. The Safety and Health person(s) shall have the authority to take immediate steps to correct unsafe or unhealthful conditions. The presence of a Safety and Health person will not abrogate safety responsibilities of other personnel.

19.2 Qualifications for Safety and Health person(s).

19.2.1 Shall have a degree in engineering or safety in at least a four year program from an accredited school; or

19.2.2 Shall have legal registration as a Professional Engineer or a Certified Safety Professional and, in addition, shall have been engaged in safety and occupational health for at least one (1) year of experience, no time being credited to this one (1) year unless at least fifty (50) percent of the time was devoted to safety and occupational health; or

19.2.3 Shall have a degree other than that specified in (a) above and, in addition, shall have been engaged in safety and occupational health for at least three (3) years, no time being credited to these three (3) years unless at least fifty (50) percent of the time each year was devoted to safety and occupational health; or

19.2.4 In lieu of a degree, shall have been engaged in safety and occupational health for at least five (5) years, no time being credited to these five (5) years unless at least fifty (50) percent of the time each year was devoted to safety and occupational health;

19.2.5 First aid work is not a creditable experience.

19.3 The name and qualification resume of the nominated safety person(s) shall be furnished to the Contracting Officer for acceptability and a functional description of duties shall be provided prior to the pre-work conference.

20. CONTINUING CONTRACTS (1985 JAN HQ USACE) EFARS 52.232-10001.

20.1 This is a continuing contract, as authorized by Section 10 of the River and Harbor Act of September 22, 1922 (33 U.S. Code 621). The payment of some portion of the contract price is dependent upon reservations of funds from future appropriations. The responsibilities of the Government are limited by this clause notwithstanding any contrary provision of the "Payments Under Fixed-Price Construction Contracts" clause or any other clause of this contract, by issuing an administrative change order to the contract.

20.2 The sum of \$\_\_\_\_\_ has been reserved for this contract and is available for payments to the Contractor during the current fiscal year. It is expected

that Congress will make appropriations for the future fiscal years from which additional funds will be reserved for this contract.

20.3 Failure to make payments in excess of the amount currently reserved, or that may be reserved from time to time, shall not entitle the Contractor to a price adjustment under the terms of this contract except as specifically provided in paragraphs 20.6 and 20.9 below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-of-contract action if an amount finally determined to be due as a termination allowance remains unpaid for one year due solely to a failure to reserve sufficient additional funds therefore.

20.4 The Government may at any time reserve additional funds for payments under the contract if there are funds available for such purpose. The Contracting Officer will promptly notify the Contractor of any additional funds reserved for the contract by issuing an administrative change order to the contract.

20.5 If earnings will be such that funds reserved for the contract will be exhausted before the end of any fiscal year, the Contractor shall give written notice to the Contracting Officer of the estimated date of exhaustion and the amount of additional funds which will be needed to meet payments due or to become due under the contract during that fiscal year. This notice shall be given not less than 45 nor more than 60 days prior to the estimated date of exhaustion.

20.6 No payments will be made after exhaustion of funds except to the extent that additional funds are reserved for the contract. The Contractor shall be entitled to simple interest on any payment that the Contracting Officer determines was actually earned under the terms of contract and would have been made except for exhaustion of funds. Interest shall be computed from the time such payment would otherwise have been made until actually or constructively made, and shall be at the rate established by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT 97, for the Renegotiation Board, as in effect on the first day of the delay in such payment.

20.7 Any suspension, delay, or interruption of work arising from exhaustion or anticipated exhaustion of funds shall not constitute a breach of this contract and shall not entitle the Contractor to any price adjustment under the "Suspension of Work" clause or in any other manner under this contract.

20.8 An equitable adjustment in performance time shall be made for any increase in the time required for performance of any part of the work arising from exhaustion of funds or the reasonable anticipation of exhaustion of funds.

20.9 If, upon the expiration of sixty (60) days after the beginning of the fiscal year following an exhaustion of funds, the Government has failed to reserve sufficient additional funds to cover payments otherwise due, the Contractor, by written notice delivered to the Contracting Officer at any time before such additional funds are reserved, may elect to treat his right to proceed with the work as having been terminated. Such a termination shall be considered a termination for the convenience of the Government.

20.10 If at any time it becomes apparent that the funds reserved for any fiscal year are in excess of the funds required to meet all payments due or to become due to the Contractor because of work performed and to be performed under the contract during the fiscal year, the Government reserves the right, after notice to the Contractor, to reduce said reservation by the amount of such excess.

21. BASIS FOR SETTLEMENT OF PROPOSALS (JUL 1989) EFARS 49.113(100). Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a termination settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the Contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for unallowable and unallocable expenses will be used to determine equipment operating expense.

(4) Ownership costs (depreciation) will be determined using the Contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the Contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

\* \* \* \* \*

SUBMITTAL REGISTER		(ER 415-1-10)	TITLE AND LOCATION		ARIZONA CANAL DIVERSION CHANNEL, REACH 4		CONTRACT NUMBER									
NAS ACTIVITY CODE  I J	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL						ACTION ELEMENT  *TECH REVIEW BY	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS
				SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT		OTHER, AS NOTED	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	
		1A-9.5.7.6.1	Haul routes													
		1E-3.5	Handling and transporting bridge beams													
		2A-1.1	Method of dewatering													
		2C-3.5.1	Blasting plan													
		2C-3.5.2	Preblast inspection report													
		2C-3.10	Blasting records													
		2C-4	Method of shoring and bracing	X												
		2E-3.3	Bituminous materials test reports													
		2E-8	Weed Killer, application method, rates													
		2E-10	Weigh bills or delivery tickets													
		2F-7.1	Job-mix formula													
		2F-17.1	New mix design for overlay													
		2F-19	Weigh bills or delivery tickets													
		2G-3.1	Aggregate test results													
		2G-3.3	Aggregate test results													
		2K-8.1.1	Concrete installation procedures													
		2L-2.2	Stone sample	X												

\*AE-Architect Engineer

ED-Engineering Division

CD-Construction Division

AREA-Area Engineer

RE-Resident Engineer

SUBMITTAL REGISTER		(ER 415-1-10)	TITLE AND LOCATION				ARIZONA CANAL, DIVERSION CHANNEL, REACH 4			CONTRACT NUMBER							
HAS ACTIVITY CODE  I J	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							ACTION ELEMENT	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS
				SHOP DRAWING	SAMPLE	GUARANTEE	MEP'S DATA	CERTIFICATE	TEST REPORT	OTHER, AS NOTED	*TECH REVIEW BY	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	ACTION CODE	
		2L-2.2.2	Stone sample	X													
		2L-5	weigh bill or delivery ticket							X							
		2M-2.1	Manufacturer recommendations							X							
		2(0)-2.1.1	Seed							X							
		2(0)-2.1.2	Fertilizer							X							
		2(0)-2.2	Delivery schedule							X							
		2P-2.1	Manufacturer recommendations							X							
		2P-2.2	Pipe							X							
		2P-6.3	Geotextile	X													
		2S-3.1	Paving units							X							
		2S-3.2	Laboratory test reports							X							
		2T-1.3	Pictorial record and measurement survey							X							
		3A-2.1	Drawings and computations	X													
		3A-2.2	Plywood, hard board, form accessories, form coating, and form lining							X							
		3B-2.1	Expansion joint filler strips, sealers and lubricant							X							

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**SUBMITTAL REGISTER**

(ER 415-1-10)

TITLE AND LOCATION

ARIZONA CANAL DIVERSION CHANNEL, REACH 4

CONTRACTOR

CONTRACT NUMBER

NAS ACTIVITY CODE	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							ACTION ELEMENT  *TECH REVIEW BY	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS
				SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT	OTHER AS NOTED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	ACTION CODE	
		3C-3.1	Reinforcement steel schedule, bar supports, and mark designations	X													
		3C-3.2	Reinforcement steel						X								
		3C-3.3	Disposition records							X							
		3D-2.1.1	Aggregates for verification testing	X													
		3D-4.1.1	Concrete mixture proportions							X							
		3D-4.1.3.1	Grout and detailed plan			X				X							
		3D-4.1.3.2	Design mix proportions and test results						X	X							
		3D-4.1.3.3	Mixture proportions with volume change controlling ingredient							X							
		3D-4.2	Accelerating admixture, curing materials air-entraining admixture, water-reducing admixture, color admixture			X											
		3D-4.3.1	Concrete plant							X							
		3D-4.3.2	Concrete mixers							X							
		3D-4.3.3	Concrete conveying equipment							X							
		3D-4.3.4	Placing equipment and methods							X							
		3D-4.3.5	Joint clean-up method and equipment							X							
		3D-4.3.6	Curing medium and methods							X							

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SECTION 1A

GENERAL REQUIREMENTS

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specifications (Fed. Spec.).

- FF-B-575C Bolts, Hexagon and Square
- FF-N-105B Nails, Brads, Staples and Spikes:  
& Am-3 Wire, Cut and Wrought  
& Int.Am-4
- FF-N-836D Nut: Square, Hexagon, Cap, Slotted,  
& Am-2 Castle, Knurled, Welding and Single  
Ball Seat
- MM-L-751H Lumber; Softwood
- TT-E-529F Enamel, Alkyd, Semi-Gloss
- TT-P-25E Primer Coating, Exterior (Undercoat  
& Am-2 for Wood, Ready-Mixed, White and  
Tints)

1.2 U.S. Department of Commerce National Bureau of Standards, Product Standard (Prod. Std).

- PS 1-83 Construction and Industrial Plywood

2. PROJECT FACILITIES. The Contractor shall construct and/or erect the following project facilities.

2.1 Construction Signs. The signs shall be erected as soon as possible and within 15 days after commencement of work under this contract.

2.1.1 Fifteen Project Signs at locations designated by the Contracting Officer.

2.1.2 Warning Signs facing approaching traffic on all haul roads crossing under overhead power transmission lines.

2.1.3 Fifteen hard hat signs at locations directed.

2.2 Bulletin Board at the Contractor's office.

2.3 Sanitary Facilities.

3. CONSTRUCTION SIGNS.

3.1 Materials.

3.1.1 Lumber shall conform to Fed. Spec. MM-L-751, and shall be seasoned Douglas Fir, S4S, Grade D or better except that posts, braces and spacers shall be construction Grade (WCLB).

3.1.2 Plywood shall conform to Prod. Std. PS 1, grade A-C, Group 1, exterior type.

3.1.3 Bolts, Nuts and Nails. Bolts shall conform to Fed. Spec. FF-B-575, nuts shall conform to Fed. Spec. FF-N-836, and nails shall conform to Fed. Spec. FF-N-105.

3.1.4 Paints and Oils. Paints shall conform to Fed. Spec. TT-P-25 for primer and TT-E-529 for finish paint and lettering.

3.2 Construction.

3.2.1 Project and hard hat signs shall be constructed as detailed on Figures 1, 2 and 3. Decals and safety signs will be furnished by the Contracting Officer.

3.2.2 Warning Signs shall be constructed of plywood not less than 1/2 inch thick and shall be securely bolted to the supports with the bottom of the sign face 3 feet above the ground. The sign face shall be 2 x 4 feet, all letters shall be 4 inches in height, and the wording shall be: "WARNING: OVERHEAD TRANSMISSION LINES."

3.3 Painting. All exposed surfaces and edges of plywood shall be given one coat of linseed oil and be wiped prior to applying primer. All exposed surfaces of signs and supports shall be given one coat of primer and 2 finish coats of white paint. Except as otherwise indicated, lettering on all signs shall be black and sized as indicated.

4. BULLETIN BOARD. A weatherproof bulletin board, approximately 36 inches wide and 30 inches high, with hinged glass door shall be provided adjacent to or mounted on the Contractor's project office. If adjacent to the office, the

bulletin board shall be securely mounted on no less than 2 posts. Bulletin board and posts shall be painted or have other approved factory finish. The bulletin board shall be easily accessible at all times and shall contain wage rates, equal opportunity notice, and such other items required to be posted.

5. MAINTENANCE AND DISPOSAL OF PROJECT FACILITIES. The Contractor shall maintain the project facilities in good condition throughout the life of the project. Upon completion of work under this contract, the facilities covered under this section will remain the property of the Contractor and shall be removed from the site at his expense.

6. SCRAP MATERIAL. Materials indicated to be removed and not indicated to be salvaged, stored or reinstalled are designated as scrap and shall become the property of the Contractor and be removed from the site of work. The Contractor by signing this contract hereby acknowledges that he made due allowance for value, if any, of such scrap in the contract price.

7. SALVAGE MATERIALS. All materials and/or equipment removed and indicated to be either stored or reinstalled are designated as salvaged materials and/or equipment. Any salvaged materials and equipment which are excess upon completion of the work and are not indicated to be stored shall become the property of the Contractor.

8. ARCHAEOLOGICAL FINDINGS DURING CONSTRUCTION. Should the Contractor or any of his employees in the performance of this contract find or uncover any archaeological remains, he shall notify the Project Engineer immediately. Such notifications will be a brief statement in writing giving the location and nature of the findings. Should the discovery site require archaeological studies resulting in delays and/or additional work, the Contractor will be compensated by an equitable adjustment under the CONTRACT CLAUSES of the contract.

9. PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS.

9.1 General. The approximate location of all railroads, pipe lines, power and communication lines, and other utilities known to exist within the limits of the work are indicated on the drawings. The sizes, locations, and names of owners of such utilities are given from available information, but their accuracy is not guaranteed. Except as otherwise indicated on the drawings, all existing utilities will be left in place and the Contractor shall conduct his operations in such a manner that the utilities will be protected from damage at all times, or arrangements shall be made by the Contractor for their relocation at the Contractor's own expense. The Contractor shall be owners responsible for any damage to utilities known to exist and shall reimburse the for such damage caused by his operations.

9.2 Relocation or Removal. Utilities to be relocated or removed not as part of this contract are designated "To be Relocated by Others" or "To be Removed by Others," respectively. Utilities shown on the plans and not so designated will be left in place and be subject to the clause of the contract: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS of the CONTRACT CLAUSES. The Contractor may make arrangements with the owner for

the temporary relocation and restoration of utilities not designated to be relocated, or for additional work in excess of the work needed to relocate utilities designated for relocation at no additional cost to the Government.

9.3 Utilities Not Shown. If the Contractor encounters, within the construction limits of the entire project, utilities not shown on the plans and not visible as of the date of this contract and if such utilities will interfere with construction operations, he shall immediately notify the Contracting Officer in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation. If such utilities are left in place, removed or relocated, as directed by the Contracting Officer, the Contractor shall be entitled to an equitable adjustment for any additional work or delay.

9.4 Coordination. The Contractor shall consult and cooperate with the owner of utilities that are to be relocated or removed by others to establish a mutual performance schedule and to enable coordination of such work with the construction work. These consultations shall be held as soon as possible after award of the contract or sufficiently in advance of anticipated interference with construction operations to provide required time for the removal or relocation of affected utilities.

9.4.1 Utilities to be Relocated or Protected.

9.4.1.1 The Contractor shall notify the Contracting Officer, in writing, 30 calendar days prior to starting work on any utility to be relocated or protected. On each relocation, notification shall include dates on which the Contractor plans excavation, by-pass work, removal work and/or installation work, as applicable. The Contractor shall also notify the following representatives of utility owners not less than 14 days prior to start of work in the vicinity of their respective utilities:

Flood Control District of Maricopa County  
3335 West Durango Street  
Phoenix, Arizona 85009  
Mr. John E. Rodriguez  
Telephone: (602) 262-1501

Arizona Public Service  
Metro Engineering Service  
P.O. Box 21666  
2121 W. Cheryl Drive  
Phoenix, Arizona 85036  
Ms. Lois Winkler  
Telephone: (602) 371-6837

Southwest Gas Corporation  
9 South 43rd Avenue  
Phoenix, Arizona 85072-2075  
Mr. Elton H. Buell  
Telephone: (602) 484-5254

Salt River Project  
Civil Engineering Dept.  
P.O. Box 1980  
Phoenix, Arizona 85001  
Mr. Timothy S. Phillips  
Telephone: (602) 236-2956

City of Phoenix  
Engineering Department

Dimension Cable Services

125 E. Washington Street  
Phoenix, Arizona 85004

Mr. Blair Tanner  
Telephone: (602) 866-0072

Mr. Dwayne Williams  
Telephone: (602) 256-3441

Water Department  
Mr. Gerald Arakaki  
Telephone: (602) 261-8229

Mountain Bell  
Mr. Fred Locke  
Telephone: (602) 842-7720

or

Mr. Robert Friess  
Telephone: (602) 842-7748

9.4.1.2 Staking of Utilities. In addition to notification of representatives of utility owners, the Contractor shall notify the Blue Stakes Center, phone (602) 263-1100, sufficient time prior to any excavation within any street right-of-way or any work in the vicinity of known underground utilities, to have underground utilities field located and staked.

9.4.1.3 The Contractor shall obtain water line shutdown permits within 30 days of the notice to proceed. Copies shall be furnished to the Contracting Officer. The application process is expected to take 14 days and the Contractor will pay a fee which is assessed to each application.

9.4.1.4 The Contractor shall contact the Salt River Project to obtain the footing depths of the transmission line towers on the north bank of the Arizona Canal.

~~No gas lines are apparent on drawings. Fill in the blanks if needed.~~

9.4.1.5 Southwest Gas (SWG) at \_\_\_\_\_. Southwest Gas will temporarily relocate the gas line in \_\_\_\_\_ to the east side of \_\_\_\_\_ underneath the detour road. SWG will complete the part of the temporary relocation in \_\_\_\_\_ after the Contractor has moved traffic to the detour. SWG will be installing their permanent lines in \_\_\_\_\_ over the top of the covered ACDC. The Contractor shall coordinate with SWG (Ron Morency 484-5306). Provide at least one month's notice to SWG for both the temporary and permanent relocations. There will be no cost to the Contractor for the SWG relocations.

~~No communication lines are apparent on drawings. Fill in the blanks if needed.~~

9.4.1.6 U.S. West Communications at \_\_\_\_\_. U.S. West Communications will suspend the existing underground cables at grade for the duration of construction. Upon completion of the covered ACDC, but before the roadway is restored, U.S. West will lower the cables to their permanent position, ready for the Contractor to complete the roadway restoration. The Contractor shall coordinate the relocations with Bob Friess of U.S. West (842-7748). Provide at least one month's notice to U.S. West for both the temporary and permanent relocations. There will be no cost to the Contractor for the relocations.

## 9.5 Notices.

9.5.1 Traffic Routing. The Contractor shall notify the Contracting Officer 7 days in advance of the time work will be started in areas requiring the rerouting of traffic, traffic lane striping, and removal of street signs. The foregoing shall apply to progressive modifications of traffic routings within an area in which work is in progress.

9.5.1.1 Special requirements applicable to traffic routing area specified in SECTION: DETOURS, STREET RECONSTRUCTION, AND TRAFFIC CONTROL FACILITIES.

9.5.2 Police, Highway Patrol, and Fire Departments shall be notified by the Contractor whenever a street is to be closed to traffic. If the closing is to be of long duration, a single notification to each department on the last working day before closing will be sufficient. A single notification shall then be made at the time the street is again opened to traffic. If the closing is to be of short duration or if different sections of the street are to be closed at different times, notifications shall be made on a day-to-day basis.

9.5.3 Utilities To be Relocated or Protected. The Contractor shall notify the Contracting Officer, in writing, 30 calendar days prior to starting work on any utility to be relocated or protected. On each relocation, notification shall include dates on which the Contractor plans excavation, by-pass work, removal work and/or installation work, as applicable.

9.5.4 The Contractor shall notify the Contracting Officer, in writing, not less than 14 days in advance of the date on which he will complete trenching, excavation, fill or rough grading, as applicable, at each location where such completed work is required for temporary or permanent relocations by others. The Contractor shall allow a period of 14 calendar days at each relocation, after which time the Contractor may resume his operations.

9.5.5 Existing Bench Marks and R/W Markers. The Contractor shall notify the Contracting Officer, in writing, 7 days in advance of the time he proposes to remove any bench mark or right-of-way marker.

9.5.6 Optional Disposal Areas. The Contractor shall notify the Contracting Officer within 30 days after receipt of Notice to Proceed, as to which optional disposal areas he proposes to use or whether the areas will not be used for disposal. Should the Contractor elect to use any of the disposal areas, he shall indicate the approximate quantities of material he proposes to place in each area. In addition to the above requirements, the Contractor shall notify the Contracting Officer 24 hours in advance of the time he proposes to start operations in the optional disposal area, and 48 hours in advance of any work which he proposes to do in the disposal areas on Saturday, Sunday or legal holidays.

9.5.7 Work in the area between the channel right-of-way and the construction easements shown on the drawings shall be subject to the following restrictions.

9.5.7.1 The Contractor shall remove all construction materials placed in this area under this contract after completion of construction.

9.5.7.2 Free access to the area by the Salt River Project shall be maintained at all times.

9.5.7.3 The area shall only be used by the Contractor for conveyance of construction equipment and for temporary parking of construction equipment.

9.5.7.4 Dust control shall conform to SECTION: ENVIRONMENTAL PROTECTION.

9.5.7.5 Permanent features in the area shall be protected in accordance with the CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS.

9.5.7.6 Haul route approval shall be coordinated in advance of construction operations.

9.5.7.6.1 Fourteen days prior to commencement of excavation in any portion of the project area, the Contractor shall submit a plan identifying haul routes proposed for use for disposal of excess excavated material and required fills. The Contractor shall not proceed with haul operations without the prior written approval of the Contracting Officer. The Contractor shall coordinate use of property for haul routes, with all landowners and public entities and shall provide copies of written approval of coordination to the Contracting Officer, with his plan.

9.5.8 Access to the project will be allowed from 12th Street, 16th Street, Glendale Avenue, Maryland Avenue, and 32nd Street.

## 9.6 Restrictions.

9.6.1 Representatives of Other Agencies. Personnel representing owners and agencies may be present for various portions of the work. However, the Contractor will be responsible only to the Contracting Officer.

9.6.2 The Contractor shall not cross existing paved roadways and residential roadways with construction equipment except at approved marked crossings. Crossings shall be maintained in accordance with applicable state, county, and city regulations.

9.6.3 Special Restrictions along the work areas shall apply as follows:

9.6.3.1 Arizona Canal. Removal and/or repair of Arizona Canal bank lining can only take place during the annual dry up period. This is expected to occur in year 1991 from January 5 through February 3. Any request to perform work outside of this period will need written permission from the Salt River Project, and is not easily obtained. For year 1992 expected dry period can be obtained from Salt River Project office.

9.6.3.2 Stanford Drive Detour. Construction of the covered section across

Stanford Drive will need to be accomplished in two phases. During the first phase, a three lane detour will be in place north of Stanford Drive. Phase One can not start prior to June 3rd and must be completed with four lanes of traffic restored, prior to September 1st.

9.6.4 Access and egress shall be limited to defined roadways only.

9.6.5 Additional restrictions related to environmental protection are stated in SECTION: ENVIRONMENTAL PROTECTION.

A Sanitary Sewer Lift Station is located at approximately Sta. 817+00. A Filtration Plant is located at approximately Sta. 891+00. Fill in the blanks if needed.

9.6.6 Power to Pump Stations at \_\_\_\_\_.

9.6.6.1 APS will disconnect power to the stormwater pump stations at Pump station locations Station \_\_\_\_\_ and Station \_\_\_\_\_ upon request from the Contractor. Provide at least one month's notice to Lois Winkler of APS (371-6837). There will be no cost to the Contractor for the APS work.

9.6.6.2 City of Phoenix (COP) Pump Restriction. The Contractor shall keep 24-hour access to COP pump stations at Station \_\_\_\_\_ and \_\_\_\_\_. When Contractor is ready to remove these pumps, he shall give one month's notice to COP. The Contractor shall also give one month's notice to APS to disconnect power supply to pumps and for overhead line and poles to be removed.

## 10. CONDUITS FOR FUTURE TV CABLE.

No Cable TV is apparent on the drawings. Fill in the blanks if needed.

10.1 Cable TV at \_\_\_\_\_. Dimension Cable will suspend the existing underground cables 22 feet overhead for the duration of construction. The Contractor shall install 2-3 inch PVC Conduits (each 180 L.F.) under the sidewalk on the west side of \_\_\_\_\_ for Cable TV. The exact location of the conduits shall be coordinated with Dimension Cable. Sweep the ends of the conduit out past the sidewalk and provide a marker. Provide a 6 inch slurry cover (1 sack mix) over the top of the conduits. The Contractor shall coordinate the relocations with Blair Tanner of Dimension Cable (866-0072 ext. 243). Provide at least one month's notice to Dimension Cable for both the temporary and permanent relocations. There will be no cost to the Contractor for the relocations.

10.2 Cable TV at \_\_\_\_\_. The Contractor shall install 2-3 inch PVC conduits (each 180 L.F.) under the sidewalk on the north side of \_\_\_\_\_ for Cable TV. The exact location of the conduits shall be coordinated with Blair Tanner of Dimension Cable (866-0072 ext. 243). Sweep the ends of the conduit out past the sidewalk and provide a marker. Provide a 6 inch slurry cover (1 sack mix) over the top of the conduits.

11. PUBLIC SAFETY. Attention is directed to the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. The Contractor shall furnish, install, maintain and

remove temporary fencing, barricades, and/or guards, as required, to provide protection in the interest of public safety and in conformance with applicable Federal, State, and local laws and ordinances. As a minimum, this will include an 8-foot chain-link fence which completely encloses each and every part of the projects (except at optional disposal areas) which the Contractor worked in or is working on. The plan of this temporary fencing shall be furnished to the Contracting Officer for approval and the fence erected prior to commencement of any work. Whenever the Contractor's operations create a condition hazardous to the public, he shall furnish at his own expense and without cost to the Government, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, or maintain such fences, barricades, lights, signs and other devices as are necessary to prevent accidents and avoid damage or injury to the public. Flagmen and guards, while on duty and assigned to give warning and safety devices, shall conform to applicable city, county, and state requirements. Should the Contractor appear to be neglectful or negligent in furnishing adequate warning and protection measures, the Contracting Officer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor without additional cost to the Government. Should the Contracting Officer point out the inadequacy of warning and protective measures, such action of the Contracting Officer shall not relieve the Contractor from any responsibility for public safety or abrogate his obligation to furnish and pay for those devices. The installation of any general illumination shall not relieve the Contractor of his responsibility for furnishing and maintaining any protective facility. Traffic control shall conform to the Traffic Barricade Manual, City of Phoenix; and Part 400 of the Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments, Arizona.

12. PERSONAL CLOTHING STANDARDS.

12.1 Each employee shall be required to wear clothing suitable for the weather and job conditions of the work. At a minimum, the following personal clothing requirements shall be enforced:

12.1.1 Short sleeve shirts.

12.1.2 Long trousers.

12.1.3 Leather work shoes or other appropriate protective shoes or boots. Canvas shoes, tennis or deck shoes are not acceptable.

13. OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA) STANDARDS. The OCCUPATIONAL SAFETY and HEALTH ACT (OSHA) STANDARDS for CONSTRUCTION (Title 29, Code of Federal Regulations Part 1926 as revised from time to time) and the Corps of Engineers General Safety and Health Requirements Manual, EM 385-1-1, are both applicable to this contract. The most stringent requirement of the two standards will be applicable.

14. PERMITS.

14.1 General. Reference is made to the clause of the contract entitled "Permits and Responsibilities," which obligates the Contractor to obtain all required licenses and permits.

15. REQUIRED INSURANCE. The Contractor shall provide and maintain during the entire period of his performance under this contract insurance coverage. The City of Phoenix and the Maricopa County Flood Control District shall be named as additionally insured.

16. SALVAGED SIGN. The Contractor shall remove the "City of Paradise Valley" sign and two posts on the South side of Stanford Drive. The sign and two posts shall be delivered to:

Mr. Gus Holka  
Street Superintendent of Paradise Valley  
6401 E. Lincoln Drive  
Paradise Valley, Arizona 85253  
Phone: (602)948-7411

\* \* \* \* \*

SECTION 1B

MEASUREMENT AND PAYMENT

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1. DIVERSION AND CONTROL OF WATER. Payment for Diversion and Control of Water will be made at the applicable contract price, which payment shall constitute full compensation for diverting and controlling the water in the channel and other work areas, complete.

2. CLEAR SITE AND REMOVING OBSTRUCTIONS.

2.1 General. Payment shall include all costs for clearing, removal, replacement, and restoration work (except work by others) including all existing obstructions within the channel rights-of-way, fill sites, and the obstructions indicated for removal outside of the rights-of-way and inside the construction easements. Except as otherwise specified, payment for clearing and removal of work includes applicable earthwork; filling holes, removing and plugging abandoned lines; removal of existing buildings, swimming pools, asphalt, other structures, slabs, and sidewalks; removal of materials for salvage; protection, replacement or restoration of utilities, fences, walls and features indicated and disposal of all materials.

2.2 Payment for Clear Site and Remove Obstructions will be made at the applicable contract price, which payment shall constitute full compensation for clearing the site and removing obstructions, including clearing and grubbing, complete.

3. EXCAVATION.

3.1 Measurement of Excavation. A survey of the site shall be made prior to commencement of work, and all measurements will be based on this survey without regard to any changes in the site that may be made between the excavation lines and

grades indicated on the drawings or staked in the field and the ground surfaces as indicated by the above mentioned survey. The actual slopes as excavated may be greater or less than those indicated or staked, depending on the materials excavated and methods used in performing the work, but such alterations shall not change the measurement for payment from the original lines as specified herein. The quantity of directed excavation necessary for the removal of unsuitable foundation material as specified shall be included in the measurement of the excavation where the unsuitable soils are encountered. Quantities will be computed in cubic yards by the average end area method and the planimeter will be considered a precise instrument for measurement of plotted cross sections. All excavation outside of excavation lines shown on the drawings will be considered as being for convenience of the Contractor.

### 3.2 Payment.

3.2.1 Payment for Excavation including rock and cemented alluvium excavation will be made at the applicable contract price, which payment shall constitute full compensation for excavation for channel construction (including shoring) and other areas as indicated on the drawings; shaping and trimming of areas to receive concrete; loading, hauling, placement, shaping, and grading of excess excavated material in optional disposal areas; and any costs associated with disposal of excess excavated or cleared material in the optional disposal areas (as shown on the drawings), complete. No payment will be included in this item for other earthwork requirements paid for under separate bid items.

3.2.2 Subgrade Preparation. No separate payment will be made for subgrade preparation and all costs in connection therewith shall be included in the contract prices for the items to which the work applies.

3.2.3 Excavation for Structures. No separate payment will be made for excavation for structures. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

3.2.4 Trenches. No separate payment will be made for excavation of pipeline trenches. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

3.2.5 Shoring. Shoring indicated or required for Items for which separate payments are listed in the Bidding Schedule will be paid for under those items as applicable.

### 4. COMPACTED FILL, CHANNEL, BACKFILL TOE, LEVEE, AND MISCELLANEOUS.

4.1 Measurement for Compacted Fill for Channel, Backfill Toe, Levee, and Miscellaneous will be by the cubic yard compacted as shown on the drawings, and will be made in accordance with the requirements of paragraph: QUANTITY SURVEYS of the SPECIAL CLAUSES.

4.2 Payment for Compacted Fill, Channel will be made at the applicable contract price, which payment shall constitute full compensation for construction of backfill behind vertical channel walls at the required slope (including fill outside the required prism), complete. No additional payment of fill outside of the required cut-slope.

4.2.1 Fill for Structures. No separate payment will be made for fill or backfill about structures. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

4.2.2 Trenches. No separate payment will be made for backfilling trenches for utilities and pipelines. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

4.3 Payment for Compacted Fill, Backfill Toe will be made at the applicable contract price, which payment shall constitute full compensation for placing and compacting the fills, complete.

4.4 Payment for Compacted Fill, Levee will be made at the applicable contract price, which payment shall constitute full compensation for construction of levee, complete.

4.5 Payment for Compacted Fill, Miscellaneous will be made at the applicable contract price, which payment shall constitute full compensation for construction of the miscellaneous fill, complete, which includes furnishing materials, placing and compaction.

5. OVERFLOW SPILLWAYS. Payment for Overflow Spillways will be at the applicable contract price, which payment shall constitute full compensation for construction of the overflow spillways and the Maintenance Road overflow spillways, including subgrade preparation; forming; aprons; cut-off walls; concrete curbs adjacent to spillways; reinforcement; guard rail; and materials (excluding color admixture); placing; finishing; and curing of concrete, complete.

#### 6. CONCRETE, TOP SLAB.

6.1 Measurement of Concrete, Top Slab for covered channel section will be made by the cubic yards of concrete placed in the top slab above the walls, including fillets. Concrete in excess of the dimensions shown on the drawings or wasted at the convenience of the Contractor shall not be included in measurement for payment.

6.2 Payment for Concrete, Top Slab will be made at the applicable contract price, which payment shall constitute full compensation for construction of the box covered channel section top slab, parapets on covered channel top slabs and fillets, and including forming; materials (excluding steel reinforcing and color admixture); placing; finishing; and curing of concrete, complete. Costs for "blockouts" required for installation of posts for steel picket fence shall be included in this bid item.

#### 7. CONCRETE, INVERT.

7.1 Measurement of Concrete, Invert will be made by the cubic yards of concrete placed in the inverts of the rectangular channel, covered channel section, outlet channel and Cudia City Wash spillway, and invert access ramp inverts (including the starter walls), and cut off wall (upstream invert), as shown on the drawings. Concrete in excess of the dimensions shown on the drawings or wasted at the convenience of the Contractor shall not be included in measurement for payment.

7.2 Payment for Concrete, Invert will be made at the applicable contract price, which payment shall constitute full compensation for construction of the rectangular channel invert, covered channel section invert, outlet channel invert, Cudia City Wash Spillway invert, invert access ramp inverts, and cutoff wall (upstream invert) including subgrade preparation; forming; materials (including scour gauges; and excluding steel reinforcing and color admixture); placing; finishing; and curing of concrete, complete. Payment will not include underpass ramp inverts for which separate item is provided.

#### 8. CONCRETE, WALLS.

8.1 Measurement of Concrete, Walls will be made by the cubic yards of concrete placed in the walls above the starter wall in the rectangular channel section, outlet channel, Cudia City Wash Spillway, invert access ramps and covered channel section. Concrete in excess of the dimensions shown on the drawings or wasted at the convenience of the Contractor shall not be included in measurement for payment.

8.2 Payment of Concrete, Walls will be made at the applicable contract price, which payment shall constitute full compensation for construction of concrete wall above the starter wall in the rectangular channel section, invert access ramps, outlet channel walls, Cudia City Wash Spillway walls, and covered channel section; materials (excluding color admixture and steel reinforcing); placing; finishing; and curing of concrete, complete. Payment will also include bridge transition walls; and channel lining (excluding shotcrete) at 12th Street, 16th Street, Maryland Avenue, Glendale Avenue, 32nd Street, and Squaw Peak Parkway Bridges. Costs for "blockouts" required for installation of posts for steel picket fence shall be included in this bid item. Payment will not include for underpass ramp walls for which separate payment is provided.

9. COLOR ADMIXTURE FOR CONCRETE. Payment for Color Admixture for Concrete will be made at the applicable price, which payment shall constitute full compensation for materials and batching of color admixture in concrete for walls and inverts of Channel and Invert Access ramps; Overflow Spillways and Maintenance Road Spillways; Curb and Gutter adjacent to Maintenance Road and Curb for Maintenance Road Spillways; Bikepaths; and other exposed concrete surfaces (excluding covered channel section except 50 feet from each end, sidewalks, driveway and concrete curb at parking lot) requiring the inclusion of color admixture, complete. Payment shall also include costs for test panels for colored concrete. Payment will not include color admixture for underpass and underpass ramp for which separate payment is provided.

#### 10. STEEL REINFORCEMENT.

10.1 Measurement of Steel Reinforcement is limited in this item to reinforcement in those concrete structures paid for in the Bidding Schedule on a cubic yard basis and will be made by the lengths of bars actually placed in the completed work in accordance with the plans and specifications, approved bar schedules, or as directed. The measured lengths will be converted to weights for the bar numbers listed in ASTM A 615. Steel in laps indicated on the drawings, in the specifications, or required by the Contracting Officer will be included in measurement for payment. No steel reinforcing wasted or included for the

convenience of the Contractor will be measured for payment. No steel supports or spacers will be included for payment in this item; all costs for furnishing and installing supports and spacers shall be included in the various structures requiring the reinforcement.

10.2 Payment for Steel Reinforcement will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and installing steel reinforcement, complete. No payment will be included in this item for other steel reinforcement paid for under separate bid items.

11. Payment for Retaining Walls will be made at the applicable contract price, which payment shall constitute full compensation for construction of vertical concrete masonry unit retaining walls complete.

12. ASPHALT CONCRETE PAVING.

12.1 The unit of measurement for the asphalt concrete will be the ton (2,000 lbs.). The Contractor shall weigh each load on a certified platform scale and shall furnish the Contracting Officer with duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector. The bituminous mixture shall be weighed after mixing and no deduction will be made for the weight of bituminous material incorporated therein. Asphalt concrete used for the convenience of the Contractor will not be measured for payment. No measurement will be made for asphalt concrete used in items paid for under separate bid items.

12.2 Payment for Asphalt Concrete Paving will be made at the applicable contract price, which payment shall constitute full compensation for asphalt concrete in place, including prime coat and weed killer, aggregate base course, subgrade preparation, and all incidentals. No payment will be included in this item for asphalt concrete requirements paid for under separate bid items. No payment will be made for excessive thickness.

13. STEEL PICKET FENCE. Payment for Steel Picket Fence will be made at the applicable contract price, which payment shall constitute full compensation for steel picket fencing and gates, complete in place, including colored concrete posts, fence panels, paint, anchor bolts or expansion bolts, steel plates, grout or dry pack, hinges, chains, plunger rods, and all incidentals. Payment will not include picket fence for underpass, underpass ramps and irrigation station enclosures for which separate payments are provided.

14. SIDE DRAINS. Payment for Side Drains will be made at the applicable contract price, which payment shall constitute full compensation for construction of side drains (except for the 35th Street Side Drains) including materials for outlet structures, flap gates, reinforcement, catch basins complete with grates, concrete swale, collars, bulkheads and earthwork, complete.

15. MISCELLANEOUS HARDWARE. Payment for Miscellaneous Hardware will be made at the applicable contract price, which payment shall constitute full compensation for pipe gates; pipe gate signs; reflectors; pipe gate stoppers; covered channel section manhole ladders and channel invert access ladders; covered channel section precast concrete manholes; sediment range markers; grating; guard rails; manhole covers;

concrete; and earthwork, complete. No payment will be made for color admixture for concrete under this item.

16. DRIVEWAY ENTRANCE. Payment for Driveway Entrance will be made at the applicable contract price which payment shall constitute full compensation for the driveway entrances, complete in place, including clearing and removing obstructions (including existing curb and gutter and pavement replacement); earthwork outside of the channel payment items limits; concrete (including steel reinforcement) for pavement, sidewalks; expansion joints; depressed curbs and all incidentals necessary to match existing street, curb and gutter, and sidewalks.

17. STATION MARKINGS. Payment for Station Markings will be made at the applicable contract price, which payment shall constitute full compensation for obtaining materials, fabrication and installation necessary for the work, complete in place.

18. GAGING STATION. Payment for Gaging Station will be made at the applicable contract price, which payment shall constitute full compensation for the gaging station, complete in place.

19. CONDUITS. Payment for Conduits will be made at the applicable contract price, which payment shall constitute full compensation for obtaining materials, fabrication, and installation of conduits, headwalls, forming, concrete, concrete cradles and encasement and steel reinforcing (excluding color admixture for concrete encasement), complete in place.

20. INTAKE BOX. Payment for Intake Box will be made at the applicable contract price, which payment shall constitute full compensation for the intake box, earthwork; including steel angles, bars, anchor or expansion bolts, steel reinforcement, forming and concrete, complete. No payment will be included for color admixture for concrete in this bid item.

21. SHOTCRETE. Payment for Shotcrete (including Arizona Canal lining) will be made at the applicable contract price, which payment shall constitute full compensation for the shotcrete, including reinforcement mesh, complete in place.

22. MISCELLANEOUS ITEMS OF WORK. Payment for Miscellaneous Items of Work will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and installing all facilities; including permits, complete. Facilities include drinking fountains complete with connections water lines, valves, fittings, drainage pit, trenching, backfill and street repair; security lighting complete with meters, service connectors, trenching, conduits, backfill, street repair, pull boxes, light poles, light fixtures and electric panels; bike racks; trash receptacles, 8-foot concrete bike path including subgrade preparation, forming and finishing; and bollards, complete.

23. DETOURS AND STREET RECONSTRUCTION.

23.1 Payment for Detours and Street Reconstruction will be made at the applicable contract price, which payment shall constitute full compensation for construction of the detours (including bridges); pedestrian bridges; earthwork; shoring for detours; roadway construction; removal of existing roadway (including driveways and sidewalk ramps), and reconstruction of the roadway in accordance with the drawings;

installation; maintenance and removal of all traffic control facilities (including pavement markings) as shown on the drawings; installation and removal of street lights; protection and adjustments to utilities; removal of all items and restoration of the area to existing grades or as indicated on the drawings; pick-up Government supplied box beams from Maricopa County storage area at Adobe Dam to a construction site; delivery Government supplied and new constructed box beams to Maricopa County storage area at Adobe Dam; and all other work indicated on the drawings or in the specifications (including catch basins at Stanford Drive).

24. 16TH STREET UNDERPASS RAMPS. Payment for 16th Street Underpass Ramps will be made at the applicable contract price, which payment shall constitute full compensation for all labor, materials and equipment to construct the underpass ramp walls and inverts at 16th Street. This includes all excavation, backfill, forming, concrete, reinforcing steel, picket fence, color admixture, finishing and curing, complete. Payment will not include security lighting for which a separate item is provided.

25. STONE.

25.1 Measurement. The quantity of stone to be paid for will be the number of tons of the various types of stone determined by scale weights acceptably placed within the lines and grades shown on the drawings or directed.

25.2 Payment for Stone of various types will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and placing the stone, complete.

26. GROUT.

26.1 Measurement. The quantity of grout to be paid for will be measured to the nearest cubic yard by weighing all ingredients in trial batches of grout and converting each batch to absolute volume; the volume thus determined and the number of batches of grout of corresponding proportions acceptably placed in the work shall be used to determine the quantity of grout.

26.2 Payment for Grout will be made at the applicable contract price, which payment shall constitute full compensation for mixing, transporting, placing, finishing, and curing grout for grouted slope, excluding cement, color admixture, complete.

27. CURB AND GUTTER.

27.1 Measurement of Curb and Gutter will be made to the nearest linear foot measured horizontally from end-to-end of the curb and gutter in place.

27.2 Payment of Curb and Gutter will be at the applicable contract price, which payment shall constitute full compensation for all labor, material and equipment to construct the curb and gutter, including transitions, subgrade preparation, forming, and finishing, complete. Payment will not include curbs or curb and gutter adjacent to driveway entrances, spillways, curbs removed for the Contractor's convenience and in parking lot.

28. LANDSCAPING. Payment for Landscaping will include all labor, materials, and

equipment necessary to furnish, install, protect and maintain the plant materials as shown on the contract drawings; furnish and install or construct landscape features, including screen walls, planters (including footings, and walls complete), concrete bands for landscape areas, sand base, interlocking pavers (including curbing and sand base), decomposed granite, seat walls, concrete headers, topsoil, turf, and other work as shown on the contract drawings. The retaining walls are included in Concrete, Retaining Walls and Conduit Headwall.

29. IRRIGATION. Payment for Irrigation will include all labor, materials, and equipment necessary to furnish, and install all irrigation system facilities complete. This includes all work necessary to tie into existing water lines; irrigation stations (including enclosures ramp and pad, complete); rain gauge stand pipe (including footing, conduit, and connections complete); necessary electrical facilities to provide power to the irrigation stations; complete.

30. DRAINAGE SYSTEM. Payment for Drainage System will be made at the applicable contract price, which payment shall constitute full compensation for materials, and installation of the drainage system, complete.

31. CONCRETE, DENTAL.

31.1 Measurement of Concrete, Dental will be made by the cubic yards of dental concrete acceptably placed in the invert of the rectangular channel between the "B" line and the "A" line, as shown on the drawings. Dental concrete placed beyond the "B" line or wasted at the convenience of the Contractor shall not be included in the measurement for payment.

31.2 Payment for Concrete, Dental will be made at the applicable contract price, which shall constitute full compensation for the dental concrete, complete in place.

32. BILTMORE HOTEL FACILITIES RESTORATION. Payment for the Biltmore Hotel Facilities Restoration will be made at the applicable contract price, which shall constitute full compensation for the restoration of the facilities at the Biltmore Hotel including keeping a pictorial record.

33. 35TH STREET SIDE DRAINS. Payment for the 35th Street Side Drains will be made at the applicable contract price, which shall constitute full compensation for the construction of side drains at 35th Street including materials for concrete, reinforcement, earthwork, and bulkheads.

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## SECTION 1C

### CONTRACTOR'S QUALITY CONTROL

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1. GENERAL. The Contractor shall establish and maintain an effective quality control system in compliance with CONTRACT CLAUSE: INSPECTION OF CONSTRUCTION. The quality control system shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with contract requirements. The system shall cover construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence.

#### 2. QUALITY CONTROL PLAN.

2.1 General. The Government will consider an interim plan for the first 15 days of operation. However, the Contractor shall furnish for approval by the Government, not later than 30 days after receipt of Notice to Proceed the Contractor Quality Control (CQC) Plan with which he proposes to implement the requirements of CONTRACT CLAUSE entitled "INSPECTION OF CONSTRUCTION". The plan shall identify personnel, procedures, instructions, records, and forms to be used. If the Contractor fails to submit an acceptable QC plan with the time herein prescribed, the Contracting Officer (CO) may refuse to allow construction to start if an acceptable interim plan is not furnished or withhold funds from progress payments in accordance with the CONTRACT CLAUSE entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS" until such time as the Contractor submits an acceptable final plan.

2.2 Coordination Meeting. Before start of construction, the Contractor shall meet with the CO and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's inspection and control with the Government's inspection. Minutes of the meeting shall be prepared and signed by both the Contractor and the CO. The minutes shall become a part of the contract file. There may also be occasions when subsequent conferences will be called to reconfirm mutual understandings.

2.3 The Quality Control Plan. This plan shall include as a minimum, the following:

2.3.1 A description of the quality control organization including chart showing lines of authority and acknowledgement that the CQC staff shall conduct the phase inspections for all aspects of the work specified and shall report to the project manager or someone higher in the Contractor's organization.

2.3.2 The name, qualifications, duties, responsibilities and authorities of each person assigned a QC functions.

2.3.3 A copy of the letter to the QC manager signed by an authorized official of the firm, which describes the responsibilities and delegates the authorities of the QC manager shall be furnished.

2.3.4 Procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.

2.3.5 Control testing procedures for each specific test. (Laboratory facilities will be approved by the Contracting Officer).

2.3.6 Reporting procedures including proposed reporting formats.

2.4 Acceptance of Plan. Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC plan and operations as necessary to obtain the quality specified.

2.5 Notification of Changes. After acceptance of the QC plan, the Contractor shall notify the CO in writing of any proposed change. Proposed changes are subject to acceptance by CO.

### 3. QUALITY CONTROL ORGANIZATION.

3.1 System Manager. The Contractor shall identify an individual, within his organization at the site of the work, who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. This CQC System Manager shall be approved by the CO.

3.2 Personnel. A staff shall be maintained under the direction of the system manager to perform all QC activities. The actual strength of the staff during any specific work period may vary to cover work phase needs, shifts, and rates of placement. The personnel of this staff shall be fully qualified by experience and technical training to perform their assigned responsibilities and shall be directly hired by and work for the Prime Contractor.

NOTE: Minimum staffing and qualifications may be specified.

4. SUBMITTALS. Submittals shall be as specified in the SPECIAL CLAUSE entitled "SUBMITTALS". The CQC Organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

5. CONTROL. Contractor Quality Control is the means by which the Contractor assures himself that his construction complies with the requirements of the contract plans and specifications. The controls shall be adequate to cover all construction operations, including both onsite and offsite fabrication, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of inspection for all definitive features of work as follows:

5.1 Preparatory Inspection. This shall be performed prior to beginning any work on any definable feature of work. It shall include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials, equipment and sample work to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Contracting Officer Representative (COR) shall be notified at least 24 hours in advance of the preparatory inspection and such inspection shall be made a matter of record in the Contractor's Quality Control documentation as required below. Subsequent to the preparatory inspection and prior to commencement of work, the Contractor shall instruct each applicable worker as to the acceptable level of workmanship required in his CQC plan in order to meet contract specifications.

5.2 Initial Inspection. This shall be performed as soon as a representative portion of the particular feature of work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements. The Contracting Officer's Representative shall be notified at least 24 hours in advance of the initial inspection and such inspection shall be made a matter of record in the CQC documentation as required below.

5.3 Follow-up Inspections. These shall be performed daily to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. Such inspections shall be made a matter of record in the CQC documentation as required below. Final follow up inspections shall be conducted and test deficiencies corrected prior to the addition of new features of work.

## 6. TESTS.

6.1 Testing Procedure. The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. The Contractor shall procure the services of an industry recognized testing laboratory or he may establish an approved testing laboratory at the project site. A list of tests which the Contractor understands he is to perform shall be furnished as a part of the

CQC plan to the Contracting Officer. The list shall give the test name, specification paragraph containing the test requirements, and the personnel and laboratory responsible for each type of test. The Contractor shall perform the following activities and record and provide the following data.

6.1.1 Verify that testing procedures comply with contract requirements.

6.1.2 Verify that facilities and testing equipment are available and comply with testing standards.

6.1.3 Check test instrument calibration data against certified standards.

6.1.4 Verify that recording forms, including all of the test documentation requirements, have been prepared.

6.2 Testing.

6.2.1 Capability Check. The COR will have the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check laboratory technician's testing procedures and techniques.

6.2.2 Capability Re-Check. If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$675.00 to reimburse the Government for each succeeding re-check of the laboratory or the checking of a subsequently-selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

6.2.3 Project Laboratory. The COR will have the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

6.2.4 Transportation of Samples for Testing. Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

For delivery by mail:

Director  
South Pacific Division Laboratory  
U.S. Army Corps of Engineers  
P.O. Box 37  
Sausalito, CA 94966

For other deliveries:

Director  
South Pacific Division Laboratory  
U.S. Army Corps of Engineers  
Bridgeway, Foot of Spring Street  
(Building directly east of 2000 Bridgeway)  
Sausalito, CA 94965

7. COMPLETION INSPECTION. At the completion of all work or any increment thereof established by a completion time stated in the paragraph: COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK of the SPECIAL CLAUSES, or stated elsewhere in the specifications, the CQC System Manager shall conduct a completion inspection of the work and develop a punch list of items which do not conform to the approved plans and specifications. Such a list shall be included in the CQC documentation, as required by paragraph: DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or his staff shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify the Contracting Officer's Representative. The completion inspection and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

8. DOCUMENTATION.

8.1 The Contractor shall maintain correct records of quality control operations, activities, and tests performed including the work of suppliers and subcontractors. In addition, these records shall include factual evidence that the required activities or tests have been performed, including but not limited to the following:

8.1.1 Type and number of control activities and tests involved.

8.1.2 Results of control activities or tests.

8.1.3 Nature of defects, causes for rejection, etc.

8.1.4 Proposed remedial action.

8.1.5 Corrective actions taken.

8.2 These records shall cover both conforming and defective or deficient features and shall include a statement that supplies and materials incorporated in the work comply with the contract. Legible copies of these records shall be furnished to the CO by noon of workday following date of report.

9. NOTIFICATION OF NONCOMPLIANCE. The Contracting Officer will notify the Contractor of any noncompliance with the foregoing requirements. The

Contractor shall, after receipt of such notice immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damage by the Contractor.

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SECTION 1D

ENVIRONMENTAL PROTECTION

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| 6. Protection of Environmental<br>Resources |  |

1. SCOPE. This section covers prevention of environmental pollution and damage as the result of construction operations under this contract and for those measures set forth in other Technical Provisions of these specifications. For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual aesthetics, noise, solid waste, radiant energy and radioactive materials, as well as other pollutants.

2. QUALITY CONTROL. The Contractor shall establish and maintain quality control for environmental protection of all items set forth herein. The Contractor shall record on daily reports any problems in complying with laws, regulations and ordinances and corrective action taken.

3. SUBMITTALS. The Contractor shall submit an environmental protection plan in accordance with provisions as herein specified.

3.1 Environmental Protection Plan shall include but not be limited to the following:

(1) A list of Federal, State and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations and permits.

(2) Methods for protection of features to be preserved within authorized work areas. The Contractor shall prepare a listing of methods to protect resources needing protection, i.e., trees, cacti, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archeological and cultural resources.

(3) Procedures to be implemented to provide the required environmental protection and to comply with the applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes or failure to follow the procedures set out in accordance with the environmental protection plan.

(4) Permit or license and the location of the solid waste disposal area.

(5) Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.

(6) Environmental monitoring plans for the job site, including land, water, air, and noise monitoring.

(7) Traffic control plan.

(8) Methods of protecting surface and ground water during construction activities.

(9) Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas.

3.2 Implementation. After receipt of Notice to proceed, the Contractor shall submit in writing the above Environmental Protection Plan within 14 days. If the Contractor fails to submit an acceptable Environmental Protection Plan within the time herein prescribed, the Contracting Officer may refuse to allow construction to start or may withhold funds from progress payments in accordance with the CONTRACT CLAUSE entitled PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS until such time as the Contractor submits an acceptable final plan. Approval of the Contractor's plan will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and other environmental protection measures.

4. SUBCONTRACTORS. Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor.

5. NOTIFICATION. The Contracting Officer will notify the Contractor in writing of any observed noncompliance with the aforementioned Federal, State or local laws or regulations, permits and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such

notice, inform the Contracting Officer of proposed corrective action and take such action as may be approved. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or costs or damages allowed to the Contractor for any such suspension.

6. PROTECTION OF ENVIRONMENTAL RESOURCES. The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications. Environmental protection shall be as stated in the following subparagraphs.

6.1 Protection of Land Resources. Prior to the beginning of any construction, the Contractor shall identify all land resources to be preserved within the Contractor's work area. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, cacti, shrubs, vines, grasses, top soil, and land forms without special permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.

6.1.1 Work Area Limits. Prior to any construction the Contractor shall mark the areas within the construction work limits that are not required to accomplish all work to be performed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be fenced or flagged. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor shall convey to his personnel the purpose of marking and/or protection of all necessary objects.

6.1.2 Protection of Landscape. Trees, cacti, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by fencing, flagging, or any other approved techniques.

6.1.3 Reduction of Exposure of Unprotected Erodible Soils. Earthwork brought to final grade shall be finished as indicated and specified. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils.

6.1.4 Temporary Protection of Disturbed Areas. Such methods as necessary shall be utilized to effectively prevent erosion and control sedimentation, including but not limited to the following:

(1) Retardation and control of Runoff. Runoff from the construction site shall be controlled by construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses, and any measures required by area-wide plans approved under paragraph 208 of the Clean Water Act.

construct or install all temporary and permanent erosion and sedimentation control features as necessary. Temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing and mulching shall be maintained until permanent drainage and erosion control facilities are completed and operative.

6.1.6 Location of Field Offices, Storage and Other Contractor Facilities. The Contractors' field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated by the Contracting Officer. Due to the sensitive nature of riparian habitat in the basin, strict adherence to the designated areas is necessary. Temporary movement or relocation of Contractor facilities shall be made only on approval by the Contracting Officer.

6.1.7 Spoil Areas shall be managed and controlled to limit spoil to areas designated and prevent erosion of soil or sediment from entering nearby water courses or lakes.

6.1.8 Temporary Excavations and Embankments for plant and/or work areas shall be controlled to protect adjacent areas from despoilment.

6.1.9 Disposal of Solid Wastes. Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. All handling and disposal shall be conducted to prevent contamination and shall conform to the requirements of applicable local, State and Federal laws and regulations.

6.1.10 Disposal of Chemical Waste. Chemical waste shall be stored in corrosion resistant containers, removed from the work area and disposed of in accordance with Federal, State and local regulations. Crankcase oil and other waste chemicals shall be captured and not drained onto the ground.

6.1.11 Disposal of Discarded Materials. Discarded material other than those which can be included in the solid waste category will be handled as directed by the Contracting Officer.

6.2 Protection of Historical, Archeological and Cultural resources shall conform to the requirements of SECTION: GENERAL REQUIREMENTS.

6.3 Protection of Water Resources. The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface and ground waters. Special management techniques as set out below shall be implemented to control water pollution by the construction activities which are included in this contract.

6.3.1 Washing and Curing Water. Waste waters directly derived from construction activities shall not be allowed to enter water areas. These waste waters shall be collected and placed in retention ponds where suspended material can be settled out or the water evaporates so that pollutants are separated from the water.

6.3.2 Monitoring of Water Areas Affected by Construction Activities shall be

6.3.2 Monitoring of Water Areas Affected by Construction Activities shall be the responsibility of the Contractor. All water areas affected by construction activities shall be monitored by the Contractor.

6.4 Protection of Wildlife Resources. The Contractor shall keep construction activities under surveillance, management and control to minimize interference with, disturbance to and damage of wildlife. Species that require specific attention along with measures for their protection will be listed by the Contractor prior to beginning of construction operations.

6.5 Protection of Air Resources. The Contractor shall keep construction activities under surveillance, management and control to minimize pollution of air resources. All activities, equipment, processes, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with the State of Arizona and all Federal emission and performance laws and standards. Ambient Air Quality Standards set by the Environmental Protection Agency shall be maintained for those construction operations and activities specified in this section. Special management techniques as set out below shall be implemented to control air pollution by the construction activities which are included in the contract.

6.5.1 Particulates. Dust particles, aerosols, and gaseous by-products from all construction activities, processing and preparation of materials, such as from asphaltic batch plants, shall be controlled at all times, including weekends, holidays and hours when work is not in progress. A permit will be required by Maricopa County Bureau of Air Pollution Control that will require particulate suppression control.

6.5.1.1 Particulates Control. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards mentioned in paragraph hereinabove to be exceeded or which would cause a hazard or a nuisance. Sprinkling, treatment with an approved non-toxic dust palliative, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated at such intervals as to keep the disturbed area damp at all times. The Contractor must have sufficient competent equipment available to accomplish this task. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

6.5.2 Hydrocarbons and Carbon Monoxide. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.

6.5.3 Odors. Odors shall be controlled at all times for all construction activities, processing and preparation of materials.

6.5.4 Monitoring of air Quality shall be the responsibility of the Contractor. All air areas affected by the construction activities shall be monitored by the Contractor.

6.6 Protection of Sound Intrusions. The Contractor shall keep construction activities under surveillance, and control to minimize damage to the environment by noise. Construction will not be allowed between the hours of 6:00 p.m. and 7:00 a.m. without the prior written approval of the Contracting Officer.

7. RESTORATION OF LANDSCAPE DAMAGE. The Contractor shall restore all landscape features damaged or destroyed during construction operations outside the limits of the approved work areas. Such restoration shall be in accordance with the plan submitted for approval by the Contracting Officer. This work will be accomplished at the Contractor's expense.

8. MAINTENANCE OF POLLUTION CONTROL FACILITIES. The Contractor shall maintain all constructed facilities and portable pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

9. TRAINING OF CONTRACTOR PERSONNEL IN POLLUTION CONTROL. The Contractor shall train his personnel in all phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual familiarization with cultural resource identification, and installation and care of facilities to ensure adequate and continuous environmental pollution control.

10. POST CONSTRUCTION CLEAN UP. The Contractor shall clean up all areas used for construction (including haul routes, disposal area) in conformance with CONTRACT CLAUSE: CLEANING UP.

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SECTION 1E

DETOURS, STREET RECONSTRUCTION, AND TRAFFIC CONTROL FACILITIES

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| 1. Detours             | 5. Traffic Control                       |
| 2. Required Detours    | 6. Removal of Detours<br>and Restoration |
| 3. Detour Construction | 7. Street Reconstruction                 |
| 4. Maintenance         |  |

1. DETOURS. Detours shall be in accordance with all applicable state, county, and city traffic regulations. Detailed plans shall be prepared for all requested detours indicating surfacing, signing, striping, pedestrian access provisions and hours of operation. These plans shall be approved by the City of Phoenix or other appropriate agency as a condition of approval by the Contracting Officer.

2. REQUIRED DETOURS. Detours shall be constructed and maintained at 24th Street to permit continuous two-way traffic use 24 hours a day. The Contractor shall keep the detour in operation until removal is authorized in writing by the Contracting Officer.

3. DETOUR CONSTRUCTION.

3.1 General. Construction of the required detours shall conform to the details and notes on the drawings and as specified herein.

3.2 Earthwork shall conform to the requirements of SECTIONS: EXCAVATION and FILLS AND SUBGRADE PREPARATION.

3.3 Asphalt Concrete shall conform to the requirements of SECTION: ASPHALT CONCRETE.

3.4 Aggregate Base shall conform to the requirements of SECTION: AGGREGATE BASE.

3.5 The Contractor shall submit a plan for approval by the Contracting Officer, of the method of handling and transporting bridge beams to the site.

3.6 Owner Supplied Materials. The Contractor shall use beams located at Adobe Dam (43rd Avenue and Beardsley Road) in the construction of the 24th Street detour bridge.

4. MAINTENANCE. The detour shall be maintained in a safe condition until it is removed. Installation and maintenance of traffic control facilities and detour surfaces, shall be performed by the Contractor. The surface shall be maintained without abrupt changes of grade in excess of 1/4 inch in 10 feet.

5. TRAFFIC CONTROL.

5.1 The Contractor shall furnish, install, maintain and remove all temporary barricades, lights, warning signs, flagmen and other facilities necessary to control the traffic and protect pedestrians within the limits of the construction area. All signs to be used on the project during periods of darkness shall be reflectorized. Traffic control shall conform to the City of Phoenix Barricade Manual; Section 400 of the Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments (MAG) and State of Arizona depending on jurisdiction.

5.2 The number and type of barricades, signs, delineators, barriers and all other traffic control devices shall be subject to approval, however, approval of traffic control devices and the approval of the Contractor's method of application of all traffic control measures, shall not relieve the Contractor of the responsibility of protecting the work, the workmen and the traveling public.

6. REMOVAL OF DETOURS AND RESTORATION.

6.1 The Contractor shall remove the detour and temporary bridges, remove materials from the site, and restore the site.

6.2 The area where the detour was placed shall be completely restored to its original condition, or as indicated in the drawings. This will include removal of the detour pavement, temporary fencing, temporary barriers and embankment, temporary bridges, and abutments to one foot below finish grade.

6.3 Utilities that had been moved or adjusted to accommodate the detour will be reset to an appropriate location and grade. Signs that were moved or changed for the detour will be replaced per their original location and type.

6.4 The bridge beams will be removed from the site and delivered to the Maricopa County Highway Department storage yard at Adobe Dam (43rd Avenue and Pinnacle Point Road). Care shall be taken so as not to damage the beams during removal or delivery. The Contractor is responsible for delivering the beams in good condition, and if the beams are seriously damaged, the Contractor will be penalized 75 percent of the cost of new beams, and shall remove the used beams from the site.

7. STREET RECONSTRUCTION.

7.1 Street Reconstruction includes all work necessary to reconstruct the street complete to the lines and grades as shown on the contract drawings.

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SECTION 2A

DIVERSION AND CONTROL OF WATER

1. REQUIREMENT.

1.1 General. All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in the basin and channels during the entire period of construction as a result of either rainfall or urban runoff. Runoff from the watersheds is rapid, and, during periods of rain, intermittent freshets may be expected. The responsibility of the Contractor for protection of work against water flows is specified in paragraph: DAMAGE TO WORK of the SPECIAL CLAUSES. All locations, where construction work to be performed is at a lower elevation than the water level, shall be dewatered prior to commencement of work. All subgrades, whether for earth fill, stone, or concrete, shall be kept drained and free of water throughout the working period. Within 10 days after receipt of Notice to Proceed, the Contractor shall submit plans showing the method that he proposes to use to dewater each working area and control the water from rain, sheet flow, urban runoff, side drains, any other surface water, seepage, and groundwater. The plans shall show the scheme of operations and a complete layout of drainage pipes, pumps, diversion channels, cofferdams, etc. The plans shall also take into consideration the following specific requirements.

1.2 Flood Flows. The Contractor shall provide for diversion of channel flows as hereinafter specified. The channel flows will include water originating from upstream of the work; urban runoff; adjacent drainages; and in addition any and all seepage and groundwater originating within the work. Flood flows are defined as follows:

- a. Arizona Canal Diversion Channel (Cudia City Wash to Dreamy Draw) - Any flows in excess of 3,000 cfs,
- b. Cudia City Wash - Any flows excess 2,000 cfs.
- c. 35th Street Inlet - Any flows in excess of 600 cfs.
- d. Ocotillo Road - Any flows in excess of 550 cfs.
- e. Myrtle Avenue Wash - Any flows in excess of 700 cfs.

1.3 Contractor shall be prepared to accept flood flows diverted to project area by the Arizona Canal.

1.4 Drainage Ditches. The location and depth of any drainage ditch to be constructed under this contract shall be subject to the approval of the Contracting Officer. Special precautions shall be taken to avoid impairing the permanent subgrade, and any excavation below the existing stream bed or invert subgrade shall be refilled with compacted fill in accordance with SECTION: FILLS AND SUBGRADE PREPARATION by and at the expense of the Contractor.

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SECTION 2B

CLEARING SITE AND REMOVING OBSTRUCTIONS

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1. PROTECTION.

1.1 Environmental Protection. All work and Contractor operations shall comply with the requirements of SECTIONS: ENVIRONMENTAL PROTECTION and EXCAVATION.

2. BURNING. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

3. REQUIREMENTS.

3.1 General. Except as otherwise specified, and/or indicated, areas to be cleared will be limited to actual excavation areas, areas to be landscaped, and areas on which fills and/or structures are to be placed. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, turf, or vegetation which can be left in place.

3.2 Existing Structures and Obstructions. The Contractor shall clear and grub the site, fill, borrow, and excavation areas, and remove and dispose of all existing structures and obstructions for project construction, except as those structures which are identified to be protected in place as shown on the drawings. Obstructions which are designed or specified to be removed but which are not designated or specified to be removed by others shall be removed by the Contractor. Except as otherwise specified, obstructions designated to be removed by others will be removed in sufficient time to preclude interference with the Contractor's operations. Utility relocations are not considered to be obstructions.

3.2.1 Clearing. Trees smaller than 1-1/2 inches in diameter and other vegetation, except as specified, shall be cut off 6 inches below the indicated channel subgrade or ground level whichever is lower. Other vegetation shall be cut off flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures, and installations under construction, or to remain in place, and to provide for the safety of employees and others. All rubbish, waste dumps, and debris areas shall be cleared.

3.2.2 Grubbing shall consist of removing all trees, stumps, roots, logs, and other objectionable vegetable matter in the required fills, foundation areas,

and all excavation areas. In grubbing out stumps and roots, all roots or other timber more than 1-1/2 inches in diameter shall be removed to 3 feet below the depth of the required excavation or existing ground level, whichever is lower. Trees and stumps shall be pulled, not cut off.

3.3 Utilities. Prior to removing an obstruction, all applicable utility relocations shall have been coordinated. Pipes designated by owners as "abandoned" shall be removed within the limits of the project as necessary for clearing. All abandoned pipes shall be plugged at the cut ends as shown on the drawings or as directed by the Contracting Officer.

4. DISPOSAL OF CLEARED, GRUBBED, AND REMOVED MATERIAL. All material removed, except material specified and/or indicated to be salvaged, is designated as scrap, shall become the property of the Contractor, and shall be removed from the site. Unsuitable materials from clearing operations may be temporarily used for diversion and control of water. Disposal shall be in accordance with the requirements of SECTION: ENVIRONMENTAL PROTECTION.

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## SECTION 2C

### EXCAVATION

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| 4. Preservation of Property       | 10. Overcut                        |
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| 6. Excavation for Curbs and Roads |                                    |

1. **APPLICABLE PUBLICATIONS.** The American Society for Testing and Materials (ASTM) Standards listed below forms a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

D 2487-85

Classification of Soils for Engineering Purposes

2. **GENERAL.** Excavation shall consist of the removal of every type of material encountered (except materials covered by the provisions of the SECTION: CLEARING SITE AND REMOVING OBSTRUCTIONS) in the designated areas or from areas directed. The material to be removed may include but is not limited to earth, hardpan, silt, clay, gravel, cemented sand and gravel, rock, adobe, detached pieces of stone and concrete, rock fills, existing fills of miscellaneous debris and rubbish, and other unsuitable materials. "Rock" is defined as solid bedrock, fractured or decomposed or weathered bedrock, and boulders and blocks 1/2 cubic yard or more in volume. All blasting required for excavation shall conform to the requirements specified in the paragraph: **BLASTING.** Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation shall be performed in a manner which will not impair the subgrade. Except for rock excavation or as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 1/2 inch above or 2 inches below indicated grade.

2.1 Topsoil shall be stockpiled in accordance with SECTION: TREES, SHRUBS AND GROUND COVER.

### 3. **BLASTING.**

3.1 **General.** All blasting required for excavation shall conform to the requirements in the following paragraphs and shall also be in accordance with the applicable portions of Section 107 of the Maricopa Association of Governments (M.A.G.) Uniform Standard Specifications and Article 12 of the City of Phoenix, Arizona Fire Prevention Code.

3.2 **Safety Requirements.** For these requirements reference is made to the

CONTRACT CLAUSE: ACCIDENT PREVENTION. Blasting will be permitted only when adequate precautions are taken for the protection of persons, the work, and property. Any damage to the work or property shall be repaired by the Contractor at no cost to the Government.

3.3 Permits. For these requirements reference is made to the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. The Contractor shall obtain all required licenses and permits for the use of explosives and shall also comply with the provisions and requirements of all applicable laws, ordinances, and regulations in the transportation, storage, handling, and use of such explosives.

3.4 Utility Notification. The Contractor shall notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given sufficiently in advance to enable the companies to advise the Contractor of any precautions that should be taken to protect their structures from damage.

3.5 Submittals.

3.5.1 Blasting Plan. The Contractor shall submit 3 copies of the proposed blasting plan to the Contracting Officer for approval not less than 30 calendar days prior to drilling for each blast. The proposed plan shall show the pertinent data on the location, depth, and area of the blast; the diameter, spacing, depth, overdepth, pattern, and inclination of the blast holes; the type, strength, amount, distribution, and powder factor for the explosives used per hole and per blast; the sequence and pattern of delays; the description and purpose of controlled blasting techniques, and the control of noise, dust, flyrock, airblast and ground vibrations.

3.5.2 Preblast Report. The Contractor shall submit 3 copies of a preblast inspection report of adjacent properties to the Contracting Officer for approval not less than thirty (30) calendar days prior to commencing blasting operations. The report shall document, on drawings and by photographs, the locations of all existing cracks and damages to structures within 500 feet of the blast site. The report shall also include information on any property owners who refused to cooperate and permit entry and inspection.

3.6 Approval of Blasting Plan. Approval by the Contracting Officer of a blasting plan shall not relieve the Contractor of his responsibility to produce satisfactory results as set forth in these specifications. When a drilling and blasting program results in damage to the excavation or adjacent structures, the Contractor shall be required to modify his blasting plan, subject to approval by the Contracting Officer, to produce the desired results.

3.7 Personnel. During blasting operations the Contractor shall have on the site, and in immediate charge of the blasting and rock excavation, a blasting expert, acceptable to the Contracting Officer, who has had no less than 3 years of continuous experience in controlled blasting and rock excavation operations. Powder handlers shall have no less than one year of continuous experience in preparation and loading of powder charges.

3.8 Blasting Procedures. Drilling and blasting within the diversion channel excavation shall be in accordance with the blasting plan approved by the Contracting Officer. The Contractor shall control the blasting procedures so as not to overshoot and shall be required to remove at his own expense, any material outside the authorized lines and grades indicated on the drawings which may be shattered or loosened by such blasting.

3.8.1 Controlled Blasting. Controlled blasting techniques (i.e., presplitting, line drilling, or smooth blasting) shall be required for blasting within the diversion channel and Cudia City Wash Sediment Basin excavation and such other areas designated by the Contracting Officer. The explosives shall be of such strength and quantity and shall be used in such a manner that will neither open seams nor otherwise damage the rock outside of prescribed limits of excavation. Controlled blasting shall be performed in a manner which will produce relatively smooth and sound faces at the final excavation lines. Where blasting is performed for excavation, buffer zones are to be provided as indicated on the drawings. Within the buffer zones the depth and spacing of blast holes and the amount of explosives shall be varied with the field conditions to prevent damage to the rock faces. Whenever, in the opinion of the Contracting Officer, blasting may injure the cut slopes or rock upon which or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation shall be completed by wedging, barring, channeling and broaching, or other suitable methods. Any damage to, or displacement of supports and any damage to any part of the work or adjacent structures caused by blasting shall be repaired by and at the expense of the Contractor and in a manner satisfactory to the Contracting Officer.

### 3.9 Restrictions.

3.9.1 No blasting shall be permitted within 100 feet of concrete which has been in place less than 7 days.

3.9.2 Ammonium nitrate type explosives shall not be used along any final excavation lines or within any buffer zones where controlled blasting techniques are employed.

3.9.3 Use of non-electric blasting caps is prohibited.

3.9.4 Blasting mats shall be used at all times and shall be in good repair. Steel mats shall not be allowed within 2000 feet of powerlines.

3.10 Records. The Contractor shall keep and furnish to the Contracting Officer accurate logs and records of all operations pertaining to the preparation, drilling, blasting, blast monitoring, and excavation procedures for each round of blasting. The records shall be submitted daily with the Quality Control Report and shall include the following:

3.10.1 A plan view of the actual blast hole layout, located on each corner by stationing, top and bottom elevations, offset from centerline, and distances from final excavation lines. The plan sketch shall include the number, size, depth, orientation, and spacing of each drill hole utilized for each round of

blasting.

3.10.2 The quantity, type, and strength of explosives, and stemming used in blasting each drill hole.

3.10.3 The type, make, and system of detonation used for each round of blasting.

3.10.4 The volume of rock excavated from each round of blasting.

3.10.5 Any unusual drilling or blasting occurrences.

3.10.6 The number, size, type, and make of all equipment used in the excavation process.

3.10.7 A copy of seismograph recordings of ground motion velocities and airblast levels together with complete and accurate interpretations of such data.

4. PRESERVATION OF PROPERTY. All excavation operations shall be conducted in such a manner that street pavements, sidewalks, curbs, utilities, structures, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores or whatever means may be necessary to adequately support material carrying such improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval all designs and shop drawings showing proposed method of shoring and bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressure exerted by and the condition and nature of the materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such a manner as not to disturb or damage the finished concrete.

4.1 Location of shoring shall be as indicated on the drawings.

4.2 The following soil parameters can be used for the design of the temporary sheet piling, cribbing, bulkheads, shores or other protective means.

Wet unit weight	=	130 lbs/ft <sup>3</sup>
Angle of internal friction	=	30 degrees
Coefficient of cohesion	=	0 lbs/ft <sup>2</sup>

5. EXCAVATION FOR STRUCTURES. Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with EM 385-1-1 (Safety Manual). Excavation

adjacent to construction already in place shall not be lower than existing grade of that existing construction.

6. EXCAVATION FOR CURBS AND ROADS. Excavation for curbs and access roads shall include materials unsuitable for road subgrade. Unsuitable materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487 as ML, CL, MH, CH, PT, OH and OL.

7. EXCAVATION FOR SIDE DRAINS. Excavation for side drains shall conform to the requirements of SECTION: SIDE DRAINS.

8. REMOVAL OF UNSATISFACTORY SOILS. The removal of soils which are unsatisfactory for foundations of the channel, structures, streets, and drains, will be required in certain areas. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487 as ML, CL, MH, CH, PT, OH and OL. The Contractor will be required to excavate any such areas to the depth directed and backfill the areas with compacted fill conforming to the requirements of the SECTION: FILLS AND SUBGRADE PREPARATION.

9. DISPOSAL OF EXCAVATED MATERIALS. Excavated materials suitable for compacted fill, structure fill, and other required fills, shall be placed in temporary stock piles or used directly in the work. All excess excavated material not disposed of within the optional disposal areas, excavated material not suitable for fills, and unsatisfactory material shall become the property of the Contractor and shall be removed from the site. No excavated material or waste of any kind shall be disposed of at any place beyond the limits of the work under this contract without express authority. Prior to placing fills in stock piles, or optional disposal areas, the site shall be cleared of trash and vegetation. Vegetation shall be cut off at the existing ground line. Clearing shall conform to the applicable requirements of SECTION: CLEARING SITE AND REMOVING OBSTRUCTIONS. Stock piles and disposal fills shall be placed in a manner to preclude the ponding of water. The Contractor shall furnish notification of his intention to use optional disposal sites in accordance with the requirements of the paragraph: PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS of the SECTION: GENERAL REQUIREMENTS.

9.1 Additional requirements for disposal of excess material can be found in the SPECIAL CLAUSES and SECTIONS: GENERAL REQUIREMENTS; ENVIRONMENTAL PROTECTION; and CLEARING SITE AND REMOVING OBSTRUCTIONS.

10. OVERCUT. Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to SECTION: FILLS AND SUBGRADE PREPARATION for earth subgrades or concrete conforming to SECTION: CONCRETE, for rock subgrades and all excavating, backfilling, compacting of backfill, and concreting occasioned thereby shall be by the Contractor at no additional cost to the Government. Any overcut under bridge footings shall be backfilled with concrete.

11. TOLERANCES FOR ROCK EXCAVATION. Excavations for concrete structures have

certain reference lines designated as "A" line and "B" line. The "A" line is located 6 inches above the "B" line in all inverts and 6 inches inside the "B" line in all walls. The "A" line represents the inner tolerance limit inside which no rock or dental concrete will be permitted to project. Any projections inside of "A" line shall be removed. The "B" line is the line to which measurement for payment of excavation will be made, and is considered to be the final excavation line indicated on the drawings. Measurement for payment will be made to this line regardless of whether the limit of the actual excavation falls inside or outside of it, but sufficient excavation inside of this line shall be performed to provide for the proper installation of steel reinforcement and placement of concrete. Any excavation beyond the "B" line shall be replaced with concrete complying with the applicable portions of these specifications without additional cost to the Government.

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SECTION 2D

FILLS AND SUBGRADE PREPARATION

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1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Standards listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

D 1556-82	Density of Soil In-Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil - Aggregate Mixtures Using 10-Lb. (4.54 Kg) Rammer and 18-In. (457 mm) Drop
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil-Aggregate Mixtures
D 2487-85	Classification of Soils for Engineering Purposes
D 2922-81	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

2. COMPACTION EQUIPMENT.

2.1 General. Compaction shall be accomplished by tamping rollers, steel drum rollers or vibratory compactors.

3. GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS.

3.1 Control. Moisture-density relations shall be established by the Contractor. Field density tests shall be performed by the Contractor in sufficient number and in such locations to insure that the specified density is being obtained. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight determinations shall be provided on the day each test is taken. The completed test reports shall be provided with the Contractor Quality Control Report on

the work day following the test.

3.1.1 Laboratory Control. One moisture-density relation shall be made for each classification, blend or change in classification of soil material encountered. Approval of moisture-density relations shall be obtained prior to the compacting of any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557 (modified as specified hereinafter).

3.1.1.1 A separate batch of materials will be used for each compaction test specimen. No materials will be re-used.

3.1.1.2 The desired amount of mixing water will be added for each compaction test specimen, mixed well, and the mixture will be placed in a container with an airtight cover and allowed to cure for 24 hours. A shorter curing time may be allowed where tests show that shortening the curing time will not affect the results.

3.1.1.3 A moisture-density relation shall be performed for every tenth field density test. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557 (modified as specified hereinafter).

3.1.1.3.1 Only one compaction test specimen (one-point) will be formed.

3.1.1.3.2 The material used for the compaction test specimen will be no wetter than minus 2 percent of optimum.

3.1.1.3.3 The addition of water and curing for the material will be as specified hereinabove.

3.1.2 Field Control. Field in-place density shall be determined in accordance with ASTM D 1556 and Field Moisture Content shall be determined in accordance with ASTM D 2216. The density tests shall be well distributed and shall average not less than one test for each 4,000 cubic yards of material. At least one test shall be made in each 2 feet of compacted material processed as a unit and at least one test shall be made in each area.

3.1.3 Moisture-Density Curves for Cohesionless and Cohesive Material. Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils may show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.2 Settling of Fills or Backfills with Water will not be permitted, except as specified hereinafter for sand fill, filling voids behind walls, and channel R.C.P. bedding.

3.3 Material shall be obtained from the required excavations, shall be free from sod, roots, brush, debris, trash or other objectionable material, and

shall contain no stone whose greatest dimension is more than 3/4 of the layer thickness.

3.4 Placement. Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with the SECTION: CONCRETE. Heavy equipment shall not be operated over pipes and buried structures until at least 2 feet of fill material has been placed and compacted over them in conformance with the requirements of SECTION: SIDE DRAINS. Compacted fill and backfill shall be placed with suitable equipment in horizontal layers which after compaction, shall not exceed 12 inches in depth for rubber-tired or vibratory rollers, 6 inches in depth for tamping rollers, and 4 inches in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

3.5 Moisture Content. Material shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after the time water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 3 percent above optimum and a minimum moisture content of not less than 3 percent below optimum.

3.6 Compaction. No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. If the Contractor elects to use rubber-tired or steel drum compaction equipment and the compacted surface of any layer of material is determined by the Contracting Officer to be too smooth to bond properly with succeeding layers, it shall be scarified by a method approved by the Contracting Officer. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to be operated within one foot of channel or structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of 2 feet. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures where rolling equipment is impracticable for use in compaction.

#### 4. COMPACTED FILL, CHANNEL.

##### 4.1 General.

4.1.1 Material for compacted fill channel shall be obtained from the required excavations as approved by the Contracting Officer. In general, the best material available will be designated as compacted fill, channel. Compacted fill, channel may consist of sand, gravelly sand, silty sands, and clayey sands as determined by ASTM D 2487. Organic material, silt, sandy silt, clay, sandy clay, broken concrete or pavement, stone when the greatest dimension is

greater than 3 inches, and other objectionable materials shall not be used.

4.1.2 Preparation for Placing. Before placing material for compacted fill, the foundation surface shall be cleared of all existing obstructions, vegetation, and debris and proofrolled by 4 passes of the compaction equipment. Unsuitable material not meeting the requirements for fill material, as defined in the above paragraph, shall be removed where directed, and the existing surfaces scarified to a depth of 6 inches before placing the fill. Sloped ground surfaces steeper than one vertical to 4 horizontal, on which fill or compacted backfill is to be placed, shall be stepped in such a manner that the compaction equipment will bear on the full depth of the fill layer.

4.1.3 Compaction. Each layer of the materials shall be compacted to not less than 90 percent of maximum density, except for the fill beneath the invert access ramps at Stations 796+71, 861+00, and 952+31. Each layer of the materials beneath the invert access ramps shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. This zone of fill compacted to 95 percent of maximum density beneath the invert access ramps shall extend past the edges of the ramps to planes drawn on a 1V to 1H slope projected from a plan projection of the ramp on the bottom of the excavation or as directed by the Contracting Officer.

#### 4.2 Behind Channel Walls.

4.2.1 Placing. Fill material as defined hereinabove shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with SECTION: CONCRETE. Backfill pressure behind both walls shall be kept as equal as possible by bringing up the fill behind the walls in equal increments of reasonable height. It is the Contractor's responsibility to assure that the walls do not become misaligned using this method. The concrete invert shall have been in place not less than 7 days, prior to completing backfill at that location. The construction sequence and backfilling operation shall be phased such that any runoff that would pool behind the walls is pumped out or flows freely from behind the walls to preclude saturating the backfill.

4.2.2 Limitations on Equipment. The gross weight of any piece of equipment, or the combined weight of any combinations of equipment coupled together, used to place, moisten and/or compact fill behind channel walls shall not exceed 35,000 pounds, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill behind the channel walls shall be of such size as to be capable of operating in the area between the cut slope and the channel wall. Compaction equipment will not be required to operate at elevations lower than 2 feet above the top of the heel of the channel invert.

4.2.3 Compaction. Each layer of fill behind channel walls shall be compacted to not less than 90 percent of maximum density as determined by ASTM D 1557.

5. COMPACTED FILL, BACKFILL TOE. Backfill toe shall consist of material placed over grouted stone protection.

5.1 Materials. Materials for compacted fill shall conform to the requirements in the paragraph: COMPACTED FILL, CHANNEL.

5.2 Compaction. Backfill toe compacted fill shall be placed in 24-inch thick horizontal layers and compacted by 2 passes of the construction equipment and smoothed and dressed to the lines and grades indicated.

6. COMPACTED FILL, LEVEE.

6.1 Materials. Materials for compacted levee fill shall conform to the requirements in the paragraph: COMPACTED FILL, CHANNEL.

6.2 Preparation for placing shall conform to the requirements specified for preparation for placing fill material in the paragraph: COMPACTED FILL, CHANNEL.

6.3 Compaction. Each layer of levee fill shall be compacted to not less than 90 percent of maximum density.

7. COMPACTED FILL, SIDE DRAINS. Bedding and backfill for side drains and storm drains shall conform to the requirements of SECTION: SIDE DRAINS.

8. BACKFILLS.

8.1 Backfill and Fill About Structures.

8.1.1 Location. Backfill and fill shall consist of all fill against and/or around structures, except backfill for side drain trenches, compacted fill channel, compacted fill backfill toe, and compacted fill levee.

8.1.2 Material. Backfill and fill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, silty sands, and clayey sands. Organic material, silt, sandy silts, clay, sandy clays, broken concrete or pavement, stone when the greatest dimension is greater than 3 inches and other objectionable material shall not be used.

8.1.3 Placing. Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with SECTION: CONCRETE.

8.1.4 Compaction shall be not less than 90 percent of maximum density.

8.2 Backfill, Side Drain Trenches. Backfill for side drains shall conform to the requirements of SECTION: SIDE DRAINS.

9. SUBGRADE PREPARATION.

9.1 Subgrade Preparation (Earth). After the channel has been excavated to rough grade in accordance with SECTION: EXCAVATION, the entire subgrade for the channel invert slab and Cudia City Wash Sediment Basin Spillway shall be

proofrolled by 4 passes of the compaction equipment and trimmed to a uniform grade and smoothed with a steel-wheeled roller to make the subgrade ready to receive concrete. If the subgrade is disturbed by the Contractor's operations or is overexcavated, or is soft and yielding the subgrade shall be restored to grade and compacted to a density of 90 percent of maximum density. The finished surface of the subgrade shall not be more than 1/2 inch from the indicated grade at any point when tested with a 10-foot straightedge.

## 9.2 Subgrade Preparation (Rock).

9.2.1 General. Bedrock surfaces upon or against which structural concrete or backfill materials are to be placed shall be prepared and treated as directed by the Contracting Officer and as specified herein below.

9.2.2 Equipment. Bedrock surfaces shall be cleaned using hand tools. Hand tools, where required or permitted by these specifications, include but are not limited to shovels, bars, picks, wedges, and brooms. Light power tools and rubber tired mechanical equipment may be used only when such use is approved by the Contracting Officer.

9.2.2.1 Air Jets. Air jets may be used only when such use is approved by the Contracting Officer. An air jet shall consist of a minimum one inch nozzle with a supply hose connected to a suitable source of compressed air. The compressed air shall be controllable at the nozzle.

9.2.3 Surface Preparation. When the excavation has reached the approximate limits shown on the drawings, the Contractor shall perform a detailed cleanup of the bedrock surface. The work shall consist of removing loose and/or weathered rock and pockets of fines, sand, rock, rubble or gravel and other objectionable material as directed from the in-place rock surfaces including depressions, large crevices, and open joints and fractures. Picking, barring, and hand excavation may be necessary to obtain a foundation surface free from loose, drummy, or shattered rock. The final rock surface shall be thoroughly cleaned by the use of hand tools or other approved methods and shall be maintained in a clean condition until the placement of structural concrete or backfill materials thereon.

9.2.4 Surface Treatment. Prior to the placement of structural concrete or backfill materials, all designated bedrock surfaces shall be treated with dental concrete as directed by the Contracting Officer. No dental concrete shall be placed until the foundation cleanup is approved by the Contracting Officer. No structural concrete or backfill materials shall be placed until all dental concrete has had a minimum of 2 days to cure.

9.2.4.1 Dental Concrete. Dental concrete shall be used to fill joints, cavities, and depressions. Prior to placement of dental concrete, the designated areas for placement shall be thoroughly cleaned using approved methods. The designated areas shall be moistened such that absorption of water from the dental concrete will be minimized, however, no standing water will be allowed. Immediately after placement, the dental concrete shall be vibrated as specified in the SECTION: CONCRETE and screen tamped to provide a rough surface texture. The edges of all dental concrete areas shall then be

trimmed, as required, so that no thin coats of concrete are left on smooth, intact rock surfaces. Concrete, including any forming required for acceptable placement, shall conform to the applicable requirements of the SECTIONS: CONCRETE and FORMWORK FOR CONCRETE.

9.2.5 Foundation Approval. No structural concrete or backfill materials shall be placed on any part of the bedrock foundation until all foundation preparation and treatment has been completed and such areas have been inspected and approved by the Contracting Officer. The Contractor shall remove, at his own expense, any backfill material or structural concrete placed on any part of the bedrock foundation surface which has not been approved by the Contracting Officer and shall reclean such areas at his own expense to the satisfaction of the Contracting Officer. Areas approved for material or concrete placement which have been exposed for more than 5 days may require re-cleaning at no additional expense to the Government. Areas approved for immediate material or concrete placement shall then be moistened as directed. Foundation approval shall be done in sections, the limits of which shall be established by the Contracting Officer in the field.

9.3 Subgrade Preparation for Spillway, Road Pavement, Curbs and Driveways. The subgrade shall be alternately watered and scarified until the material is uniformly moistened throughout for a depth of not less than 6 inches. All stones larger than 4 inches in diameter, and hard ribs of earth shall be removed. The amount of water to be applied shall be that which is required to provide optimum results in compaction under rolling. Following the above operations, the subgrade shall be shaped to a true cross section sufficiently higher than the specified grade to allow for subsequent compaction and then be thoroughly compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. After the subgrade has been prepared and completed, the surface shall be firm, hard, and unyielding, with a true, even and uniform surface conforming to the grade and cross section indicated on the drawings. All points of the finished subgrade shall be not more than 1/4 inch below or above true subgrade. Subgrades on rock shall be prepared as specified in paragraph: SUBGRADE PREPARATION.

10. MISCELLANEOUS FILL. Miscellaneous fill shall consist of material from the required excavation, placed in the area indicated and shall be placed with suitable equipment in layers which shall not exceed 24 inches in depth before consolidation. No depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required. Broken concrete, rock, bituminous paving and other objectionable material shall not be used.

11. OPTIONAL DISPOSAL AREAS. Fill to be placed in the optional disposal areas shall consist of material from the required excavation.

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SECTION 2E

PRIME COAT AND WEED KILLER

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Standards.

D 140-88	Sampling Bituminous Materials
D 2027-76 (R 1986)	Cutback Asphalt (Medium-Curing Type)

2. BITUMINOUS MATERIAL. The bituminous material for the prime coat shall be liquid asphalt, conforming to ASTM D 2027, designation MC-70.

3. SAMPLING AND TESTING.

3.1 Sampling. Samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140.

3.2 Testing shall be the responsibility of the Contractor. Testing shall be performed by an acceptable commercial testing laboratory or by the Contractor on approval of the Contracting Officer. Materials shall be tested to establish compliance with the specified requirements.

3.3 Certified Laboratory Test Reports. Before delivery of bituminous materials, certified copies, in triplicate, of the tests specified herein and in referenced publications shall be submitted to and approved by the Contracting Officer. The testing shall have been performed by an independent laboratory approved by the Contracting Officer.

4. QUANTITY TO BE APPLIED. Bituminous material for the prime coat shall be applied in quantities of not less than 0.10 gallon nor more than 0.35 gallon per square yard of the surface to be primed. Application of prime coat shall be divided, if necessary, into 2 applications to avoid flowing off the surface. The exact quantities which may be varied to meet field conditions shall be determined by the Contractor and approved.

5. WEATHER LIMITATIONS. The prime coat shall be applied only when the prepared surface is dry or contains moisture not exceeding quantity to permit uniform distribution and desired penetrations. Prime coat shall be applied only when the ambient temperature is 50 degrees F. or above and the temperature has not been below 35 degrees F. for 12 hours immediately prior to application.

6. EQUIPMENT.

6.1 General. All equipment, tools, and machines, used in the performance of the work required by this section shall be subject to the approval of the Contracting Officer.

6.2 Bituminous Distributor shall have pneumatic tires of such width and number that the load produced on the base surface shall not exceed 650 pounds per inch of tire width. The distributor shall be designed and equipped to distribute the bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with a pressure range of 25 to 75 pounds per square inch and with an allowable variation not to exceed 5 percent from any specified rate. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating the materials to the proper application temperature, a thermometer to show the temperature of the tank contents, and a hose attachment suitable for applying bituminous material to spots unavoidably missed by the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

6.3 Heating Equipment for Storage Tanks. Equipment for heating bituminous material shall consist of steam coils and equipment for producing steam, so designed that steam cannot get into the material. An armored thermometer with a range from 40 to 200 degrees F. shall be fixed to the tank so that the temperature of the bituminous material may be read at all times.

6.4 Brooms and Blowers shall be of the power type and shall be suitable for cleaning prepared surfaces.

7. PREPARATION OF SURFACE. Immediately before applying the weed killer and prime coat, all loose material, dirt, clay or other objectionable substance shall be removed from the surface by means of a power broom or blower supplemented with hand brooms. After the cleaning operation and prior to the application of the material, an inspection of the area to be treated shall be made by the Contractor to determine the fitness of the area to receive the material. The Contracting Officer shall be notified 24 hours in advance of application of the material. To assure a uniform spread of the material, the areas prepared for treatment, if excessively dry, shall be lightly sprinkled with water immediately before the application as directed.

8. WEED KILLER. A chemical weed killer shall be applied to all areas to receive prime coat prior to application of the prime coat. The weed killer shall be EPA- approved pre-emergent herbicide specifically formulated for the

intended purpose and suitable for eradicating weed species found in the area. The weed killer shall have demonstrated satisfactory performance for a period of at least 3 years. Application methods and rates shall be as recommended by the manufacturer. The proposed weed killer, application methods and rates shall be submitted to the Contracting Officer for approval.

9. APPLICATION OF BITUMINOUS MATERIAL. Immediately following the preparation of the surface, the bituminous material shall be applied by means of a bituminous distributor. The bituminous material shall be applied at a pressure within the range of 25 to 75 pounds per square inch and in the amounts as directed. The bituminous material shall be so applied that uniform distribution is obtained at all points of the surface to be treated. Unless the distributor is equipped to obtain satisfactory results at the junction of the previous and subsequent application, building paper shall be spread on the surface of applied material for a sufficient distance back from the ends of each application so that flow from the sprays can be started and stopped on the paper, and all sprayers operate at full force on the surface to be treated. Immediately after the application, building paper shall be removed from the site by the Contractor. Spots unavoidably missed by the distributor shall be properly treated with bituminous material. Following the application of bituminous material, the surface shall be allowed to dry without being disturbed for a period of not less than 48 hours, or longer as necessary to attain penetration into the foundation course and evaporation of the volatiles from prime material. The Contractor shall furnish and spread enough approved sand to blot up effectively and cure any excess bituminous material. The Contractor shall maintain the primed surface until the succeeding layer of pavement is placed by protecting the surface against damage and by repairing and repriming deficient areas at no additional cost to the Government. No smoking, fires, or flames other than heaters that are a part of the equipment shall be permitted in the vicinity of heating, distributing, or transferring operations of bituminous material.

9.1 Application Temperature shall be as directed and shall provide an application viscosity between 40 and 120 centistrokes, kinematic, or 20 and 60 seconds, Saybolt-Furol. Application temperatures shall be between 120-190 degrees F., except that appropriate changes should be made when the ranges of viscosity are raised or lowered. The temperature-viscosity relationship shall be furnished to the Contracting Officer.

10. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be submitted during the progress of the work. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified weigh bills and/or certified delivery tickets for all bituminous material actually used in the construction of pavement covered by this section of the specification.

\* \* \* \* \*

SECTION 2F

ASPHALT CONCRETE

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Association of State Highway and Transportation Officials (AASHTO) Standard.

M 226-80  
(R 1986)

Viscosity Graded Asphalt Cement

1.2 American Society for Testing and Materials (ASTM) Standards.

C 117-87

Materials Finer Than No. 200  
(75um) Sieve in Mineral  
Aggregates by Washing

C 127-88

Specific Gravity and Absorption of  
Coarse Aggregate

C 128-88

Specific Gravity and Absorption of  
Fine Aggregate

C 136-84  
(Rev A)

Sieve Analysis of Fine and  
Coarse Aggregates

D 140-70  
(R-1981)

Sampling Bituminous Materials

D 242-85

Mineral Filler for Bituminous  
Paving Mixtures

D 977-86

Emulsified Asphalt

## 1.3 Military Standard.

MIL-STD-620A  
& Notice 1Test Methods for Bituminous Paving  
Materials

2. DESCRIPTION. Asphalt concrete indicated as "A.C." shall consist of fine and coarse aggregates and mineral filler, if required, uniformly mixed with hot bituminous material, and placed and compacted on a prepared base course subgrade.

3. AGGREGATES shall consist of crushed stone, crushed or uncrushed gravel, screenings, sand, and mineral filler. Aggregates shall have a satisfactory service record in bituminous pavement construction. The source selected shall be approved by the Contracting Officer. Material passing the No. 200 sieve shall be known as mineral filler. Mineral filler shall conform to ASTM D 242. The combined aggregates and mineral filler shall meet the requirements of subsequent paragraphs entitled AGGREGATE GRADATION and COMPOSITION OF MIXTURE.

## 4. BITUMINOUS MATERIAL.

4.1 Bituminous material to be mixed with the mineral aggregates shall be asphalt cement conforming to AASHTO M226, viscosity grade AR-40 or AR-80, Table 3.

4.2 Bituminous material used for the tack coat shall be an asphalt emulsion conforming to the requirements of ASTM D 977, Type RS-1h.

## 5. SAMPLING AND TESTING.

5.1 Sampling. Samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140.

5.2 Quality Control Testing shall be the responsibility of the Contractor. Testing shall be performed by an acceptable commercial testing laboratory or by the Contractor on approval of the Contracting Officer. Materials shall be tested to establish compliance with the specified requirements. Certificates of compliance shall be furnished.

5.3 Minimum Quality Control Testing. In addition to other tests specified elsewhere, the Contractor is required to perform the following tests on materials as specified hereinafter. At least one set of tests, as described below, shall be completed for each day's placement of asphalt.

5.3.1 Two tests for aggregate gradation for each 500 tons of aggregate produced.

5.3.2 One determination each for stability, flow, voids total mix, and voids

filled with bitumen for every 500 tons of AC produced.

6. AGGREGATE GRADATION. The aggregate gradation as determined by ASTM C 117 and C 136 shall conform to the following.

Sieve Opening	Percentage By Weight Passing
1-inch	100
3/4-inch	97-100
1/2-inch	85-100
3/8-inch	70-90
No. 4	50-75
No. 8	35-65
No. 30	20-40
No. 200	2-8

7. COMPOSITION OF MIXTURE.

7.1 Job-Mix Formula shall be submitted by the Contractor, and no bituminous mixture shall be manufactured until it has been approved. The formula will indicate the percentage of each sieve fraction of aggregate, percentage of asphalt, and temperature of the mixture as discharged from the mixer. The percentage of asphalt in the job-mix formula will be between 5.5 percent and 6.5 percent.

7.2 Test Properties of Bituminous Mixtures. The apparent specific gravity, as determined by ASTM C 127 and C 128, shall be used in computing the voids total mix and voids filled with bitumen, and the mixture shall meet the following requirements as determined by ASTM D 1559:

Test Property	50-Blow Compaction
Stability, minimum, pounds,	500
Flow, maximum, 1/100-inch	20
Voids total mix, percent	3-5
Voids filled with bitumen, percent	75-85

7.3 Retained Stability. If the index of retained stability of the job-mix formula is less than 75 when tested in accordance with Method 104 of MIL-STD-620, the aggregates shall be rejected or treated by one of the following procedures:

(1) Addition of heat-stable additives to bitumen.

(2) Addition of hydrated lime, or other cementitious material containing free lime, as a portion of the mineral filler.

8. MIXING PLANT shall be a weigh-batch or continuous-mixing type approved by the Contracting Officer and operated so as to produce a mixture within the job-mix formula.

9. OTHER EQUIPMENT.

9.1 Bituminous-Materials Spreaders shall be self-propelled and capable of producing a finished surface conforming to the smoothness requirements specified hereinafter. The use of a spreader that leaves indentations or other objectionable irregularities in the freshly-laid mix will not be permitted.

9.2 Blowers and Brooms shall be of the power type suitable for cleaning the surface to be paved.

9.3 Saws shall be of the power type, capable of rapidly cutting pavement and trimming joints and edges of pavement.

9.4 Small Tools available on the work shall consist of the following: rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters for heating small tools, wood sandals and stilt sandals of standard type, and other small tools as may be required.

9.5 Steel-Wheel Rollers shall be self-propelled, 3-wheel (tricycle) and/or tandem type, weighing not less than 20,000 pounds each. The rollers shall have adjustable wheel scrapers, water tanks, and sprinkling apparatus to keep the wheels sufficiently wet to prevent the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing without backlash and shall be free from worn parts. Roller wheels shall not have flat or pitted areas or projections that will leave marks in the pavement.

9.6 Pneumatic-Tired Rollers shall be self-propelled and shall consist of 2 axles on which are mounted multiple pneumatic-tired wheels in such a manner that the rear group of wheels will not follow in the tracks of the forward group but spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth and capable of being inflated to at least 90 p.s.i. Construction of the roller shall be such that each wheel can be loaded to a minimum of 4,500 pounds.

9.7 All equipment, tools and machines used in the performance of work specified herein shall be subject to approval and shall be maintained in satisfactory working conditions.

10. TREATMENT OF UNDERLYING SURFACE. Prior to laying a bituminous course, the underlying surface shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, and hand brooms, as directed. The surface to be paved shall receive prime coat and weed killer conforming to the requirements of the SECTION: PRIME COAT AND WEED KILLER.

11. TRANSPORTATION OF BITUMINOUS MIXTURE. The bituminous mixture shall be transported from the mixing plant to the site in trucks having tight, clean, smooth bodies with a minimum coating of concentrated solution of hydrated lime and water to prevent adhesion of the mixture. Each load of mixture shall be covered with canvas or other suitable material to protect the mixture from the weather and to prevent loss of heat. Mixtures having temperatures greater than 350 degrees, mixtures having temperatures less than 235 degrees, or mixtures which form or show indications of moisture will be rejected. Hauling over freshly laid material will not be permitted.

12. PLACING. Contact surfaces of previously constructed pavement, curbs, manholes and other structures shall be sprayed with a thin coat of asphalt conforming to the requirements of paragraph: TACK COAT. The mechanical spreader shall be adjusted and it's speed regulated so that the surface of the course being placed will be smooth and continuous without tears and pulling. The course will be of such depth that after compaction, the cross section, grade, and contour will be as indicated. In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Unless otherwise directed, placing shall begin on the high side of areas with a one-way slope or along the centerline of areas with a crowned section and shall be in the direction of the main traffic flow. Placing of the mixture shall be as continuous as possible, and the speed of placing shall be adjusted, as directed, to permit proper rolling.

13. COMPACTION OF MIXTURE shall be accomplished by steel-wheel and pneumatic rollers. Rolling shall begin as soon after placing as the mixture will support the roller without undue displacement. Rolling of the course shall be continued until all roller marks are eliminated and at least 95 percent of the density of a laboratory specimen of the same mixture has been obtained. The speed of the rollers at all times shall be slow enough to avoid displacement of the hot mixture. The wheels of the roller shall be moistened to prevent adhesion of the mixture. In areas not accessible to the roller, the mixture shall be compacted with hot hand tampers.

14. TACK COAT.

14.1 Quantities to be Applied. Bituminous materials for the tack coat shall be applied in quantities of not less than 0.02 gallon nor more than 0.15 gallon per square yard. The exact quantities within the range specified may be varied to suit field conditions, shall be determined by the Contractor and approved by the Contracting Officer.

14.2 Equipment. All equipment, tools, and machines used in performance of work required by this section shall be subject to approval and shall be maintained in satisfactory working condition.

14.3 Weather Limitations. Tack coat shall be applied only when the surface to be treated is dry and the temperature shall not have been lower than 35 degrees F. for 12 hours immediately prior to application. It shall not be applied when the atmospheric temperature in the shade is lower than 50 degrees F.

14.4 Preparation of Surface. Immediately before applying the tack coat, all loose material, dirt, clay, or other objectionable material, shall be removed from the surface to be treated with a power broom or blower supplemented with hand brooms. After the cleaning operation, and prior to application of the tack coat, an inspection of the area to be treated will be made by the Contracting Officer to assure fitness of the area to receive the bituminous coating. That portion of surface prepared for immediate treatment shall be dry and in a satisfactory condition.

14.5 Application of Bituminous Material. Immediately following preparation of surface, the bituminous material shall be applied at a temperature within the range of 75 to 130 degrees F. Under no circumstances shall emulsion be heated to a temperature greater than 140 degrees F. or exposed to a temperature of less than 40 degrees F. The bituminous material shall be applied so uniform distribution is obtained over all points of the surface to be treated. Lightly coated areas and spots missed shall be properly treated with bituminous material. Following application of bituminous material, the surface shall be allowed to dry to a proper condition of tackiness to receive surfacing. The Contractor shall furnish and spread a sufficient quantity of clean, dry sand on all areas that show an excess of bituminous material, to effectively blot up and cure the excess when directed by the Contracting Officer. The treated surface shall be maintained by the Contractor until the succeeding layer of pavement has been placed. During this interval the Contractor shall protect the treated surface against damage and shall repair all damaged spots at no additional cost to the Government.

15. JOINTS. The joints between old and new pavements or between lanes of new work shall be constructed so as to insure uniform bond, texture, density, and smoothness as in other sections of the course. Edges of existing pavements shall be cut to straight, vertical surfaces. All contact surfaces of existing pavement shall be painted with a thin, uniform coat of tack coat.

16. PROTECTION OF PAVEMENT. After final rolling, no vehicular traffic shall be permitted on the pavement for at least 6 hours after rolling.

17. THICKNESS AND SURFACE REQUIREMENTS.

17.1 Thickness. The finished pavement shall not be 1/4 inch less than the thickness specified on the drawings. If the pavement is more than 1/4 inch deficient in thickness, the Contractor shall either (1) remove the entire pavement thickness and replace it or (2) overlay the pavement to bring it to the specified thickness. If the Contractor elects to overlay the pavement he will submit a new mix design to the Contracting Officer. This mix design will utilize a maximum nominal aggregate size of 1/4 inch and shall supply the same properties as listed under paragraph: TEST PROPERTIES OF BITUMINOUS MIXTURES, as the original mixture proposed. This mix design shall be subject to all approvals and requirements of other bituminous mixtures as stated above. No payment will be made for excessive thickness.

17.2 The finished surface shall not vary more than 1/4 inch from a 10 foot straightedge. The straightedge shall be furnished by the Contractor. Defective areas shall be corrected by the Contractor at no additional cost to the Government.

18. SAMPLING. Sampling for the determination of thickness and density of the completed pavements will be performed by the Contracting Officer. All other tests necessary to determine conformance with the specified requirements will be performed by the Contractor. The Contractor shall replace the pavement where samples are removed, at his expense. No payment will be made for areas of pavement deficient in composition, density, or thickness until they are removed and replaced by the Contractor as directed by the Contracting Officer.

19. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets for asphalt concrete shall be submitted during the progress of the work. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified weigh bills and/or certified delivery tickets for all material used in the construction of the pavement covered by this section of the specifications.

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SECTION 2G

AGGREGATE BASE

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Standards.

C 117-87	Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
C 127-88	Specific Gravity and Absorption of Coarse Aggregate
C 128-84	Specific Gravity and Absorption of Fine Aggregate
C 131-89	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 136-84 (Rev. A)	Sieve Analysis of Fine and Coarse Aggregates
D 75-87	Sampling Aggregates
D 422-63 (R 1972)	Particle-Size Analysis of Soils
D 1556-82	Density of Soil In Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.5-kg) Rammer and 18-in. (457-mm) Drop

D 2216-80

Laboratory Determination of Water  
(Moisture) Content of Soil, Rock, and  
Soil-Aggregate Mixtures

D 4318-84

Test Method for Liquid Limit, Plastic  
Limit, and Plasticity Index of Soils

E 11-87

Wire-Cloth Sieves for Testing Purposes

1.2 American Association of State Highway and Transportation Officials (AASHTO)  
Standard.

T 180-86

Moisture-Density Relations of Soils Using  
a 10-lb (4.54 Kg) Rammer and an 18-in.  
(457 mm) Drop

2. MATERIALS. Aggregates shall consist of crushed stone, crushed gravel, angular sand, soil, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. It shall be the responsibility of the Contractor to obtain materials that will meet the requirements specified herein and that can be constructed to meet the grade and smoothness requirements specified herein after all compaction requirements have been completed. The material retained on a No. 4 sieve shall be known as coarse aggregate, and the material passing the No. 4 sieve shall be known as binder material.

2.1 Coarse Aggregate conforming to the requirements specified above shall have a percentage of wear not to exceed 50 percent after 500 revolutions. Coarse aggregate shall consist of angular fragments reasonably uniform in density and quality. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3.

2.1.1 Coarse aggregate retained on each sieve specified shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are adjacent, the angle between the planes of the fractures must be at least 30 degrees to count as two fractured faces.

2.2 Binder Material shall consist of screenings, angular sand, soil, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements stated herein shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.3 Gradation requirements specified herein shall apply to the completed base course, and it shall be the responsibility of the Contractor to obtain materials

that will meet the gradation requirements after mixing, placing, compacting, and other operations. The aggregates shall be continuously graded within the limits specified below:

Sieve Designation	Percentage by Weight Passing Square-Mesh Sieve
1-1/8 inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12

The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

3. SAMPLING AND TESTING shall be by and at the expense of the Contractor.

3.1 Samples shall be the size required and shall be taken by the Contractor. Copies of test results shall be submitted for approval 7 days prior to starting the work, and thereafter at regular intervals during production as specified hereinafter. These samples shall be obtained at the source, from test pits, borings, trucks, stockpiles, or from other designated locations. Samples for material gradation, liquid-limit determination, and plasticity-index tests shall be taken in conformance with ASTM D 75. After the material has been placed and compacted, samples for density tests shall be taken as specified in ASTM D 1556, and additional samples for gradation, liquid-limit, and plasticity-index tests shall be taken by an appropriate method. Where deemed necessary, the sampling will be supervised by the Contracting Officer. The Contractor shall arrange his work so that sampling and testing may be performed without interruption.

3.2 Tests.

3.2.1 Aggregate Gradation. Aggregate gradation shall be determined in accordance with ASTM C 117, C 127, C 128, C 136, and D 422. Sieves shall conform to ASTM E 11.

3.2.2 Liquid Limit shall be determined in accordance with ASTM D 4318.

3.2.3 Plasticity Index shall be determined in accordance with ASTM D 4318.

3.2.4 Wear Test shall be made in conformance with ASTM C 131.

3.2.5 Field In-Place Density shall be determined in accordance with ASTM D 1556. The Field Moisture content shall be determined in accordance with ASTM D 2216. Moisture-density relations shall be established in the laboratory in accordance with ASTM D 1557 or AASHTO T 180.

3.3 Testing Frequency. Results of tests to determine particle shape, presence of objectionable and foreign matter, percentage of wear, fracture count, gradation, liquid-limit, plasticity-index, specific gravity, and other specification requirements for determination of the acceptability of the source shall be submitted for approval at least 7 days prior to starting of manufacture of the base course material. Production testing for material gradation, liquid limit, and plasticity index shall be performed at regular intervals with at least one test being made for each 500 cubic yards or fraction thereof, of material produced and results shall be submitted on a daily basis. Deviations from specification requirements shall be corrected immediately upon discovery. After the material has been placed and compacted, one field density test for each 1,000 square yards or fraction thereof of finished base course and one additional gradation, liquid-limit, and plasticity index test for each 3,000 square yards of base course or fraction thereof shall be performed. Maximum-density moisture relations shall be established for each 5,000 square yards of base course material. The location of the after-placement tests shall be as directed by the Contracting Officer. One copy of density data (less dry weight determinations) shall be provided on the day each test is taken. The completed test report shall be provided with the Contractor Quality Control Report on the following work day. Results of all tests made shall be submitted for approval on a daily basis and subsequent paving operations shall not commence until final approval has been obtained. Failure of any test shall be reported verbally, by the most expeditious means and followed promptly by written report. Contractor field operations shall immediately reflect corrective measures. For every failing test, retesting after completion of corrective measures have been taken will be required.

3.4 Approval of Materials. The source of the material shall be selected 7 days in advance of the time materials will be required in the work. Tentative approval of the preliminary reports submitted by the Contractor and the source will be based on an inspection by the Contracting Officer. Tentative approval of the materials will be based on test samples as specified herein. Final approval of both the source and the materials will be based on specified tests performed on samples taken from the completed and compacted base course.

4. EQUIPMENT. All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and have the capability of producing the required compaction, meeting grade controls, thickness controls, and smoothness requirements as set forth herein and within the specified time limits.

5. OPERATION OF PITS OR QUARRIES. All work involved in clearing, stripping, and excavating in opening or operation of pits or quarries shall be performed by the Contractor. Pits or quarries shall be opened to expose vertical faces of deposit to depths suitable for working. Materials excavated from pits shall be obtained in successive vertical cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring within the deposit shall be wasted as directed. The methods of operating pits or quarries and the processing and blending of the material may be changed or modified by the Contracting Officer when necessary to obtain material conforming to the

specified requirements. Quarries shall be conditioned in agreement with the local laws or authorities.

6. WEATHER LIMITATIONS. Aggregate base courses shall be constructed when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F., the Contractor shall protect all areas of the completed aggregate base course, by approved methods, against any detrimental effects of freezing. Areas of completed aggregate base course damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

7. PREPARATION OF UNDERLYING SURFACE. Prior to constructing the aggregate base course, the previously constructed subgrade shall be cleaned of all foreign substances. The surface of the subgrade shall be inspected by the Contractor for adequate compaction and surface tolerances. The Contractor shall give the Contracting Officer a 24 hour notice to inspect the subgrade before aggregate base course is placed. The subgrade shall conform to SECTION: FILLS AND SUBGRADE PREPARATION. Ruts or soft, yielding spots that may appear in the subgrade areas having inadequate compaction, and deviations of the surface from the requirements set forth therein shall be corrected to line and grade and to all specification requirements. The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

8. GRADE CONTROL. During construction, the lines and grades, including crown and cross slope indicated for the aggregate base course, shall be maintained by means of line and grade stakes placed by the Contractor at the worksite in accordance with paragraph: LAYOUT OF WORK of the SPECIAL CLAUSES.

9. MIXING AND PLACING MATERIALS. The materials shall be mixed by the stationary-plant, traveling-plant or road-mix method and placed in such a manner as to obtain uniformity of the aggregate base course material and at a uniform optimum moisture content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory aggregate base course meeting all the requirements of this specification.

10. LAYER THICKNESS. The compacted thickness of the aggregate base course shall be as indicated on the drawings. When a compacted layer of 6 inches or less is indicated, the material may be placed in a single layer. When a compacted layer thickness of more than 6 inches is indicated, the material shall be placed in two layers of approximately equal thickness.

11. COMPACTION. Each layer of the aggregate base course (including shoulders) shall be compacted with approved compaction equipment. Water content shall be maintained at optimum plus or minus 2 percent. In places not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of maximum density. The Contractor shall make such adjustments in rolling or finishing procedures as may be required to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or gain of

water, and to insure a satisfactory aggregate base course. Unsatisfactory placed materials shall be reworked until they are a satisfactory material. When materials become damaged during placing they shall be removed from the work and disposed of as directed by the Contracting Officer.

12. EDGES OF BASE COURSE. Where the course is not placed between curbs or similar construction, approved material shall be placed along the edges of the aggregate base course in such quantities as will compact to the thickness of the course being considered, or when the course is being constructed in two layers, to the thickness of each layer of the course. Allow in each operation at least a 1-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

13. SMOOTHNESS TEST. The surface of each layer shall not show any deviations in excess of 3/8 inch when tested with either a 10- or 12-foot straightedge applied both parallel with and at right angles to the centerline of the paved area. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

14. THICKNESS CONTROL. The completed thickness of the base course shall be within 1/2 inch, plus or minus, of the thickness indicated. Thickness test shall be made and recorded by the Contractor. The thickness of the base course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of base course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the base course. Where the measured thickness of the base course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the base course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated.

15. MAINTENANCE. The Contractor shall maintain the aggregate base course in a satisfactory condition until the completed work is accepted.

16. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be attached to the Daily Contractor Quality Control Report for the day of delivery. Before the final statement is allowed, the Contractor shall file with the Contracting Officer weigh bills and/or certified delivery tickets for all aggregates actually used in the construction covered by the contract.

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SECTION 2H

MISCELLANEOUS AGGREGATES

By LAD

SECTION 2I

TREES, SHRUBS, AND GROUND COVERS

By LAD

SECTION 2J  
IRRIGATION SYSTEM

By LAD

SECTION 2K

CONCRETE SIDEWALKS, CURBS, GUTTERS AND DRIVEWAY ENTRANCES

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specification (Fed. Spec.).

SS-S-1401C

Sealant, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavements

1.2 American Association of State Highway and Transportation Officials (AASHTO) Publication.

M 182-60  
(R 1974)

Burlap Cloth Made From Jute or Kenaf

1.3 American Society for Testing and Materials (ASTM) Standards.

C 94-86  
(Rev B)

Ready-Mixed Concrete

C 171-69  
(R 1986)

Sheet Materials for Curing Concrete

C 309-81

Liquid Membrane-Forming Compounds for Curing Concrete

D 1751-83

Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

D 1752-84

Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

2. FIELD-CONTROL TESTS. Preparation of field-control samples and testing of samples shall be by the Contractor at no additional cost to the Government. The taking of samples, the making of test specimens, and the testing thereof shall be performed under the supervision of the Contracting Officer.

3. MATERIALS. Materials shall conform to the respective publications and other requirements specified herein.

3.1 Concrete Curing Materials.

3.1.1 Burlap. AASHTO M 182 having a weight of 14 ounces or more per square yard when dry, and shall be non-staining.

3.1.2 Impervious Sheeting. ASTM C 171.

3.1.3 Liquid Membrane Curing Compound. ASTM C 309 Type 1D. Compound shall be free of paraffin or petroleum.

3.2 Concrete Protection Materials. Linseed oil mixture shall be equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used except that emulsified mixtures are not acceptable.

3.3 Joint Materials.

3.3.1 Expansion Joint Fillers. ASTM D 1751 or ASTM D 1752 or shall be resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

3.3.2 Joint Sealers. ASTM D 1850 or Fed. Spec. SS-S-1401.

4. CONCRETE STRENGTH AND USAGE.

4.1 Sidewalk Concrete. Concrete and materials therefore shall conform to the applicable requirements of SECTION: CONCRETE and ASTM C 94, Alternative No. 2 except as specified below. Concrete shall have a minimum compressive strength of 2,500 psi. The maximum size of aggregate shall be one inch. Concrete shall have a slump of not more than 3 inches.

4.2 Curb, Gutter, and Driveway Entrance Concrete. Concrete and the equipment, workmanship and materials therefore shall conform to the applicable requirements of SECTION: CONCRETE and ASTM C 94, except as specified below. Concrete shall have a minimum compressive strength of 2,500 psi. The maximum size of aggregate shall be one inch. Concrete shall have a slump of not more than 3 inches.

4.3 Color. An integral color admixture shall be added to the curb and gutter

concrete adjacent to the maintenance road, and exposed footings for gates and bollards. The colors shall conform to the requirements of the SECTION: CONCRETE.

## 5. FORMS.

5.1 Sidewalk. Sidewalk forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete, and of a height equal to the full depth of the finished sidewalk. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Form ends shall be interlocked and self-aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Forms shall have a nominal length of 10 feet, with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips, designed for use with steel forms.

5.2 Curb, Gutter, and Driveway Entrance. Curb and gutter forms shall be of wood or steel, straight, and of sufficient strength to resist springing during depositing and consolidating the concrete. The outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Straight forms of wood shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits, or other defects. Wood forms shall have a nominal length of 10 feet, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Form ends shall be interlocked and self-aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Forms shall have a nominal length of 10 feet, with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips, designed for use with steel forms. Rigid forms shall be provided for curb returns, except that benders of thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

6. SUBGRADE PREPARATION. The subgrade shall be constructed to grade and cross section.

6.1 Sidewalk Subgrade. The subgrade shall be thoroughly wetted and then

compacted with two passes of a 500-pound roller. Yielding material deflecting more than 1/2 inch under the specified roller shall be removed to a depth of not less than 4 inches below subgrade elevation and replaced with an approved granular material. The material shall then be compacted as described above. The completed subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

6.2 Curb, Gutter, and Driveway Entrance Subgrade. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement and shall be placed and compacted to conform with applicable requirements of SECTION: FILLS AND SUBGRADE PREPARATION. The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter.

6.3 Maintenance of Subgrade. The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

## 7. FORM SETTING.

7.1 Sidewalk. Forms for sidewalks shall be set with the upper edge true to line and grade and shall be held rigidly in place by stakes placed at intervals not to exceed 4 feet. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Forms shall be coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory. Side forms shall not be removed for less than 12 hours after finishing has been completed.

7.2 Curbs and Driveway Entrances. Forms for curbs and driveway entrances shall be set to alignment and grade and to conform to the dimensions of the curb and driveway entrances. Forms shall be held rigidly in place by the use of stakes placed at intervals not to exceed 4 feet. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. The forms on the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

## 8. CONCRETE PLACEMENT AND FINISHING.

8.1 Sidewalk Concrete. Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished the sidewalk will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be tamped and consolidated with a suitable wood or metal tamping bar, and the surface shall be finished to grade with a wood float. Finished surface of the walk shall not vary more than 3/16 inch from the testing edge of a 10 foot-straightedge. Irregularities exceeding the above shall be corrected. The surface shall be divided into rectangular areas by means of contraction joints spaced at not more than 5 feet on centers.

8.1.1 Concrete Finishing. After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic. Contractor shall submit installation procedures for concrete to the Contracting Officer for approval. All sidewalk and bike path surfaces shall be given a rough texture by brooming with a fiber-bristle broom in a direction transverse to that of the main traffic flow. The rough texture finish shall also be applied to adjacent surfaces a sufficient distance in all directions to provide adequate texture for traction in turning areas.

8.1.2 Edge and Joint Finishing. All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Transverse joints shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corner and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

8.1.3 Contraction Joints. The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. The time of sawing shall be varied, depending on existing and anticipated weather conditions, and such sawing shall be at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

8.1.4 Expansion Joints. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Transverse expansion joints shall be filled with 1/2-inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be

rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. Expansion joints shall be formed about structures and features that project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. The filler shall be installed in such manner as to form a complete, uniform separation between the structure and sidewalk pavement. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealer. Concrete at the joint shall be surface dry, and the atmospheric and pavement temperatures shall be above 50 degrees F. at the time of application of joint-sealing materials. Joints shall be filled flush with the concrete surface in such manner as to minimize spilling on the walk surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned. Dummy groove joints shall not be sealed.

8.1.5 Surface Uniformity. The completed surface shall be uniform in color and free of surface blemishes and tool marks.

8.2 Curb, Gutter, and Driveway Entrance Concrete. Concrete shall be placed in layers not to exceed 6 inches. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators.

8.2.1 Concrete Finishing. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2-inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float. Except at grade changes or curves, finished surfaces shall not vary, from the testing edge of 10-foot straightedge, more than 1/8 inch for gutter and entrance and 1/4 inch for top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected. Visible surfaces and edges of finished curb and gutter shall be free of blemishes and form and tool marks, and shall be uniform in color, shape, and appearance.

8.2.2 Joints. Expansion joints and contraction joints shall be constructed at right angles to the line of curb and gutter.

8.2.2.1 Contraction Joints. Contraction joints shall be constructed by means of 1/8-inch thick separators, of a section conforming to the cross section of the curb and gutter. Contraction joints shall be constructed directly opposite contraction joints in abutting portland-cement-concrete pavement. Where curb and gutter do not abut portland-cement-concrete pavements, contraction joints shall be so placed that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint. Separators shall be removed prior to finishing.

8.2.2.2 Expansion Joints. Expansion joints shall be formed by means of preformed expansion-joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb at the end of all returns. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland-cement-concrete pavement and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland-cement-concrete pavement, expansion joints at least 1/2-inch in width shall be provided at intervals not exceeding 25 feet. Expansion joints shall be provided in non-reinforced concrete gutter at locations indicated.

## 9. CURING AND PROTECTION.

9.1 Curing. Immediately after the finishing operations, exposed concrete surfaces shall be cured by one of the following methods as the Contractor may elect.

9.1.1 Mat Method. The entire exposed surface shall be covered with two or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

9.1.2 Impervious Sheeting Method. The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18 inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or by placing a bank of moist earth along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

9.1.3 Membrane-Curing Method. The entire exposed surface shall be covered with a membrane-forming curing compound. Where type 1 curing compound is used, the concrete surface shall be shaded from the direct rays of the sun during the curing period. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat to all surfaces showing discontinuity, pinholes or other defects. Concrete surfaces that are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by the above method and at the above coverage at no additional cost to the Government. Expansion-joint openings shall be sealed at the top by inserting moistened paper or fiber rope or covering with strips of waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for

7 days from pedestrian and vehicular traffic and from any other action that might disrupt the continuity of the membrane. Any area covered with curing compound and damaged by subsequent construction operations within the 7-day curing period shall be resprayed as specified above at no additional expense to the Government. Color concrete shall be cured as specified in SECTION: CONCRETE.

9.2 Backfilling. After curing, debris shall be removed, and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

9.3 Protection. Completed concrete shall be protected from damage until accepted. The Contractor shall clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

10. SEALING JOINTS. The approximately horizontal sections of expansion joints and the top one-inch depth of contraction-joint openings of gutter shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F. at the time of application of joint-sealing materials. Excess material on exposed surfaces of the concrete shall be removed immediately and exposed concrete surfaces cleaned.

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SECTION 2L

STONE PROTECTION

Index

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| 1. Applicable Publications                    | 4. Scale Weight Measurement         |
| 2. Materials                                  | 5. Weigh Bills and Delivery Tickets |
| 3. Foundation Preparation and Stone Placement |                                     |

1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Standards listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

C 88-83	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 127-88	Specific Gravity and Absorption of Coarse Aggregate
C 295-85	Petrographic Examination of Aggregates for Concrete
C 535-81 (R 1987)	Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
D 1141-86	Substitute Ocean Water

2. MATERIALS.

2.1 Definitions.

a. Cobblestone. Stone which is obtained from alluvial deposits and is nearly spherical and well rounded (river-run), ranging from 4 to 12 inches in size.

b. Stone. Sound, durable, weather-resistant rock over 4 inches in diameter resulting from alluvial deposits.

2.2 Source and Material Approval. No stone shall be placed without prior written acceptance of stone from the source by the Contracting Officer. The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The source from which the Contractor proposes to obtain the material shall be selected and a sample submitted a minimum of 45 days in advance of the time when the material will be required in the work. Stone from a proposed source will be tested by the

to the tests outlined in these specifications. Before a proposed source or sources of cobblestone will be considered for sampling and testing the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements.

2.3.1 Service records are considered to be acceptable if stone from a proposed source has remained sound and functional after 10 or more years of exposure on a project similar to the one to be constructed under these specifications.

2.4 Quality Compliance Tests for Stone Protection. Stone shall meet the following test requirements.

Test	Test Method	Requirement
Specific Gravity (Bulk SSD)	ASTM C 127	2.50 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting & Drying	SPD Test Procedure(1)	No fracturing(3)
Sulfate Soundness	ASTM C 88(2)	10% max. loss
Abrasion Loss	ASTM C 535	50% max. loss

In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C 295. The stone must not contain any expansive clay.

NOTE: (1): Test procedure for wetting-and-drying test. The initial step of the test is the careful examination of the entire sample and the selection of representative test specimens. The piece should be large enough to produce two cut slabs, one inch thick ( $\pm 1/4$  inch) with a minimum surface area of 30 square inches on one side. Two chunks approximately three by four inches are also chosen. The slabs and chunks are carefully examined under a low-power microscope and all visible surface features are noted and recorded. The specimens are then oven dried at 140 degrees F., for eight hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 140 degrees F. After each cycle the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these action occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all flakes or particles which come off during the test are oven dried, weighed and photographed.

NOTE: (2): The test shall be made on 50 particles each weighing 100 grams, 25 grams, in lieu of the gradation given in C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible unless bond of the surface grains softens and causes general disintegration of

the surface material.

2.4.1 Stone to be used in the work shall be of the same lithology as the stone sampled for testing and for which service records are provided as a basis for approval. All stone shall be sound, durable, hard, and free from laminations, weak cleavages or undesirable weathering. Stone shall be of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing. All stone shall be clean and free from earth, clay, refuse, and adherent coatings.

2.5 Gradation Sampling and Testing for Stone Protection shall be performed by an approved testing laboratory on samples selected by the Contracting Officer. The Government reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. Each gradation sample shall consist of not less than five tons of stone selected at random from the production run for the first test or from material placed on grade or stockpiled on-site for required additional tests. One gradation test shall be required at the beginning of production prior to delivery of stone from the source to the project site and a minimum of one additional test shall be required for each 5,000 tons of material placed. All sampling and gradation tests performed by the Contractor shall be under the supervision of the Contracting Officer.

## 2.6 Gradation.

2.6.1 General. All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading due to segregation or degradation during placement shall be rejected. If best results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

2.6.2 Stone may be obtained from any source approved by the Contracting Officer and shall be reasonably well graded between 4 and 12 inches with not less than 25 nor more than 50 percent 6 inches in size.

## 3. FOUNDATION PREPARATION AND STONE PLACEMENT.

3.1 Prior to placing stone, the subgrade shall have been compacted in accordance with the requirements of SECTION: FILLS AND SUBGRADE PREPARATION, and shall be inspected, in sufficient time prior to each stone placement by the Contractor in order to certify to the Contracting Officer that it is ready to receive stone. The results of each inspection shall be reported in writing.

3.2 Stone shall be placed to produce a surface in which the tops of the individual stones have a tolerance of plus 2 inches to 0 inches from true grade.

Double decking of the flat stones to bring the surface up to the required grade will not be permitted.

4. SCALE WEIGHT MEASUREMENT. Scales used for measurement shall, at the option of the Contractor, be either public scales or approved scales provided by the Contractor. Weighing shall be at the point nearest the work at which a public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type and shall be equipped with the type registering beam and an "over and under" indicator and be capable of accommodating the entire vehicle. Scales shall be tested, approved and sealed by an inspector of the state in which the scale is located. Scales shall be calibrated and resealed as often as necessary and at least once every 3 months, to insure continuous accuracy. All calibrations and sealing of the scales shall be at the expense of the Contractor. The necessary number of standard weights for testing the scales shall be on hand at all times. When the Contractor's scales are used, the Contractor shall be certified and bonded as a licensed weighmaster in accordance with all requirements of the State Inspection Bureau, and any employees of the Contractor engaged in weighing materials under this contract shall be deputized to perform such weighing under the provision of the State Inspection Bureau charged with scales inspection. No more than one licensed weighmaster shall be employed during a single shift of weighing under the provision of the State Inspection Bureau charged with scales inspection. No more than one licensed weighmaster shall be employed during a single shift of weighing operations. Multiple weighmasters including individual truck drivers are prohibited. Vehicles used for hauling materials shall be weighed empty daily at such time as desired, and each shall bear a plainly legible identification mark.

5. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be submitted to the Contracting Officer during the progress of the work. The Contractor shall furnish the Contracting Officer or his designated representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, date, time, and location of loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicles loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer or his designated representative, the master log of loadings, certified weigh bills and/or certified tickets within 24 hours of material delivery. Prior to final payment, the Contractor shall furnish written certification that the material recorded on the submitted weigh bills and/or certified tickets are actually used in the construction covered by the contract.

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SECTION 2M

SIDE DRAINS

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specification (Fed. Specs.).

SS-S-210A  
& Am-1

Sealing Compound, Preformed  
Plastic for Expansion Joints and  
Pipe Joints

1.2 Federal Standard (Fed. Std.).

No. 601 and change  
Notices 1 thru 7

Rubber: Sampling and Testing

1.3 American Association of State Highway and Transportation Officials (AASHTO) Publications.

Standard Specifications for Highway Bridges (1983) & Interim  
Specifications (1984)

M 33-81

Preformed Expansion Joint Filler  
for Concrete (Bituminous Type)

M 91-78  
(R 1986)

Sewer and Manhole Brick

M 114-85

Building Brick (Solid Masonry  
Units made from Clay or Shale)

M 170-85

Reinforced Concrete Culvert, Storm  
Drain, and Sewer Pipe

M 198-75  
(R 1986)

Joints for Circular Concrete Sewer  
Culvert Pipe Using Flexible  
Watertight Gaskets

M 199-85

Precast Reinforced Concrete

## Manhole Sections

### 1.4 American National Standards Institute (ANSI) Publications.

A 14.3-84 Ladders-Fixed-Safety Requirements

### 1.5 American Society for Testing and Materials (ASTM) Publications.

C 32-73 (R 1984)	Sewer and Manhole Brick (Made from Clay or Shale)
C 55-85	Concrete Building Brick
C 62-88	Building Brick (Solid Masonry Units Made from Clay or Shale)
C 76-89	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C 270-88 (Rev A)	Mortar for Unit Masonry
C 443-85 (Rev A)	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
C 478-88	Precast Reinforced Concrete Manhole Section
D 1556-82	Density of Soil in Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.45kg) Rammer and 18-in. (457 mm) <u>Drop</u>
D 1751-83	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-84	Preformed Sponge Rubber and Cork Expansion Joint Filler for Concrete Paving and Structural Construction
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures

D 3034-88

Type PSM Poly(Vinyl Chloride)  
(PVC) Sewer Pipe and Fittings

D 3212-86

Joints for Drain and Sewer Plastic  
Pipes Using Flexible Elastomeric  
Seals

1.6 American Water Works Association (AWWA) Publications.

C 111-85

Rubber-Gasket Joints for  
Ductile-Iron and Gray-Iron  
Pressure Pipe and Fittings

C 150-81  
(R 1986)

Thickness Design of Ductile-Iron  
Pipe

1.7 Uniform Standard Specifications (MAG Specs) and Details, Maricopa  
Associations of Governments, Arizona, year 1979 and the current revisions  
thereto.

The City of Phoenix (COP) Supplement to MAG Uniform Standard  
Specification.

2. SUBMITTALS.

2.1 Manufacturers Recommendation. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to submit the recommendations can be cause for rejection of the material.

3. CERTIFICATION. Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

4. DELIVERY, STORAGE, AND HANDLING OF MATERIALS.

4.1 Delivery and Storage. Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

4.2 Handling. Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried to the trench not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

5. PIPE FOR SIDE DRAINS.

5.1 Reinforced concrete pipe shall conform to requirements for the following pertinent types. ASTM C 76 or AASHTO M 170, Class as indicated on the drawings.

5.2 Poly (Vinyl Chloride) (PVC) Pipe and Fittings. ASTM D 3034, Type PSM with a maximum SDR of 35, size 15-inch or less in diameter, with flexible elastomeric seal joint.

5.3 Ductile Iron Pipe. All water line pipe shall comply with subsection 750.2, "Ductile Iron Water Pipe," of the MAG Standard Specifications and shall be minimum Class 51, in accordance with AWWA C-150. All pipe, except where shown on plans, shall comply with AWWA C-111 for mechanical joint pipe, C1.150. Fittings shall be mechanical joints with cement mortar lining and coal-tar coated.

## 6. DRAINAGE STRUCTURES.

6.1 Catch Basins. Construction shall be cast-in-place reinforced concrete complete with frames and covers.

6.2 Manholes. Construction shall be precast reinforced concrete in accordance with AASHTO M 199 or ASTM C 478 complete with frames and covers as shown on the drawings. Frames and covers shall conform to the requirements of SECTION: MISCELLANEOUS METALS.

## 7. MATERIALS FOR DRAINAGE STRUCTURES.

7.1 Concrete. Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under SECTION: CONCRETE. Expansion-joint filler material shall conform to ASTM D 1751, ASTM D 1752, or AASHTO M 33, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752. Color admixture shall be excluded for this item.

7.2 Mortar. Mortar for pipe joints and connections to other drainage structures shall conform to ASTM C 270, Type M, except the maximum placement time shall be one hour. Color admixture shall be excluded for this item.

7.2.1 The quantity of water in the mixture shall be only that sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

7.2.2 The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

7.3 Flap Gates, Grating and Frames. Flap gates, gratings, and frames shall conform to the requirements of SECTION: MISCELLANEOUS METALS.

7.4 Brick. Brick shall conform to ASTM C 62 or AASHTO M 114, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32 or AASHTO M 91, Grade MS. Mortar for

jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

## 8. JOINTS.

8.1 For Concrete Pipe Use Cement-Mortar Bell-and-Spigot Joint. The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be cleaned with wet brush and the lower portion of the bell filled with mortar to such depth as to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that sections are closely fitted. After each section is laid, remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. Cement mortar, finish, and protection of joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

8.1.1 Cement-Mortar Oakum Joint for Bell-and Spigot Pipe. A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket then shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space then shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type joint shall be kept at least five joints behind laying operations. The cement mortar, finish, and protection of joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.2 Cement-Mortar Diaper Joint for Bell-Spigot Pipe. The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and outside of spigot shall be cleaned.

8.1.2.1 Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut into such lengths that they will extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for ends to be twisted at top of pipe to hold band securely in place; bands shall be accurately centered around lower portion of joint.

8.1.2.2 Grout shall be poured between band and pipe from only the high side of band, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to insure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be carefully forced out by pouring and removed.

8.1.2.3 The remaining unfilled upper portion of the joint shall then be filled with mortar and a bead formed around outside of this upper portion of the joint with sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until the joints have been fully inspected by the Contractor and approved by the Contracting Officer. The Contractor shall notify the Contracting Officer 24 hours prior to inspecting the joints. The cement mortar, finish and protection of the joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.2.4 The inside of the joint and the annular space shall be cleaned by brooming or other approved methods. The inside of the joint and the annular space shall then be dry packed so as to supply an unbroken flow line between adjacent pipe segments.

8.1.3 Cement-Mortar Tongue-and Curve Joint. The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The groove end of the first pipe shall be cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe then shall be inserted in the groove end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside. The cement mortar, finish, and protection of joints shall be as specified in the paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.4 Cement-Mortar Diaper Joint for Tongue-and Groove Pipe. The joint shall be of the type described for Cement-Mortar Tongue-and-Groove Joint, in this paragraph, except that the shallow excavation directly beneath the joint shall

not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2-inch thick, and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. No backfilling around the joints shall be done until the joints have been fully inspected and approved. The cement mortar, finish, and protection of joints shall be as specified in the paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.5 Self-Centering Tongue and Groove Pipe. "Self-centering" tongue and groove pipe 36 inches or greater in diameter will not require outside grouting except where the pipe is used on curves or angle points. All joints shall be butted together. The overlap of the tongue and the groove portion of the joint shall not be less than 50 percent of the overlap measured from the manufacturer's designed full seat position. The material and layout drawings shall specify the maximum inside annular space that satisfies these specifications. Non-conforming joints shall require outside grouting or a concrete collar as determined by the Contracting Officer.

8.1.5.1 The inside annular space between pipe sections shall be completely filled with mortar and finished smooth with the inside pipe surface. All joints shall be cleaned with a wire brush and wetted before mortaring. Joints shall not be mortared before the next two joints in advance are laid. The entire depth of the finished inside joint shall be filled with mortar in such a manner as to insure a strong tight joint.

8.1.5.2 Tongue and groove joints will not be permitted for pipe under 36 inches in diameter.

8.1.6 Rubber Gasket Joint. Design of joints and physical requirements for rubber-type gaskets shall conform to ASTM C 443 or AASHTO M 198. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber gasket type are permitted if nominal diameter of pipe being gasketed exceeds 54 inches. Material conforming to Fed. Spec. SS-S-210 is acceptable as an alternate to ASTM C 443 provided the necessary installation instructions are furnished. Gaskets or jointing materials shall not swell more than 100 percent by volume when immersed in accordance with Method 6211 of Fed. Std. 601, in immersion medium No. 3 for 70 hours at 212 degrees F. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished if specifically approved. Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making

the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

8.2 Poly(Vinyl Chloride) (PVC) Pipe. Elastomeric gasket joint in accordance with ASTM D 3212.

9. EXCAVATION AND TRENCHING FOR SIDE DRAINS. Excavation of trenches for side drains, storm drains, and appurtenances, shall be in accordance with the following requirements.

9.1 Trenching. All excavations shall be made by open cut unless otherwise specified. The banks of trenches shall be kept as nearly vertical as practicable. Unless otherwise indicated, the banks of trenches below the level of the top of the pipe shall be not less than 12 inches wider nor more than 16 inches wider than the outside diameter of the pipe to be laid therein, and shall be excavated true to line, so that a clear space not less than 6 inches nor more than 8 inches in width is provided on each side of the pipe. The maximum width of trench specified applies to the width at any point below the top of the pipe; the width of the trench above the top of the pipe may be made as wide as necessary for sheathing and bracing; and the proper installation of the work. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for the proper sealing of pipe joints.

9.2 Removal of Unstable Material. Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in bottom of trench, such material shall be removed to depth required and replaced to the proper grade with selected material, and compacted as provided in paragraph: BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, resulting material shall be excavated and replaced. Removal of unstable material shall be done at no additional cost to the Government.

9.3 Excavation for Drainage Structures. Excavation for junction structures, drop inlets, catch basins or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as indicated on the drawings. Removal of unstable material shall be as specified hereinbefore. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade shall not be made until just before the concrete or masonry is to be placed.

10. MATERIALS FOR BEDDING AND BACKFILLING.

10.1 General. Bedding for side drains shall consist of sandfill placed around the pipe in accordance with paragraph: BACKFILLING. Compacted fill above the sandfill shall be placed in accordance with the paragraph: BACKFILLING. Material for the sandfill for the side drain shall be clean sand, free of trash, organic materials, debris and with 100 percent passing No. 4 sieve and not more than 10 percent passing the No. 100 sieve.

10.2 Material for compacted fill above the sandfill shall not contain any stone larger than one inch and may consist of sand, gravelly sands, silty sands and clayey sands. Organic material, trash debris, silt, sandy silt, clay, sandy clay, broken concrete or pavement and other objectionable material shall not be used.

11. BEDDING. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. Pipe shall be bedded carefully in a sandfill layer accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe for the entire length of pipe. The layer of sandfill material shall be at least 4 inches. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth and width as required for properly making the particular type joint.

12. PLACING PIPE. Each pipe shall be examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those damaged during placement shall be removed and replaced at no additional cost to the Government. Laying shall proceed upgrade with spigot ends of bell-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of flow.

13. BACKFILLING.

13.1 Backfilling, Pipe and Utilities in Trenches. After the bedding has been prepared and the pipe installed, sandfill material shall be placed along both sides of pipe in a single lift to the springing line (maximum horizontal dimension of a pipe). The sandfill shall be brought up evenly on both sides of pipe for the full length of pipe. Vibrating compaction equipment shall be used to obtain not less than 90 percent of maximum density. Care shall be taken to insure thorough compaction of the sandfill under the haunches of the pipe. Above the springing line, the trench shall be filled with material conforming to paragraph: MATERIALS FOR BEDDING AND BACKFILLING. The completed fill material shall be placed along both sides of pipe in layers not exceeding 4 inches in compacted depth of pipe at a moisture content that will facilitate compaction. The compacted fill shall be brought up evenly on both sides of pipe for the full length of pipe. Each layer shall be thoroughly compacted with mechanical tampers or vibrators to not less than 90 percent of maximum density. This method of filling and compacting shall continue until the fill has reached an elevation of at least 24 inches above the top of the

pipe or to the bottom of the aggregate base course. The remainder of the trench shall be backfilled and compacted by spreading and rolling parallel with the pipe in layers not exceeding 6 inches or by mechanical tampers or vibrators in layers not exceeding 6 inches compacted to 90 percent of maximum density. Where it is necessary in the opinion of the Contracting Officer, any sheeting and/or portions of bracing used shall be left in place, and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

13.2 Backfilling Pipe in Fill Sections. For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified above. The fill material above the springing line shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 4 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or vibrating to obtain not less than 90 percent of maximum density. Prior to commencing normal filling operation, the crown width of the fill at a height of 24 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 24 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 6 inches.

13.3 Movement of Construction Machinery. When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a side drain at any stage of construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at no additional cost to the Government.

13.4 Backfilling for Drainage Structures. After the junction structure, drop inlet, catch basin or similar structure has been constructed, backfill around and above structure shall be placed in accordance to the requirements of paragraph: BACKFILLS of SECTION: FILLS AND SUBGRADE PREPARATION and as specified herein.

13.4.1 The structure shall not be damaged by the shock of falling earth and the backfill shall be placed in such a manner as to prevent eccentric loading and excessive stress on the structures. Any damaged structure thereby shall be repaired or replaced at no cost to the Government.

13.5 Compaction.

13.5.1 Laboratory Control. The moisture-density relationships shall be determined in a laboratory in accordance with ASTM D 1557.

13.5.2 Field Control. Tests shall be well distributed and shall average not less than one test for each 200 lineal feet of trench for each 2 feet or less of backfill. At least one test shall be made in each trench. Field in place density shall be determined in accordance with ASTM D 1556 and field moisture content shall be determined in accordance with ASTM D 2216.

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SECTION 2N

GROUTED STONE PROTECTION

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM), Publications.

C 150-86

Portland Cement

1.2 U.S. Department of the Army, Corps of Engineers, Handbook for Concrete and Cement.

CRD-C 300-88

Membrane-Forming Compounds for Curing  
Concrete

2. MATERIALS.

2.1 Aggregate shall conform to the requirements specified for fine aggregate of the SECTION: CONCRETE.

2.2 Portland Cement shall conform to the requirements of ASTM C 150, Type II. The alkali content of the cement shall not exceed 0.6 percent.

2.3 Water shall be fresh, clean, and potable.

2.4 Color Admixture. The color admixture shall conform to the requirements of the color admixture specified in the SECTION: CONCRETE.

2.5 Curing compound shall conform to the requirement of ASTM C 309 Type 1D. The compound shall be free of paraffin or petroleum.

3. MIXING. Grout shall be composed of cement, sand, and water mixed in the proportions as directed. The Contractor shall add color admixture to all grout (except grout used in grouted stone toe below 2 feet vertically under the channel invert). Color of colored grout shall be considered satisfactory based on the comparative analysis of color produced from test panels in accordance with the paragraph: TEST PANEL, and Munsell color samples in accordance with U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of test panel shall conform to Munsell color number 10YR5/3 with respect to hue, value, and chroma. Evaluation of color shall be made within the time limits prescribed in paragraph: TEST PANEL. The estimated cement content requirement per cubic yard of grout shall be 7-1/2 sacks. The water content of the mix shall not exceed

8-1/2 gallons per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included. Slump of grout mix shall be between 9 and 10 inches for the first course and between 7 and 8 inches for the second course or where one course is placed. The grout shall be mixed in a concrete mixer in the manner specified for concrete, except that time of mixing shall be as long as is required to produce a satisfactory mixture, and the grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted. The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming. Grout batches in the same course shall be uniform in mix, size, and consistency. The color admixture shall be batched in a manner that will assure that the admixture is completely and thoroughly mixed throughout the batch.

#### 4. PLACING.

4.1 Prior to grouting, the stone shall be thoroughly washed with water to wash down the fines and to prevent absorption of water from the grout. The stone shall be kept wet just ahead of the actual placing of grout.

4.2 The grout shall be placed in one course in flat areas and in 2 courses in side slopes. Each course shall be placed full width or in successive lateral strips approximately 10 feet in width, as applicable, extending from toe of slope to top of side slopes. The grout shall be brought to the place of final deposit by approved means and discharged directly on the stone. A splash plate of metal or wood shall be used where necessary to prevent displacement of stone directly under discharge. The flow of grout shall be directed with brooms or other approved baffles to cover the entire area and to assure that all crevices are filled. Sufficient barring shall be done to loosen tight pockets of stone and otherwise aid the penetration of grout. The first course shall fully penetrate the stone blanket. The second course shall be placed as soon as the first course has sufficiently stiffened so that it will not flow when additional grout is added. On side slopes, all brooming shall be uphill.

4.3 Placement and brooming of the grouted surface shall be such that the outer layer of rock projects 1/3 to 1/4 their diameter above the grouted surface. After the top course has stiffened the entire surface shall be rebroomed to eliminate runs in the top course and to fill voids caused by sloughing of the layers of grout.

4.4 All surfaces of grouted stone, above the embedment depth specified, shall be cleaned by air-water blasting, sandblasting or a combination thereof.

##### 4.4.1 Air-water Blasting.

4.4.1.1 Equipment used for air-water blasting shall be capable of producing a minimum pressure of 150 psi and shall be of such nature as to adequately perform the work required.

4.4.1.2 The grout will be allowed to set for a minimum of one hour, or other length of time as directed by the Contracting Officer before air-water blasting is commenced. The air-water blasting shall be at right angles to the surface

of the grout.

4.4.2 Sandblasting. All grouted stone surfaces to which grout has been applied and cannot be cleaned adequately by air-water blasting shall be sandblasted, in order to remove grout paste remaining on the surface. Sandblasting will not commence at least 14 days after placement of the grout.

4.5 After completion of any strip or panel, to include cleaning, no workers or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun; shall be protected from rain, flowing water, and mechanical injury; and shall be moist cured or membrane cured at the Contractor's option.

## 5. CURING AND PROTECTION.

5.1 Moist curing shall consist of covering the grout with a uniform thickness of 2 inches of sand which shall be kept continuously saturated for a period of 14 days.

5.2 Curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate of not to exceed 200 square feet per gallon for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angles to the direction of the first application.

6. TEST PANEL. The Contractor shall place a test panel for colored grout with a dimension of 20 feet by 20 feet by 12 inches thick. The test panel shall be placed in the presence of the Contracting Officer, and the stone and grout mix design shall conform in all respects to those proposed for use in the project. The grouted stone shall be finished, protected, and cured on a 2H to 1V slope on the site of proposed construction using methods proposed for use by the Contractor on the features of the project which shall receive colored grout. The test panel shall not be protected from the effects of the sun while curing. Color comparisons as a basis for acceptance of color shall not be made in less than 17 days after placement of grout for the test panel. Wetting of the grouted stone shall not be permitted within a period of 3 days prior to making color comparisons. No grouting of stone shall be scheduled for placement within 30 days of construction of test panel, and no grout shall be placed prior to demonstrating compliance with finishing and color requirements herein. In the event that the test panel color does not conform to the color requirements of these specifications, the Contractor shall be required to place additional test panels for grout similar to the panels required for concrete under the SECTION: CONCRETE until a final mix design has been approved which supplies colored grout conforming to the requirements specified above. Approval of test panel color and mix design shall not relieve the Contractor of the requirements of these specifications. The Contractor shall not remove the test panel until all grouting stone work has been completed. At completion of grouting stone work, the test panel shall be considered scrap materials.

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SECTION 2(O)

TURF

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1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.1 Federal Specification (Fed. Spec.).

O-F-241D

Fertilizer, Mixed, Commercial

1.2 U.S. Department of Agriculture Publication.

Federal Seed Act of August 9, 1939 (53 Stat. 1275) Rules and Regulations

2. SUBMITTALS.

2.1 Certificates of Compliance and Certified Laboratory Test Reports. Prior to the delivery of materials, certificates of compliance shall be submitted in accordance with the SPECIAL CLAUSES certifying that materials meet the requirements specified. Certified copies of the reports for the following materials shall be submitted.

2.1.1 Seed. For mixture percentage, pure live seed, weed seed content, germination.

2.1.2 Fertilizer. For chemical analysis and composition percent.

2.2 Delivery Schedule. Submittal of the schedule shall be at least 10 days before delivery.

3. DELIVERY, STORAGE, AND HANDLING.

3.1 Delivery.

3.1.1 Turf material shall be inspected upon arrival at the jobsite, and unacceptable material shall be removed from the jobsite.

3.1.2 Delivery of fertilizer to the site shall be in original, unopened containers bearing manufacturer's chemical analysis. Instead of containers,

fertilizer may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

3.1.3 Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

### 3.2 Storage.

3.2.1 Materials shall be stored in areas approved by the Contracting Officer.

3.2.2 Seed and fertilizer shall be stored in cool, dry locations away from contaminants.

### 3.3 Handling.

3.3.1 Materials. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

## 4. MATERIALS.

### 4.1 Seed.

4.1.1 Seed Classification. State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for mixture percentage, purity, germination, weed seed content, and inert material. Labels shall be in conformance with USDA Federal Seed Act, Rules and Regulations and applicable state seed laws.

4.1.2 Seed Mixtures. Seed mixtures shall be proportioned by weight as follows.

Botanical Name	Common Name	Percent Pure Live Seed
Cynodon dactylon	Common Bermuda	98%
Pod Annual	Rye-Grass	95%

4.1.3. Weed Seed. Weed seed shall not exceed one percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed will be rejected.

### 4.2 Soil Amendments.

4.2.1 Fertilizer. Commercial grade, free flowing, uniform in composition and conforming to Fed. Spec. O-F-241.

4.2.1.1 Granular Fertilizer. Consists of nitrogen-phosphorus-potassium ratio: 16 percent nitrogen, 20 percent phosphorus, and 0 percent potassium.

4.2.1.2 Controlled-Release Fertilizer. Consists of nitrogen-phosphorus-potassium ratio: 18 percent nitrogen, 6 percent

phosphorous, and 12 percent potassium.

4.3 Soil Conditioner. For single use or in combination to meet requirements for topsoil.

4.3.1 Organic Soil Conditioner.

a. Rotted Manure. Well rotted, horse or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials, free of stones, sticks, soil and containing no chemicals weed seed or ingredients harmful to plants.

b. Decomposed Wood Derivatives. Ground bark, sawdust, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, stabilized with nitrogen and having the following properties.

Particle Size. Minimum percent by weight passing.

	Percent
No. 4 Mesh Screen	95
No. 8 Mesh Screen	80

Nitrogen Content. Minimum percent based on dry weight.

	Percent
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

4.4 Mulches. Free from weeds, mold, and other deleterious materials.

4.4.1 Wood Cellulose Fiber. Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 3.5 to 5.0. Use with hydroseeding application of grass seed and fertilizer. When added to water, it forms a homogeneous slurry.

4.5 Water. A quality suitable for irrigation.

5. SEEDING TIMES.

5.1 Seeding Time. Over seed with Bermuda seed from May to September for spring and summer planting and Annual Rye from October to April for fall and winter planting. Seeding times may vary depending on temperature and weather conditions.

6. SITE PREPARATION.

6.1 Preparation of Seeding Areas.

6.1.1 The Contracting Officer shall verify the finished grades are as indicated on drawings, the placing of topsoil, and the smooth grading has been completed in accordance with the paragraph: FINISHED GRADING.

6.1.2 Site preparation work shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory condition prevails, the work shall be stopped as directed by the Contracting Officer.

## 6.2 Application of Soil Amendments.

6.2.1 Fertilizer. Fertilizer shall be applied at the rate of 10 pounds per 1,000 square feet. Fertilizer shall be incorporated into the soil to a minimum depth of 6 inches or may be incorporated as part of the tillage or hydroseeding operation.

6.2.2 Soil Conditioner. Soil conditioner shall be a 50/50 mix of rotted manure and decomposed wood derivatives applied at the rate of 2 cubic yards per 1,000 square feet and thoroughly incorporated by tillage into the soil to a minimum depth of 6 inches.

6.2.3 Deviations. Deviations in the ground surface in relation to the grades indicated shall be corrected prior to turfing.

## 6.3 Tillage.

6.3.1 Soil shall be tilled to a minimum depth of 6 inches by plowing, disking, harrowing, rototilling or other method. On slopes 2 horizontal to 1 vertical and steeper, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1 horizontal to 1 vertical and steeper, no tillage is required.

6.3.2 Fertilizer, as specified, may be applied during tillage.

## 6.4 Finished Grading.

6.4.1 Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to requirements specified in the SECTION: FILL AND SUBGRADE PREPARATION. Finished grade shall be 2 inches below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

6.4.2 Lawn areas shall have debris and stones larger than one inch in any dimension removed from the surface.

6.4.3 Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

7. SEEDING.

7.1 General. Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause, shall be reworked to restore the ground condition previously specified. Do not hydroseed or over seed when the wind velocity is such as to prevent uniform seed distribution.

7.2 Applying Seed. Rye seeding and Bermuda over seeding shall be specified hereinafter. Prior to over seeding with Bermuda the existing Rye grass shall be flail mowed (scalping) to the ground, and the area aerified with approved methods. All chipping and waste material shall be removed from the site prior to over seeding.

7.2.1 Rye seeding from October 1 to November 1. The seed and fertilizer shall be mixed in the required amount of water to produce a homogeneous slurry and then uniformly applied under pressure at the following rates (dry weight) per acre:

Annual Rye Turf

2000 lbs. wood cellulose fiber mulch  
300 lbs. 16-20-0 inorganic fertilizer  
650 lbs. of seed mix  
300 lbs. slow release fertilizer 18-6-12

7.2.2 Bermuda over seeding from June 1 to September 30. The seed and fertilizer shall be mixed in the required amount of water to produce a homogeneous slurry and then uniformly applied under pressure at the following rates (dry weight) per acre:

Bermuda Over Seeding

2,000 lbs. wood cellulose fiber mulch  
300 lbs. 16-20-0 inorganic fertilizer  
140 lbs. of seeding mix  
300 lbs. slow release fertilizer 18-6-12

Over seeded area shall conform to requirements specified in paragraph: TURF ESTABLISHMENT PERIOD.

7.3 Water Seeded Areas. Watering shall be started within one day or as directed by the Contracting Officer after completing the seeded area. Water shall be applied at the rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches. Run-off and puddling shall be prevented.

8. RESTORATION AND CLEAN UP. Excess and waste material shall be removed and disposed of off the site. Adjacent paved areas shall be cleaned. Existing turf areas which have been damaged during the contract operations shall be restored to original conditions.

9. PROTECTION OF TURFED AREAS. Immediately after turfing, the area shall be

protected against traffic or other use by erecting barricades and providing signage as required or as directed by the Contracting Officer.

10. TURF ESTABLISHMENT PERIOD.

10.1 Length of Period. On completion of the last day of the turfing operation, the Turf Establishment Period will be in effect for 3 months.

10.2 Stand of Turf.

10.2.1 A stand of turf from the seeding operation is defined as a minimum of 100 grass plants per square foot. Bare spots shall be no larger than 6-inches square. The total bare spots shall not exceed 2 percent of the total seeded area.

10.3 Maintenance During Establishment Period.

10.3.1 General. Maintenance of the turfed areas shall include eradicating weeds, protecting embankments from erosion, and protecting turfed areas from traffic.

10.3.2 Repair. Turf condition shall be reestablished as specified herein for eroded areas, damaged or barren areas. Mulch shall be repaired or replaced as required.

10.3.3 Mowing. Turfed areas shall be mowed to a minimum height of 1-1/2 inches when the average height of the turf becomes 2 inches. Clippings shall be removed.

10.3.4 Watering. Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 2 inches. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

10.3.5 Post-Fertilization. Fertilizer (16-8-4 with trace elements) shall be applied at the rate of 5 pounds per 1,000 square feet after the first month and again prior to the final acceptance.

11. FINAL ACCEPTANCE. At the end of the Turf Establishment Period, a final inspection will be made. Final acceptance of the turf will be based upon a satisfactory stand of turf as defined in the paragraph: TURF ESTABLISHMENT PERIOD. Rejected areas shall be replanted or repaired as directed by the Contracting Officer.

\* \* \* \* \*

SECTION 2P

DRAINAGE SYSTEM

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| 1. Applicable Publications                         | 4. Drain Aggregate       |
| 2. Submittals                                      | 5. PVC Pipe and Fittings |
| 3. Delivery, Storage, and Handling<br>Of Materials | 6. Filter Fabric         |

1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Standards.

D 123-88	Terminology Relating to Textiles
D 1682-64 (R 1975)	Breaking Load and Elongation of Textile Fabrics
D 1683-81	Failure in Sewn Seams of Woven Fabrics
D 3034-88	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D 3787-80 (Rev. A)	Bursting Strength of Knitted Goods - Constant-Rate-of-Traversal (CRT) Ball Burst Test
D 4491-85	Water Permeability of Geotextiles by Permittivity

1.2 U.S. Army Corps of Engineers, Engineering Manuals (EM).

EM 1110-2-1906	Laboratory Soils Testing
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2. SUBMITTALS.

2.1 Manufacturer's Recommendations. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be submitted to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to submit the recommendations can be cause for rejection of the material.

2.2 Certification. Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

3. DELIVERY, STORAGE, AND HANDLING OF MATERIALS.

3.1 Delivery and Storage. Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

3.2 Handling. Materials shall be handled in such a manner as to insure delivery to the site in sound undamaged condition. Pipe shall be carried to the trench, not dragged. Plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

4. DRAIN AGGREGATE. A filter course layer of drain aggregate shall be placed on the prepared subgrade as shown on the plans. The thickness of the drain aggregate shall be as shown on the drawings and it shall be placed in such a manner as to avoid segregation of sizes. Where applicable, compaction of the material shall be accomplished by 2 passes of a heavy rubber-tired roller or other approved compaction equipment. Drain aggregate, consisting of gravel and sand shall be of clean, hard, tough, durable quality and free from laminated, soft or flaky particles, shale, organic matter or other deleterious material. Material shall be graded between the limits specified below:

Drain Aggregate

<u>Sieve Size</u>	<u>Percent</u>
<u>U.S. Standard Square Mesh</u>	<u>Passing by Weight</u>
1 inch	100
3/4 inch	90-100
3/8 inch	15-45
No. 4	0-5

5. PVC PIPE AND FITTINGS. ASTM D 3034, Type PSM with a maximum SDR of 35, size 3-inch in diameter, with flexible elastomeric seal joint.

6. FILTER FABRIC.

6.1 Geotextile. The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall meet the physical requirements listed in Table No. 1 of the specifications. The geotextile fiber shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amide, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

6.2 Seams. The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 10 feet wide. Seams shall be tested in accordance with

method ASTM D 1683, using 1-inch square jaws and 12 inches per minute constant rate of traverse. The strengths shall be not less than 90 percent of the required tensile strength (Table 1) of the unaged geotextile in any principal direction.

6.3 Acceptance Requirements. All brands of geotextile and all seams to be used shall be accepted on the following basis. The Contractor shall furnish the Contracting Officer, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification. If requested by the Contracting Officer, the Contractor shall provide to the Government geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 60 days prior to the beginning of installation of the same geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation.

6.4 Determination of Equivalent Opening Size (EOS). Five unaged geotextile samples shall be tested. Obtain 50 gm of each of the following fractions of standard glass beads:

U.S. Standard Designated Sieve Number			U.S. Standard Designated Sieve Number		
<u>EOS</u>	<u>Passing</u>	<u>Retained On</u>	<u>EOS</u>	<u>Passing</u>	<u>Retained On</u>
20	18	20	60	50	60
30	25	30	70	60	70
40	35	40	80	70	80
50	45	50	100	80	100
120	100	120	140	120	140

Table No. 1 - Physical Requirements

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Acceptable Values ++</u> Note 2
Tensile Strength (unaged geotextile) Note 1	ASTM D 1682 Grab Test Method using 1 inch square jaws and a 12 inches per minute constant rate of traverse.	120 pound minimum in any principal direction
Breaking Elongation (unaged geotextile)	ASTM D 1682 Determine Apparent Breaking Elongation	15 percent minimum in any principal direction.

Table No. 1 - Physical Requirements (Cont'd)

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Acceptable Values ++</u> Note 2
Puncture Strength (unaged geotextile) Note 1	ASTM D 3787 except polished steel ball replaced with a 5/16-inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.	40 pound minimum
Equivalent Opening Size (EOS)	Specification Paragraph titled "Determination of Equivalent Opening Size (EOS)."	No finer than the U.S. Standard Sieve No 70 and no coarser than the U.S. Standard Sieve No. 30.
Geotextile Permeability (k sub G)	ASTM D 4491 Test Methods for Water Permeability of Geotextiles By Permittivity	The permeability of the Geotextile shall be at least 0.001 cm/sec but not greater than 0.20 cm/sec

Note 1 Unaged geotextile is defined as geotextile in the condition received from the manufacturer or distributor.

Note 2 All numerical values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the minimum in the table).  
Two possible sources of suitable glass beads are:

Cataphote Division		Potters Industries Inc.
Ferro Corporation	or	377-T Route 17
P.O. Box 2369		Hasbrouck Heights, NJ 07604
Jackson, Mississippi 39205		Telephone: (201) 288-4700
Telephone: (601) 939-4631		

Glass beads should be at least 90 percent true spheres. Beads should not be used without verifying the sizing by sieving on the sieves given above for each designated EOS. Beads shall be periodically re-sieved to eliminate beads of other sizes, broken beads, and other undesirable material. The geotextile shall be affixed to a standard sieve 8 inches in diameter having openings larger than the largest beads to be used in the test. The textile shall be attached to the sieve in such a manner that no beads can pass between the geotextile and the sieve wall. Shaking shall be accomplished as described in paragraph 2d(1) (g), Appendix V, EM 1110-2-1906, except the time for shaking shall be 20 minutes. Determine by sieving (using successively coarser fractions) that size of beads of which five percent or less by weight passes through the geotextile; the equivalent opening size, EOS of the geotextile specimen is the "retained on" U. S. Standard Sieve number or nominal sieve opening in millimeters of this fraction. A minimum of five randomly chosen specimens shall be tested. The EOS for the fabric sample shall be reported as the values representing the largest and smallest EOS values of the individual

specimens.

6.5 Determination of Percent of Open Area. Five samples of unaged woven geotextile shall be placed separately in a 2-inch by 2-inch slide holder and the image projected with a slide projector on a rigid screen. A square block of 25 openings near the center of that image shall be selected and the length and width of each of the 25 openings shall be measured to the nearest 0.02 inch. The total area shall be determined by measuring the length of the sides of the 5 openings and 5 adjacent fibers in each direction to the nearest 0.02 inch. The percent open area is determined by dividing the sum of the 25 open areas by the total area of the 25 openings and their adjacent fibers. The percent open area shall be quoted as the percent determined by averaging the percent open areas of the five individual specimens. However, if more than one of the five specimens are outside the specified POA limits, the fabric shall be considered to have failed the test.

6.6 Installation of the Geotextile. The geotextile shall be placed in the manner and at the locations shown on the drawings. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris and soft or low density pockets of material. Erosion features such as rills, gullies, etc. must be graded out of the surface before geotextile placement. The geotextile shall be placed with the long dimension parallel to the centerline of the channel and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 12 inches of overlap for each joint. Temporary pinning of the textile to help hold it in place until the drainage aggregate is placed shall be allowed. The temporary pins shall be removed as the drainage aggregate is placed to relieve high tensile stress which may occur during placement of material on the geotextile. The placement procedure requires that the length of the geotextile be approximately 15 percent greater than the slope length. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of drainage aggregate shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of riprap or other materials. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Before placement of drainage aggregate, the Contractor shall demonstrate that the placement technique will prevent damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

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SECTION 2Q

PAVEMENT MARKINGS

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| 1. Applicable Publications | 4. Equipment           |
| 2. Materials               | 5. Surface Preparation |
| 3. Sampling and Testing    | 6. Application         |

1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specifications (Fed. Spec.).

TT-P-115E	Paint, Traffic, Highway, White and Yellow
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1.2 Federal Standard (Fed. Std.).

No. 141a & Change Notices 1, 2, 3, 4	Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing
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2. MATERIALS. Paint shall be in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacturer, manufacturer's name, formulation number and directions, all of which shall be plainly legible at time of use. The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of six months.

2.1 Paints. Paints shall conform to Fed. Spec. TT-P-115. Color shall be white.

3. SAMPLING AND TESTING. Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply. Upon notification by the Contractor that the material is at the site or source of supply, a quart sample of each batch of paint shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Contents of the sampled containers shall be so thoroughly mixed as to render the sample truly representative. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. The material may be approved for use based on either the following data furnished by the Contractor:

a. A test report showing that the proposed batch meets all specified requirements.

b. A test report showing that a previous batch manufactured using the same formulation as that used in manufacturing the proposed batch met all specified requirements, and a report showing test results on the proposed batch for the following properties required in the material specification: weight per gallon, viscosity, fineness of grind, drying time, and gradation. Testing procedures and reports shall be as specified in paragraph 5 of Method 1031.2 of Fed. Std. 141. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application. When tested by the Government and samples fail to meet specification requirements, the materials represented by the samples shall be replaced and cost of testing will be deducted from the payments due the Contractor at the rate of \$100 per sample retested.

4. EQUIPMENT. All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

4.1 Sandblasting Equipment. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 c.f.m. of air at a pressure of not less than 90 psi at the nozzle for each nozzle used.

5. SURFACE PREPARATION. New pavement surfaces shall be allowed to cure for a period of not less than 30 days before application of marking materials. All surfaces to be marked shall be thoroughly cleaned before application of the paint. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Where oil or grease are present on old pavements to be marked, affected areas shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping and marking. Surfaces shall be recleaned, when work has been stopped due to rain.

6. APPLICATION. Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

6.1 Paint shall be applied to clean, dry surfaces, and unless otherwise approved, only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. Paint shall be applied pneumatically with approved equipment at rate of coverage specified herein. The Contractor shall provide guidelines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. All edges of markings shall be sharply outlined. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

6.2 Traffic Controls. Suitable warning signs shall be placed near the beginning and end of the worksite for alerting approaching traffic. Small markers shall be placed along newly painted lines to control traffic and prevent damage to newly painted surfaces.

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SECTION 2R

SCOUR GAGES

1. GENERAL. The scour gages shall be of the dimension shown on the drawings and installed at the locations indicated.

2. MATERIAL.

2.1 Concrete. Scour gages shall be integrally colored precast concrete. Concrete shall conform to the requirements of SECTION: CONCRETE. The maximum aggregate size may be reduced to 3/8 inch. The finish surface of the concrete shall be finished smooth and without blemish.

2.2 Color Additive shall be manufacturers' standard black pigmented color additive. Additive shall be mixed in accordance with manufacturers' written instructions and in sufficient quantities to provide vivid coloration of the concrete. The color shall be certified as non-fading by the supplier.

3. TOLERANCES. Tolerances of scour gages shall be within 1/32 inch of the dimension shown on the drawings.

4. INSTALLATION. Scour gages shall be installed perpendicular and flush to finish surfaces.

\* \* \* \* \*

SECTION 2S

CONCRETE PAVING STONE

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| 4. Delivery, Storage,<br>and Handling | 8. Placing                           |

1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

C 33-86

Concrete Aggregates

C 936-82  
(R 1988)

Solid Concrete Interlocking Paving  
Units

2. GENERAL. Paving units shall be precast interlocking paving units produced by a manufacturer regularly engaged in the manufacture of paving units conforming to the requirements specified herein. The Contractor, selected to install the paving stones, shall have at least five years experience in the installation of interlocking concrete paving units.

3. SUBMITTALS.

3.1 Certificates of Conformance. Before delivery of the paving units, notarized certificates attesting that materials meet the requirements specified shall be submitted in accordance with the SPECIAL CLAUSES.

3.2 Certified Laboratory Test Reports. Certified copies of the reports of all tests specified herein and required in referenced publications shall be submitted to the Contracting Officer.

4. DELIVERY, STORAGE, AND HANDLING. Handle, store, and protect paving units in a manner to avoid chipping, breakage, discoloration, or contact with contaminating materials and exposure to the elements.

5. MATERIALS.

5.1 Paving stones (pavers) shall conform to ASTM C 936, 60mm in thickness, made from normal weight aggregates and Portland Cement, and shall meet the shape and color of the pavers installed on the Arizona Canal Diversion Channel, Reach 2C, Cave Creek Channel and Sediment Basin.

5.2 Admixtures. Admixtures, if used, shall conform to the requirements of the SECTION: CONCRETE.

5.3 Sand. Sand for laying course shall conform to the requirements of ASTM C 33 for washed concrete sand.

6. SAMPLING AND TESTING. All sampling and testing shall be the responsibility of the Contractor.

7. PREPARATION OF SAND LAYING COURSE.

7.1 The sand laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce 1-inch thickness when the paving units have been placed and vibrated.

7.2 The finished sand laying course shall be protected from any damage.

8. PLACING.

8.1 Paving units shall be laid in the pattern, as indicated, and the joints between units will not exceed 1/8 inch.

8.2 Gaps at the edge of the paved surface shall be filled with standard edge unit or with units sawcut to fit. Sawcut edges shall be clean, true, and sharp. Whenever possible, units less than 1/3 of original dimension shall not be used.

8.3 Paving units shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and joints open.

8.4 After vibration, clean sand shall be spread over the paving stone surface, allowed to dry, and vibrated into joints with additional vibrator passes and brushing so as to completely fill joints.

8.5 Surplus sand shall be swept from the surface to insure that joints have been completely filled.

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SECTION 2T

BILTMORE HOTEL FACILITIES RESTORATION

1. REQUIREMENTS.

1.1 General. The Contractor shall restore any facilities to their original condition after construction on the Arizona Canal Diversion Channel at the Biltmore Hotel.

1.2 Pictorial Record. Prior to construction, the Contractor shall make a pictorial record of all existing facilities in the Biltmore Hotel Complex. The Contractor shall make and record all necessary measurements in order to replace all the facilities including, but not limited to, paved parking areas, curbs, gutters, trees, shrubs, fences, irrigation systems, walks, game courts, lighting facilities, roads, buildings, and walls.

1.3 Submittals. The pictorial record and measurement survey shall be submitted for approval by the Contracting Officer. One copy of each of the pictorial record and measurement survey shall become the property of the Government and shall be given to the Contracting Officer prior to start of construction in this area. The Contractor shall use these surveys to reconstruct the facilities in kind after the construction of the Arizona Canal Diversion Channel.

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SECTION 2U

WATER LINES

By LAD

10/10/14

SECTION 3A

FORMWORK FOR CONCRETE

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1. REFERENCE STANDARDS.

1.1 American Concrete Institute (ACI) Standards.

ACI 347-81

Recommended Practice for Concrete  
Formwork

1.2 American Society for Testing and Materials (ASTM) with Corresponding CRD  
Standard Indicated where Available.

C 31-84 (CRD-C 11)

Making and Curing Concrete Test  
Specimens in the Field

C 39-84 (CRD-C 14)

Compressive Strength of  
Cylindrical Concrete Specimens

1.3 U. S. Department of Commerce, National Bureau of Standards (NBS) Product  
Standard.

PS 1-74

For Construction and Industrial  
Plywood

2. SUBMITTALS.

2.1 Shop Drawings. Drawings and computations for all formwork required shall be submitted at least 15 days before either fabrication on site or before delivery of prefabricated forms. The drawings and data submitted shall include the type, size, quantity and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

2.2 Manufacturers Literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, form coating and form lining materials.

2.3 Sample Panels and Posts. After shop drawings have been approved, sample panels and posts for Class A and F finish treatments shall be delivered to the Contracting Officer where directed. At least three sample posts shall be delivered. Panels shall be of sufficient size to contain joints and shall be

not less than 6 feet long and 4 feet high. The panels shall be of typical wall thickness. Posts shall be full size. Panels and posts shall be constructed containing the full allocation of reinforcing steel that will be used and with the forming system that duplicates in every detail the one that will be used in construction of the structures. The same concrete mix design and materials, the same placement techniques and equipment, and the same finishing techniques and timing shall be used that are planned for the posts. Construction of structures with Class A and F finishes will not be permitted until sample panels and posts have been approved. Sample panels and posts shall be protected from construction operations in a manner to protect approved finish and are not to be removed until all Class A and F finish concrete has been accepted.

3. DESIGN. The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. The formwork shall be designed for loads, lateral pressure and allowable stresses in accordance with Chapter 1 of ACI Standard 347. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

#### 4. MATERIALS.

4.1 Forms shall be fabricated with facing materials that produce the specified construction tolerance requirements and the surface requirements of SECTION: CONCRETE.

4.1.1 Class "A" Finish. This class of finish shall apply to the concrete posts used in the picket fence construction. The form facing material shall be composed of new, well-matched tongue-and-groove or shiplap lumber; new plywood panels conforming to NBS PS-1 grade B-B concrete form Class I; tempered concrete hardboard or steel. Steel lining on wood sheathing will not be allowed.

4.1.1.1 All bolts, wires, and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and patched with mortar. Mortar shall be composed of 1 part cement and 2 parts fine sand. Additionally, the mortar shall be colored to match the color used in manufacture of the posts. The surface shall then be promptly covered with polyethylene film, wet burlap or cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive, or other suitable means. Only white polyethylene film for covering will be acceptable.

4.1.1.2 When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such a lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be

left on the finished surface. The grout shall be colored as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform surface.

4.1.2 Class "B" Finish. This class of finish shall apply to all surfaces except those specified to receive Class A or those to receive a formed textured finish. The sheathing shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to NBS Product Standards PS-1 grade B-B concrete form, tempered concrete form hardboard, or steel. Steel lining on wood sheathing will not be permitted.

4.1.3 Class "F" Finish. This class of finish shall apply to those surfaces described in the drawings as "rough lumber finish". This finish is roughly described as Cedar Grapestake and shall have a minimum relief of 5/8 inch. It shall be obtained by use of textured form liners. These liners may be of formed plastic sheet, wood, sheetmetal or other approved material.

4.2 Form Accessories. Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

4.3 Form Coating shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

5. INSTALLATION. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements and conforming to construction tolerance of SECTION: CONCRETE. Where concrete surfaces are to be permanently exposed to view, joints in form panels shall be arranged to provide a pleasing appearance. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. All surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material before concrete is placed in them.

6. CHAMFERING. All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated a sufficient

distance outside the limit of the earth or rockfill so that the end of the joints will be clearly visible.

7. COATING. Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

8. REMOVAL. Forms shall not be removed without approval and all removal shall be accomplished in a manner which will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum time indicated below, except as otherwise directed or specifically authorized. When conditions of the work are such as to justify the requirement, forms will be required to remain in place for a longer period.

8.1 Unsupported Concrete. Formwork for walls, columns, sides of beams, gravity structures and other vertical type forms not supporting the weight of concrete shall not be removed in less than 24 hours, except as specified hereinafter. Forms for walls not designed to support any other work may be removed after 16 hours provided the minimum compressive strength exceeds 700 psi for each of two compressive strength cylinders tested in accordance with ASTM C 31 and C 39. The time depends on temperature, lift heights and type and amount of cementitious material in the concrete. Where forms for columns, walls and sides of beams also support formwork for slabs or beam soffits, the removal time of the latter shall govern.

8.2 Supported Concrete. Pan joist forms of the type which can be removed without disturbing shoring shall not be removed in less than 4 days. Supporting forms and shoring shall not be removed until structural members have acquired sufficient strength to support safely their own weight and any construction load to which concrete may be subjected. In no case shall forms and shoring be removed until both minimum time and sufficient strength have been attained.

Concrete Mixtures

Concrete Mixtures

Containing Type II  
or Type IP cement

Containing Type II  
cement with flyash

Joist, beams or girder  
soffits where clear  
structural span  
between support is  
under 10 feet  
10 to 20 feet  
over 20 feet

4

7

14

6

10

21

In addition to minimum times in days specified above, results of control tests conducted in accordance with ASTM C 31 and C 39 will be used as evidence that concrete has attained sufficient strength to permit removal of forms. Concrete cylinders shall be stored in the structure or as near the structure as possible, shall receive insofar as possible the same curing and protection as given those portions of the structure they represent, and shall be tested within 12 hours after removal from the structure. Cylinders will be tested by and at the expense of the Contractor. The Contracting Officer shall either witness the tests or shall receive written certification from the Contractor attesting to the strengths of the test specimens at least 4 hours prior to form removal, or by 4 p.m. of the day preceding, if the Contractor elects to commence form removal prior to noon. Supporting forms shall not be removed until after the minimum time specified above and control test specimens have attained at least 80 percent of strength required for the structure in accordance with quality and location requirements of SECTION: CONCRETE.

9. FIELD QUALITY CONTROL. Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. Forms for walls may be removed after 16 hours, provided that 2 compressive strength cylinders tested in accordance with ASTM C 31 and C 39 each has a compressive strength greater than 700 psi. The cylinders will be fabricated and tested by the Contractor in the presence of the Contracting Officer. The results of each inspection shall be reported in writing.

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SECTION 3B

EXPANSION, CONTRACTION AND  
CONSTRUCTION JOINTS IN CONCRETE

Index

- |                            |                 |
|----------------------------|-----------------|
| 1. Applicable Publications | 3. Materials    |
| 2. Submittals              | 4. Installation |

1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Standards. (With corresponding U.S. Army Corps of Engineers Handbook for Concrete and Cement (CRD) Specifications where indicated.)

D 1751-83  
(CRD-C 508)

Performed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

D 1752-84  
(CRD-C 509)

Preformed Sponge Rubber and Cork Expansion Joint Fillers and Concrete Paving and Structural Construction

D 1850-74  
(R 1979)

Concrete Joint Sealer, Cold-Application Type

D 3406-85

Joint Sealant, Hot Applied, Elastomeric Type, for Portland Cement Concrete Pavements

1.2 Federal Specification (Fed. Spec.).

TT-S-00227E  
& Am-3

Sealing Compound, Elastomeric-Type, Multi-component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

2. SUBMITTALS.

2.1 Test Reports. Certified manufacturer's test reports shall be provided for premolded expansion-joint filler strips, sealers, and lubricant to verify compliance with the applicable specification.

3. MATERIALS.

3.1 Expansion Joint Filler Strips, Premolded shall conform ASTM D 1751 or ASTM D 1752, Type I or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752

3.2 Joint Sealants and Seals.

3.2.1 Field Molded Sealants shall conform to Fed. Spec. TT-S-00227, Type II for vertical joints and Type I for horizontal joints, Class A; or ASTM D 1850 or D 3406. All sealants shall be tested in bond to 50 percent extension. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and nonabsorptive material type such as extruded butyl or polychloroprene foam rubber.

4. INSTALLATION. Joint locations and details, including materials and methods of installation of joint fillers, shall be as specified, shown on the drawings and as directed. Joints shall be provided in the invert slabs of the channel whenever concrete placement is stopped for periods exceeding 45 minutes. In no case shall any fixed metal be continuous through an expansion or contraction joint. In vertical walls and covered channel roof, vertical construction joints shall be provided at intervals of 30 to 60 feet measured along the walls or the centerline of the invert. On curves, the 60-foot maximum interval shall be measured along the channel wall with the greater radius. In no case shall any fixed metal be continuous through an expansion or contraction joint in a vertical wall.

4.1 Expansion Joints. Premolded filler strips shall have oiled wood strips secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces. The wood strips shall be slightly tapered, dressed and of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant or seals to the size shown on the drawings. Material used to secure premolded fillers and wood strips to concrete shall not harm the concrete and shall be compatible with the joint sealant or seals. The wood strips shall not be removed until after the concrete curing period. The groove shall be thoroughly cleaned of all laitance, curing compound, foreign materials, protrusions of hardened concrete and any dust which shall be blown out of the groove with oil-free compressed air.

4.1.1 Joints With Field-Molded Sealant. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degree F. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

4.2 Contraction Joints. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint.

\* \* \* \* \*

SECTION 3C

STEEL BARS, STEEL WELDED WIRE FABRIC, AND ACCESSORIES  
FOR CONCRETE REINFORCEMENT

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| 1. Applicable Publications | 4. Materials |
| 2. Certification Testing   | 5. Placement |
| 3. Submittals              |              |

1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Concrete Institute (ACI) Standards.

ACI 315-80 (R 1986)	Details and Detailing of Concrete Reinforcement
ACI 318-83 (R 1986)	Building Code Requirements for Reinforced Concrete

1.2 American Society for Testing and Materials (ASTM) Standards.

A 184-88	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
A 370-88 (Rev A)	Mechanical Testing of Steel Products
A 497-86	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
A 615-87 (Rev A)	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 706-88	Low-Alloy Steel Deformed Bars for Concrete Reinforcement

1.3 American Welding Society (AWS) Code.

D 1.4-79	Structural Welding Code Reinforcing Steel
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2. CERTIFICATION TESTING. The Contractor shall have required material tests performed by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests shall be performed and certified at the Contractor's expense.

2.1 Reinforcement Steel Tests. Mechanical testing of steel shall be in accordance with ASTM A 370 except as otherwise specified herein or required by the material specifications. Tension tests shall be performed on full cross section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. The ladle analysis shall show the percentages of carbon, phosphorous, manganese, and sulfur present in the steel.

3. SUBMITTALS. The Contractor shall submit the following items to the Contracting Officer for approval.

3.1 Shop Drawings shall be in accordance with specified requirements and include the following:

- (1) Reinforcement steel schedules showing quantity, size, shape, dimensions, weight per foot and total weights, and bending details.
- (2) Details of bar supports showing types, sizes, spacing, and sequence.
- (3) Mark designations used on shop drawings shall be the same as on the reinforcement steel contract drawings.

3.2 Test Reports. Certified test reports of reinforcement steel showing that the steel complies with the applicable specifications shall be furnished for each steel shipment and identified with specific lots prior to placement. Three copies of the ladle analysis shall be provided for each lot of steel and the Contractor shall certify that the steel furnished conforms to the ladle analysis.

3.3 Disposition Records. A system of identification which shows the disposition of specific lots of approved materials in the work shall be established and submitted before completion of the contract.

#### 4. MATERIALS.

4.1 Steel bars shall conform to the grade, size, and length shown on the drawings.

4.1.1 Billet-Steel Bars shall conform to ASTM A 615, deformed.

4.1.2 The bend test requirements shall be based upon 180 degree bends of full size bars for all grades of steel. The bend diameters for bend test shall be as indicated in the following table and shall be measured on the inside of bars:

Bar Size	Maximum Diameter
No. 3, 4, and 5	3-1/2 bar diameters
No. 6, 7, and 8	5 bar diameters
No. 9, 10, and 11 (Grade 40)	5 bar diameters

4.1.3 Low-Alloy Bars. ASTM A 706.

4.1.4 Fabricated Bar Mats. ASTM A 184, clipped or welded mats, billet-steel bars specified herein.

4.2 Steel Welded Wire Fabric. ASTM A 497 wire spacing and sizes as indicated on the drawings. For wire with a specified yield strength (fy) exceeding 60,000 psi, fy shall be the stress corresponding to a strain of 0.35 percent.

4.3 Accessories.

4.3.1 Bar Supports. ACI 315. Supports for formed surfaces exposed to view or to be painted shall be plastic protected wire, stainless steel, or precast concrete supports. Precast concrete supports shall be wedge-shaped, not larger than 3-1/2 x 3-1/2 inches, of thickness equal to that indicated for concrete cover, and have an embedded hooked tie-wire for anchorage. If formed surface is exposed to view, precast concrete supports shall be the same quality, texture, and color as the finish surface.

4.3.2 Wire Ties shall be 16-gage or heavier black annealed wire.

5. PLACEMENT. Reinforcement steel and accessories shall be placed as specified and as shown on contract drawings and approved shop drawings. Placement details of steel and accessories not specified or shown on the drawings shall be in accordance with ACI 315 and ACI 318 or as directed by the Contracting Officer. Steel shall be fabricated to shapes and dimensions shown, placed where indicated within specified tolerances, and adequately supported during concrete placement. At the time of concrete placement all steel shall be free from loose, flaky rust, scale (except tight mill scale), mud, oil, grease, or any other coating that might reduce the bond with the concrete. No cutting of reinforcing steel by torch will be allowed without approval of the Contracting Officer.

5.1 Hooks and Bends. Steel may be mill or field bent. All steel shall be bent cold unless otherwise authorized. No steel bars shall be bent after being partially embedded in concrete unless indicated on the drawings or otherwise authorized.

5.2 Welding of steel will be permitted only where indicated on the drawings or as otherwise directed by the Contracting Officer. Welding shall be performed in accordance with AWS D 1.4 except where otherwise specified or indicated on the drawings.

5.3 Placing Tolerances.

5.3.1 Spacing. The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than one inch.

5.3.2 Concrete Cover. The minimum concrete cover of main reinforcement steel shall be as shown on the drawings. The allowable variation for minimum cover shall be as follows:

Minimum Cover

Variation

6"	+ 1/2"
4"	+ 3/8"
3"	+ 3/8"
2"	+ 1/4"
1-1/2"	+ 1/4"
1"	+ 1/8"
3/4"	+ 1/8"

5.4 Splicing. Splices in steel shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government, subject to the approval of the Contracting Officer.

5.4.1 Lap Splices shall be used only for bars smaller than Size No. 14 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches.

\* \* \* \* \*

SECTION 3D

CONCRETE

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| 1. Reference Standards       | 9. Preparation for Placing                       |
| 2. Quality Assurance         | 10. Placing                                      |
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| 4. Submittals                | 12. Curing and Protection                        |
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| 7. Production Equipment      |  |
| 8. Conveying Equipment       |  |

1. REFERENCE STANDARDS.

1.1 American Concrete Institute (ACI) Standards.

- |  |  |
|--|--|
| ACI 211.1-81<br>(R 1985)<br>(CRD-C 99) | Standard Practice for Selecting<br>Proportions for Normal,<br>Heavyweight, and Mass Concrete |
|--|--|

1.2 American Society for Testing and Materials (ASTM) with Corresponding CRD Standard Indicated Where Available.

- |                                     |   |
|-------------------------------------|---|
| C 31-88<br>(CRD-C 11)               | Making and Curing Concrete Test<br>Specimens in the Field |
| C 33-86<br>(CRD-C 133)              | Concrete Aggregates                                       |
| C 39-86<br>(CRD-C 14)               | Compressive Strength of<br>Cylindrical Concrete Specimens |
| C 70-79<br>(R 1985)<br>(CRD-C 111)  | Surface Moisture in Fine Aggregate                        |
| C 94-86<br>(Rev. B)<br>(CRD-C 31)   | Ready-Mixed Concrete                                      |
| C 136-84<br>(Rev. A)<br>(CRD-C 103) | Sieve Analysis of Fine and Coarse<br>Aggregates           |
| C 143-78<br>(CRD-C 5)               | Slump of Portland Cement Concrete                         |

C 150-86 (CRD-C 201)	Portland Cement
C 171-69 (R 1986) (CRD-C 310)	Sheet Materials for Curing Concrete
C 172-82 (CRD-C 4)	Sampling Freshly Mixed Concrete
C 192-88 (CRD-C 10)	Making and Curing Concrete Test Specimens in the Laboratory
C 231-82 (CRD-C 41)	Air Content of Freshly Mixed Concrete by the Pressure Method
C 260-86 (CRD-C 13)	Air-Entraining Admixtures for Concrete
C 494-86 (CRD-C 87)	Chemical Admixtures for Concrete
C 566-84 (CRD-C 113)	Total Moisture Content of Aggregate by Drying
C 595-86 (CRD-C 203)	Blended Hydraulic Cements
C 618-87 (CRD-C 255)	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
D 75-87 (CRD-C 155)	Sampling Aggregates
E 329-77 (R 1983) (CRD-C 500)	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

1.3 Concrete Plant Manufacturer's Bureau (CPMB).

In the CRD (6th Revision (CRD-C 95) Concrete Plant Standards

1.4 National Bureau of Standards (NBS) Handbook.

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Specifications, Tolerance and  
Other Technical Requirements for  
Commercial Weighing and  
Measuring Devices (4th Edition  
1971 with Replacement Sheets)

1.5 U.S. Army Corps of Engineers Handbook for Cement and Concrete (CRD).

CRD-C 100-75	Concrete Aggregate and Aggregate Sources and Selection of Material for Testing
CRD-C 104-80	Calculation of the Fineness Modulus of Aggregate
CRD-C 112-69	Surface Moisture in Aggregate by Water Displacement
CRD-C 143-62	Meters for Automatic Indication of Moisture in Fine Aggregate
CRD-C 300-88	Membrane-Forming Compounds for Curing Concrete
CRD-C 400-63	Water for Use in Mixing or Curing Concrete
CRD-C 521-81	Frequency and Amplitude of Vibrators for Concrete
CRD-C 621-89	Non-Shrink Grout

2. QUALITY ASSURANCE.

2.1 Preconstruction Sampling and Testing.

2.1.1 Aggregates. The aggregate sources listed in SPECIAL CLAUSES have in the past been determined to be capable of supplying aggregates of quality acceptable for use in this project. Proposed aggregates produced from similar strata, or of similar quality, will be approved. If the Contractor proposes to furnish aggregates from a source listed in SPECIAL CLAUSES, he will be required to supply not less than 1000 pounds of each size coarse aggregate and 1000 pounds of fine aggregate taken from the proposed source under the supervision of the Contracting Officer in accordance with CRD-C 100 and shall deliver them to:

Director  
South Pacific Division Laboratory  
U.S. Army Corps of Engineers  
Bridgeway, Foot of Spring Street  
(Building directly east of 2000 Bridgeway)  
Sausalito, CA 94695  
Phone: (415) 332-3374

within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. The laboratory will require 45 days after delivery of the samples to complete evaluation of the aggregates.

Testing by and at the expense of the Government will be in accordance with the applicable CRD or ASTM test methods. Tests to which aggregate may be subjected are specific gravity, absorption, freezing-and-thawing in concrete, alkali-aggregate reaction, organic impurities and any other test necessary to demonstrate that the aggregate is of a quality which is at least equivalent to those sources listed in SPECIAL CLAUSES. If the Contractor proposes to furnish aggregates from a source not listed in SPECIAL CLAUSES, samples will be obtained as described above. The aggregates' suitability for use in concrete will be determined by the Government. The division laboratory will require 60 days after delivery of the samples to evaluate the aggregates. If the source selected by the Contractor fails to supply materials that are at least equivalent to the sources listed in SPECIAL CLAUSES, as determined by the Government, the Contractor will be required to propose a new source or elect a source listed in SPECIAL CLAUSES to supply aggregates for the project. If the Contractor elects to obtain aggregates from more than one source, samples of aggregates from each source to be evaluated will be obtained as described above. Any testing of additional sources or retesting of sources which fail initially, will be at the expense of the Contractor. The Government reserves the right to reject materials found to be unsuitable when produced from any source even a source that is noted in SPECIAL CLAUSES. Regardless of the source selected, the Contractor will be required to submit samples as described for verification testing. A period of 45 days will be required to perform the verification testing.

2.1.2 Cementitious Materials, Admixtures, Curing Compound. At least 60 days in advance of concrete placement the Contractor will notify the Contracting Officer of the source of materials, along with sampling location, brand name, type and quantity to be used in the manufacture and/or curing of the concrete. Sampling and testing will be performed by and at the expense of the Government except as otherwise specified. No material shall be used until notice has been given by the Contracting Officer that test results are satisfactory and all movement of materials after sampling shall be as directed. The Government will sample and test the following.

2.1.2.1 Cement and Pozzolan. If cement or pozzolan is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

2.1.2.2 Prequalified Cement Sources. Cement shall be delivered and used directly from a mill of a producer designated as a qualified source. Samples of cement for check testing will be taken at the project site or concrete producing plant by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified cement sources is available from Commander and Director, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi 39180.

2.1.2.3 Prequalified Pozzolan Sources. Pozzolan shall be delivered and used directly from a producer designated as a qualified source. Samples of pozzolan for check testing will be taken at the project site by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified pozzolan sources is available from the Commander and Director, U.S. Army Engineer Waterways Experiment Station, P.O.

Box 631, Vicksburg, MS 39180.

2.1.2.4 Cement, if not from a prequalified source will be sampled at the source and stored in sealed bins pending completion of certain tests. Sampling, testing and the shipping inspection from the point of sampling, when the point is other than at the site of the work, will be made by, or under the supervision of the Government and at its expense. No cement shall be used until notice has been given by the Contracting Officer that test results are satisfactory. In the event of failure, the cement may be resampled and tested at the request of the Contractor, at his expense. When the point of sampling is other than at the site of the work, the fill gates of the sampled bin and conveyances used in shipment will be sealed under Government supervision and kept sealed until shipment from the bin has been completed. If tested cement is rehandled at transfer points the extra cost of inspection will be at the Contractor's expense. The cost of testing cement excess to the project requirements will also be at the expense of the Contractor. The charges for testing cement at the expense of the Contractor will be deducted from the payments due the Contractor at a rate of \$1.20 per ton of cement represented by the tests.

2.1.2.5 Pozzolan, if not from a prequalified source, will be sampled at the source and stored in sealed bins pending completion of certain tests. Pozzolan will also be sampled at the site when determined necessary. All sampling and testing will be by and at the expense of the Government. Release for shipment and approval for use will be based on compliance with 7-day lime-pozzolan strength requirements and other physical and chemical and uniformity requirements for which tests can be completed by the time the 7-day lime-pozzolan strength test is completed. Release for shipment and approval for use on the above basis will be contingent on continuing compliance with the other requirements of the specifications. If a bin fails, the contents may be resampled and tested at the Contractor's expense. In this event the pozzolan may be sampled as it is loaded into cars, trucks or barges provided they are kept at the source until released for shipment. Unsealing and resealing of bins and sealing of shipping conveyances will be done by or under the supervision of the Government. Shipping conveyances will not be accepted at the site of the work unless received with all seals intact. If pozzolan is damaged in shipment, handling, or storage, it shall be promptly removed from the site of the work. Pozzolan which has not been used within six months after test will be retested at the expense of the Contractor when directed by the Contracting Officer and shall be rejected if the test results are not satisfactory. If tested pozzolan is rehandled at transfer points, the extra cost of inspection will be at the Contractor's expense. The cost of testing excess pozzolan will be at the Contractor's expense at a rate of \$2.00 per ton of pozzolan represented by the tests. The amount will be deducted from payment to the Contractor.

2.2 Construction Testing By Government. The Government will sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be

determined in accordance with ASTM C 143 and ASTM C 231, respectively. Compression test specimens will be made and laboratory cured in accordance with ASTM C 31 and compression test specimens tested in accordance with ASTM C 39.

3. EVALUATION AND ACCEPTANCE.

3.1 Concrete Strength. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equal or exceed the required specified strength f'c and no individual test result falls below the specified strength f'c by more than 500 pounds per square inch. Additional analysis or testing may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient. Concrete work judged inadequate shall be reinforced with additional construction as directed by the Contracting Officer or shall be replaced at the Contractor's expense.

3.2 Construction Tolerances. Variation in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shown on the drawings shall be within the tolerances specified in the following tables:

Table I. Tolerances for Concrete Channel Walls and Inverts, and Spillways.

(1)	Departure from established alignment	.....	2-inches on tangents
		.....	4-inches on curves
(2)	Departure from established profile grade	.....	1-inch
(3)	Footings:		
	a. Variation of dimensions in plan	Minus.....	1/2-inch
		Plus.....	2-inches
			when formed or plus 3-inches when placed against unformed excavation.
	b. Misplacement of eccentricity		2 percent of the footing width in the direction of misplacement but not more than 2-in.
	c. Reduction in thickness	Minus.....	5 percent of specified thickness.

(4)	Reduction in thickness in lining or walls	.....	10 percent of specified thickness: provided that average thickness is maintained as determined by daily batch volumes.
(5)	Variation from specified width of channel section at any height.	.....	1/4 of 1 percent plus 1-inch.
(6)	Variation from established height of lining	.....	1/2 of 1 percent plus 1-inch.
(7)	Variations in surfaces	..... .....	Invert 5/16-inch in 10 feet Side slopes and walls 1/2-inch in 10 feet.

Table II. Tolerances for Covered Channel, Erosion Protection Structures and Small Hydraulic Structures.

(1)	Departure from established alignment	.....	1-inch
(2)	Departure from established grades	.....	1-inch
(3)	Variation from the plumb or the specified batter in the lines and surfaces of columns, piers, walls, and in arises	Exposed, in 10 feet..... Backfilled, in 10 feet.....	1/2-inch 1-inch
(4)	Variation from the level or from the grades indicated on the drawings in slabs, beams, horizontal grooves, and railing offsets	Exposed, in 10 feet..... Backfilled, in 10 feet.....	1/2-inch 1-inch
(5)	Variation in cross-sectional dimensions of columns, piers slabs, walls, beams, and similar parts	Minus..... Plus.....	1/4-inch 1/2-inch
(6)	Variation in thickness of bridge slabs	Minus..... Plus.....	1/8-inch 1/4-inch

- (7) Variation in the sizes and ..... 1/2-inch locations of slab and wall openings

3.2.1 Colors. Colors of pigmented concrete shall be considered satisfactory based on the comparative analysis of color produced from test panel(s) in accordance with paragraph: TEST PANEL, and Munsell Color samples in accordance with U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of concrete shall conform to Munsell Color number 10YR5/3 with respect to hue, value and chroma. Evaluation of color shall be made within the time limits prescribed in paragraph: TEST PANEL.

3.3 Surface Requirements. The surface requirements for the classes of finish required by SECTION: FORMWORK FOR CONCRETE, shall be as hereinafter specified. Allowable irregularities are designated "abrupt" or "gradual" for purposes of providing for surface variations. Offsets resulting from displaced, misplaced or mismatched forms, or sheathing, or by loose knots in sheathing, or other similar form defects, shall be considered "abrupt" irregularities. Irregularities resulting from warping, unplaneness or similar uniform variations from planeness, or true curvature, shall be considered "gradual" irregularities. "Gradual" irregularities will be checked for compliance with the prescribed limits with a 5-foot template, consisting of a straightedge for plane surfaces and a shaped template for curved or warped surfaces. In measuring irregularities, the straight edge or template may be placed anywhere on the surface in any direction, with the testing edge held parallel to the intended surface.

Class of Finish	Irregularities	
	Abrupt, inches	Gradual, inches
A	1/8	1/4
B	1/4	1/2
F	1/8	1/4

3.4 Appearance. Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method which does not harm the concrete and which is approved by the Contracting Officer.

4. SUBMITTALS.

4.1 Test Reports.

4.1.1 Concrete mixture proportions shall be determined by the Contractor and submitted for approval. The proportions of all ingredients and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate weight of cement and water and weights of aggregates in a saturated surface-dry condition. The submission shall be accompanied by test reports from a laboratory complying with ASTM E 329 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be

made in the source or type of materials used in the work without additional tests to show that the new materials and quality of concrete are satisfactory.

4.1.2 Cement and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which it is furnished. Certification and mill test reports shall identify the particular lot furnished. No cement or pozzolan shall be used until notice of acceptance has been given by the Contracting Officer. Cement and pozzolan will be subject to check testing from samples obtained at the mill, at transfer points or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

#### 4.1.3 Non-shrink Grout.

4.1.3.1 General. Descriptive literature of the grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered. In addition, a detailed plan shall be submitted for approval, showing equipment and procedures proposed for use in mixing and placing the grout.

4.1.3.2 Prepackaged material requiring only the addition of water will be accepted on the basis of certified laboratory test results showing that the material meets the requirements of CRD-C 621. When fine aggregate is to be added, the Contractor shall also furnish for approval the design mix proportions together with certified copies of laboratory test results indicating that the mix is in conformance with the requirements of CRD-C 621.

4.1.3.3 Mixture proportions using a volume-change controlling ingredient shall be submitted for approval. The submittal shall include the design mix proportions of all ingredients and certified copies of laboratory test results indicating that the materials and the mix is in conformance with the requirements of CRD-C 621.

#### 4.2 Manufacturers' Certificate.

4.2.1 Accelerating Admixture shall be certified for compliance with all specification requirements.

4.2.2 Impervious Sheet Curing Materials shall be certified for compliance with all specification requirements.

4.2.3 Air-entraining Admixture shall be certified for compliance with all specification requirements.

4.2.4 Water-reducing Admixture shall be certified for compliance with all specification requirements.

4.2.5 Color Admixture shall be certified to be non-fading by the manufacturer.

#### 4.3 Review of Plant, Equipment and Methods.

4.3.1 Batch Plant. Details of the data on concrete plant shall be submitted for review by the Contracting Officer for conformance with paragraph: BATCHING PLANT.

4.3.2 Concrete Mixers. The make, type and capacity of concrete mixers proposed for mixing concrete shall be submitted for review by the Contracting Officer for conformance with paragraph: MIXERS. The results of the initial mixer uniformity tests as required in paragraph: MIXER UNIFORMITY shall be submitted within five days of the initiation of placing.

4.3.3 Conveying Equipment. The methods and equipment for transporting, handling, and depositing the concrete shall be submitted for review by the Contracting Officer for conformance with paragraph: CONVEYING EQUIPMENT.

4.3.4 Placing. All placing equipment and methods shall be submitted for review by the Contracting Officer for conformance with paragraph: PLACING.

4.3.5 Joint Clean-up. The method and equipment proposed for joint clean-up and waste disposal shall be submitted for review by the Contracting Officer for conformance with paragraph: CONSTRUCTION JOINT TREATMENT.

4.3.6 Curing. The curing medium and methods to be used shall be submitted for review by the Contracting Officer for conformance with paragraph: CURING AND PROTECTION.

4.3.7 Cold-Weather Requirements. If concrete is to be placed under cold weather conditions, the proposed materials, methods and protection shall be submitted in accordance with the requirements of paragraph: COLD WEATHER PLACING for approval by the Contracting Officer.

4.3.8 Hot-Weather Requirements. If concrete is to be placed under hot weather conditions, the proposed materials and methods shall be submitted in accordance with the requirements of paragraph: HOT WEATHER PLACING for approval by the Contracting Officer.

#### 5. MATERIALS.

5.1 Cementitious Materials shall be Portland cement, Portland-pozzolan cement, or Portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Usage for architectural concrete shall be restricted to one color and one type.

5.1.1 Portland Cement. ASTM C 150, Type II including false set requirements. Low alkali including heat of hydration requirement at 7 days.

5.1.2 High-Early-Strength Portland Cement. ASTM C 150, Type III with tricalcium aluminate limited to 8 percent, low alkali, used only when specifically approved in writing.

5.1.3 Portland-Pozzolan Cement. ASTM C 595 Type IP (MS). The Portland

cement or clinkers shall meet the requirements of ASTM C 150 for low alkali cement; the pozzolan shall meet the requirements of ASTM C 618 Table 1, available alkali.

5.1.4 Pozzolan. Pozzolan shall conform to the requirements of ASTM C 618, Class F with the loss on ignition limited to 6 percent. The optional requirements of Table 2 for available alkalis will be invoked. The optional Table 3 will be invoked except that the mortar expansion at 14 days limit is amended so that the expansion of the mortar is not more than that of the cement acting alone with the selected aggregates.

5.2 Aggregates shall be produced from the sources and under the conditions described in paragraph: QUALITY ASSURANCE. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size of coarse aggregate shall be as listed in paragraph: COARSE AGGREGATE SIZE.

5.3 Admixtures to be used, when required or permitted shall conform to the appropriate specification listed below:

5.3.1 Air-entraining Admixture. ASTM C 260.

5.3.2 Accelerating Admixture. ASTM C 494, Type C except no calcium chloride will be allowed.

5.3.3 Water-reducing or Retarding Admixtures ASTM C 494, Type A, B or D.

5.3.4 Color Admixture. Color admixture for concrete shall be the product of a manufacturer regularly engaged in the production of colored admixtures for concrete, and shall have a history of at least 2 years of use of the material in a similar environment without substantial fading or deleterious effects on the structural qualities of the concrete. Color admixture must be capable of evenly distributing the color throughout the concrete without segregation or causing irregular concentration of color.

5.4 Curing Materials.

5.4.1 Impervious Sheet Materials shall conform to ASTM C 171, type optional except polyethylene film, if used, shall be white opaque.

5.4.2 Curing Compounds.

5.4.2.1 Curing Compounds for colored concrete to be exposed upon completion of construction shall conform to the requirements of CRD C-300, except that it will be clear non-pigmented.

5.4.2.2 Membrane-Forming Curing Compound CRD C-300, White Opaque. This compound will only be used on the backs of channel walls or other concrete structural elements which will not be exposed to permanent view as approved by the Contracting Officer.

5.5 Water for mixing and curing shall be fresh, clean, drinkable, and free of injurious amounts of oil, acid, salt, and alkali, except that undrinkable

water may be used if it meets the requirements of CRD-C 400.

5.6 Non-Shrink Grout shall conform to CRD-C 621. The type shall be Expansive- Cement.

## 6. MIXTURE PROPORTIONING.

6.1 Quality and Location. For each portion of the structure, mixture proportions shall be selected so that the following strength and water-cement ratio requirements are met.

6.1.1 Strength. Specified compressive strength f'c for structural elements shall be as follows, except where indicated otherwise.

Compressive Strength @ 28 days, psi	Structure or Portion of Structure
4000 @ 28 days	Covered Channel
3000 @ 28 days	All elements not described below
2500 @ 28 days	Concrete for sidewalks
2000 @ 28 days	Canal bottom
1000 @ 28 days	Dental Concrete

6.1.2 Maximum Water-Cement Ratio. Maximum water cement ratio shall be as follows:

Water-Cement Ratio, by Wt.	Structure or Portion of Structure
None	Dental Concrete
0.45	Concrete for invert, channel walls, and covered channel roof.
0.55	Concrete for structures not described elsewhere.
0.65	Curbs, Gutters, and Sidewalks

6.2 Coarse Aggregate Size. Coarse aggregate shall be ASTM C 33 size No. 467 for invert and footings and shall be ASTM C 33 size No. 57 for all other elements except where indicated otherwise.

6.3 Air Content. Air content as determined by ASTM C 231 shall not exceed 7 percent in all concrete. During the preparation of mix designs the Contractor shall determine the amount of air to be used in the concrete mixtures and this amount will be reported in the mix design submittal. This amount of air will be the sum of the entrapped or naturally entrained air and air entrained by admixtures. Once production of concrete has commenced the amount of air shall not vary more than 1-1/2 percent from the selected air content, nor shall it ever exceed the value stated above.

6.4 Slump. The slump shall be determined in accordance with ASTM C 143 and shall be within the following ranges. Where placement by pump is approved, the slump shall not exceed 6 inches and shall remain within a 3-inch band.

Item	Maximum Slump	Placement Restrictions
Invert and Footings	0-2 inches	No pumping
Vertical Walls and Other Elements	1-4 inches	None

6.5 Concrete Proportioning. Trial design batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of material other than aggregate shall be representative of those proposed for the project and shall be accompanied by manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on ACI Standard 211.1. The water-cement ratios required in paragraph: MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan or by weight equivalency as described in ACI Standard 211.1 to determine the maximum allowable water. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each maximum aggregate size selected at each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength.

6.6 Average Strength. In meeting the water-cement ratio and strength requirements specified in paragraph: QUALITY AND LOCATION above, the selected mixture proportion shall produce an average strength (fcr) exceeding the specified strength f'c by the amount indicated below with a water-cement ratio at or below that specified above. Where a concrete production facility has a large amount of test records, verifying that concrete of the strengths and water-cement ratios specified are being produced, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, including admixtures and colors, quality control procedures, and conditions similar to those expected in the current construction. Changes in materials and proportions within the test records shall not have been more restricted than those for the proposed work and shall represent concrete produced to meet a specified strength or strengths f'c meeting or exceeding that specified for proposed work at or below water-cement ratio specified; and shall consist of at least 30 consecutive tests or two groups of consecutive tests totalling at least 30 tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of f'c.

6.6.1 Required average compressive strength fcr used as the basis for selection of concrete proportions shall be the larger of the equations which follow using the standard deviation as determined above:

$$fcr = f'c + 1.34S \text{ where } S = \text{standard deviation}$$

$$fcr = f'c + 2.33S - 500$$

6.6.2 Where a concrete production facility does not have test records meeting requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation may be established as the product of the calculated standard deviation and a modification factor from the following table:

No. Of Tests*	Modification Factor For Standard Deviation
less than 15	Use table in 6.6.3
15	1.16
20	1.08
25	1.03
30 or more	1.00

\* Interpolate for intermediate numbers of tests.

6.6.3 When a concrete production facility does not have field strength test records for calculation of standard deviation the required average strength  $fcr$  shall be determined as follows:

If the specified compressive strength  $f'c$  is less than 3000 psi,

$$fcr = f'c + 1000.$$

If the specified compressive strength  $f'c$  is 3000 to 5000 psi,

$$fcr = f'c + 1200.$$

6.7 Color. Where concrete is to be colored, the admixture shall be batched in a manner that will ensure that the admixture is completely and thoroughly mixed throughout the concrete. Quantities of admixture added to concrete shall be controlled to avoid variations in color between adjacent placements as well as maintain a consistent coloring throughout the project area.

## 7. PRODUCTION EQUIPMENT.

7.1 Capacity. The batching and mixing equipment shall have a capacity of at least 100 cubic yards per hour.

7.2 Batching Plant shall conform to the requirements of the Concrete Plant Standards of CPMB and as specified; however, rating plates attached to batch plant equipment are not required.

7.2.1 Equipment. The batching controls shall be semi-automatic or automatic. The semi-automatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The semi-automatic or automatic batching system shall be equipped with an accurate recorder or recorders which meet the

requirement of the Concrete Plant Standards of CPMB. Separate bins or compartments shall be provided for each size group of aggregate and cement and pozzolan. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement, or pozzolan. If both cement and pozzolan are used they may be batched cumulatively provided Portland cement is batched first. If measured by weight, water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Where use of truck mixers make this requirement impracticable, the admixture dispensers shall be interlocked with the sand batcher. Admixtures will not be combined prior to introduction in water or sand. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment.

7.2.2 Weighing Equipment. The weighing equipment shall conform to the applicable requirements of NBS Handbook 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the frequency required in paragraph: SCALES and in the presence of a Government inspector.

7.2.3 Batching Tolerances.

7.2.3.1 Weighing Tolerances. Whichever of the following tolerances is greater shall apply, based on required scale reading.

Material	Percent of Required Weight	Percent of Scale Capacity
Cementitious Materials	1	0.3
Aggregate	2	0.3
Water	1	0.3
Admixture	3	0.3

7.2.3.2 Volumetric Tolerances. For volumetric batching equipment the following tolerances shall apply to the required volume of material being batched:

Water: Plus or minus 1 percent.

Admixtures: Plus or minus 3 percent.

7.2.4 Moisture Control. The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates, and to change

the weights of the materials being batched. An electric moisture meter complying with the provisions of CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

### 7.3 Mixers.

7.3.1 General. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

7.3.2 Concrete Plant Mixers shall be tilting, non-tilting, horizontal shaft or vertical-shaft type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the paragraphs in ASTM C 94 applicable to central-mixed concrete.

7.3.3 Truck Mixers. Truck mixers, the mixing of concrete therein, and concrete uniformity, shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

## 8. CONVEYING EQUIPMENT.

8.1 General. Concrete shall be conveyed from mixer to forms as rapidly as practicable and within the time interval in paragraph: TIME INTERVAL BETWEEN MIXING AND PLACING by methods which will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper which is conical in shape and shall not be dropped vertically more than five feet, except where suitable equipment is provided to prevent segregation and where specifically authorized. Telephonic or other satisfactory means of rapid communication between the mixing plant and the forms in which concrete is being placed shall be provided and available for use by Government inspectors.

8.2 Buckets. The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum size aggregate and the area of the gate opening shall be not less than two-square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in

each dumping position.

8.3 Transfer Hoppers. Concrete may be charged into non-agitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles, and have conical-shaped discharge features. The machine shall be equipped with a hydraulically-operated gate and with a means of external vibration to effect complete and facile discharge. Concrete shall not be held in non-agitating transfer hoppers more than 30 minutes.

8.4 Trucks. Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Non-agitating equipment may be used for transporting plant mixed concrete over a smooth road when hauling time is less than 15 minutes. Bodies of non-agitating equipment shall be smooth, watertight, metal containers equipped with gates that will permit the discharge of the concrete.

8.5 Chutes. When concrete can be placed directly from a truck mixer, agitator or non-agitating equipment, the chutes attached to this equipment may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete except when specifically approved.

8.6 Belt Conveyors. Belt conveyors may be used when approved. Such conveyors shall be designed and operated to assure uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall meet the additional requirements as follows: The idler spacing shall not exceed 36 inches. If concrete is to be placed through installed horizontal or sloping reinforcing bars the conveyor will discharge concrete into a pipe or elephant trunk which is long enough to extend through the reinforcing bars. In no case will concrete be discharged to free fall through the reinforcing bars.

8.7 Pump Placement. Concrete may be conveyed by positive displacement pump when approved. Invert and side slope concrete will not be pumped. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or heavy duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. The maximum size coarse aggregate will not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

## 9. PREPARATION FOR PLACING.

9.1 Embedded Items. Before placing concrete, care shall be taken to

determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids.

9.2 Concrete on Earth Foundations. Earth surfaces upon which concrete is to be placed shall be clean, damp, and free from frost, ice, and standing or running water. Prior to placing concrete, the earth foundation shall have been satisfactorily compacted in accordance with the requirements of the SECTION: FILLS AND SUBGRADE PREPARATION. Additionally, the foundation shall be inspected by the Contractor prior to concrete placement in order to certify that it is ready to receive concrete. The results of each inspection shall be submitted in writing.

9.3 Concrete on Rock Foundation. Rock surfaces upon or against which concrete is to be placed shall be prepared as specified in the SECTION: FILLS AND SUBGRADE PREPARATION. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon.

9.3.1 Dental Concrete. Dental concrete shall be low slump, 3/4 inch aggregate, and 1000 psi minimum strength or as directed to produce a satisfactory mixture consistent with placing requirements for foundation surface treatment as determined by the Contracting Officer.

9.4 Construction Joint Treatment.

9.4.1 General. Concrete surfaces to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, sandblasting, high pressure water jet, or other approved method.

9.4.2 Cleaning.

9.4.2.1 Air-Water Cutting. Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The surface shall be cut with an air-water jet to remove all laitance and to expose clean, sound fine aggregate, but not so as to undercut the edges of the larger particles of aggregate. The air pressure used in the jet shall be 100 psi plus or minus 10 psi and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. The surface shall again be washed just prior to placing the succeeding lift. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, sandblasting will be required as the last operation before placing the next lift.

9.4.2.2 High-Pressure Water Jet. A stream of water under a pressure of not less than 3000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is

removed and there is no undercutting of coarse aggregate particles. Where the cleaning occurs more than two days prior to placing the next lift or where work in the area subsequent to the cleaning causes dirt or debris to be deposited on the surface, the surface shall be cleaned again as the last operation prior to placing the next lift. If the water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

9.4.2.3 Sandblasting. When employed in the preparation of construction joints, sandblasting shall be performed as the final operation completed before placing the following lift. The operation shall be continued until all accumulated laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose materials. The surface shall again be washed just prior to placing the succeeding lift.

9.4.2.4 Waste Disposal. The method used in disposing of waste water employed in cutting, washing and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. Method of disposal shall be subject to approval.

## 10. PLACING.

10.1 General. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms, and in so depositing there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 1-1/2 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. The surfaces of construction joints shall be kept continuously wet for the first twelve hours during the twenty-four hour period prior to placing concrete. Free water shall be removed prior to placement of concrete. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed.

10.2 Time Interval Between Mixing and Placing. Concrete shall be placed within thirty minutes after discharge into non-agitating equipment. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site. Not more than 80 percent of the water and all other materials except cement shall be batched at the distant batch plant and transported to the cement batcher without mixing.

10.3 Cold-Weather Placing. Concrete shall not be placed without a procedure approved in accordance with paragraph: COLD WEATHER REQUIREMENTS when the concrete is likely to be subjected to freezing temperatures before the expiration of the curing period. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32-degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 degrees F. and 75 degrees F. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 degrees and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperatures. Materials entering the mixer shall be free from ice, snow or frozen lumps. Salt, chemicals or other materials shall not be mixed with the concrete to prevent freezing, except that a chemical accelerator may be used.

10.4 Hot-Weather Placing. Concrete shall be properly placed and finished with approved procedures in accordance with paragraph: HOT-WEATHER REQUIREMENTS. The concrete placing temperature shall not exceed 85 degrees F. Cooling of the mixing water and/or aggregates will be required to obtain an adequate placing temperature. An approved retarder may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete placing temperature.

10.5 Consolidation. Immediately after placing, each layer of concrete shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required if necessary with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used. Consolidation shall proceed independently of all other placing operations. Vibrators for consolidation shall not be attached to Bidwell Type or any other screening or leveling equipment selected by the Contractor. Vibrators of the proper size, frequency and amplitude shall be used for the type of work being performed in conformance with the following requirements:

Application	Head Diameter (inches)	Frequency VPM	Amplitude (inches)
Thin walls, beams, etc.	1-1/4 - 2-1/2	9000 - 13500	0.02 - 0.04
General construction	2 - 3-1/2	8000 - 12000	0.025 - 0.05

The frequency and amplitude shall be within the range indicated in the table above as determined in accordance with paragraph: VIBRATORS. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly. Spare vibrators and a standby power source shall be

available at all times during concrete placement.

## 11. FINISHING.

### 11.1 Unformed Surfaces.

11.1.1 General. The ambient temperature of spaces adjacent to surfaces being finished shall not be less than 50 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305, may reasonably be expected to exceed 0.2 pounds per square feet per hour, provision for windbreaks, shading, fog spraying, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

11.1.2 General. The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 50 degrees F. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, unless a steel trowel finish is specified, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown on the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions.

11.1.3 Float Finish. A float finish shall be applied to channel invert and side slopes. Surfaces shall be screeded and darried or bull-floated to bring the surface to the required finish level with no coarse aggregate visible. No cement or mortar shall be added to the surface during the finishing operation. The concrete, while still green, but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power driven equipment. Hand floats shall be made of magnesium or aluminum. Tolerance for a floated finish shall be true plane within 5/16-inch in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

11.1.4 Trowel Finish. A steel trowel finish shall be applied to the following surfaces: spillways, tops of channel walls, and as indicated on the drawings. Concrete surfaces shall be finished with a float finish and after surface moisture has disappeared, the surface shall be steel-troweled to a smooth, even, dense finish free from blemishes including trowel marks. Tolerance shall be true planes within 5/16-inch in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

11.1.5 Broom Finish shall be applied to the traffic surface of all bridges and to the surfaces indicated on the drawings. The concrete surface shall be finished with a float finish and trowel finish. The troweled surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

11.2. Formed Surfaces. After form removal, all fins and loose materials

shall be removed. All voids, and honeycombs exceeding 1/2 inch in diameter and all tie rod holes permanently exposed to view shall be reamed or chipped and filled with dry pack mortar. Defective areas larger than 36 square inches in any surface, permanently exposed or not shall be delineated in a rectangular shape by a saw cut a minimum depth of one-inch and repaired with concrete replacement. The cement used in the mortar or concrete for all surfaces permanently exposed to view shall be a blend of Portland Cement, white cement, and coloring agent properly proportioned so that the final color when cured will be the same as adjacent concrete. Temperature of the concrete, ambient air, replacement concrete or mortar during remedial work including curing shall be above 50 degrees F. The prepared area shall be dampened, brush-coated with a neat cement grout or with an approved epoxy resin, and filled with mortar or concrete. The mortar shall consist of 1 part cement to 2-1/2 parts fine aggregate. The quantity of mixing water shall be the minimum necessary to obtain a uniform mixture and permit placing. Mortar shall be thoroughly compacted in place and struck off to adjacent concrete. Replacement concrete shall be drier than the usual mixture and thoroughly tamped into place and finished. Forms shall be used if required. Metal tools shall not be used to finish permanently exposed surfaces. All repairs shall be completed within 24 hours of form removal. The patched areas shall be cured for 7 days.

11.2.1 General. Surfaces, unless other type of finish is specified, shall be left with the texture imparted by the forms except defective surfaces shall be repaired as described above. Unless painting of surfaces is required, uniform color shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure which is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects which would impair the quality of the surface.

11.2.2 Textured Finish. This type of finish shall be applied where specified to conform to details shown on the drawings by use of approved textured form liners. Liner panels shall be secured in the forms by cementing or stapling, but not by methods which will permit impressions of nail heads, screw heads, washers or the like to be imparted to the surface of the concrete. Edges of textured panels shall be sealed to each other to prevent grout leakage. The sealant used shall be non-staining to the surface.

## 12. CURING AND PROTECTION.

12.1 General. All concrete shall be cured by an approved method for a period of 7 days. Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical injury. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours, flowing water for 14 days (7 days with type III cement). Concrete shall be shielded from direct rays of the sun for 3 days. Channel

wall faces cured with clear curing compound shall be shielded from direct rays of the sun by the use of opaque sheets conforming to the requirements of ASTM C 171. The sheets will be white opaque. No vehicular traffic shall be allowed on invert or footing concrete until a period of 28 days has passed or until the concrete has reached the specified design strength. The strength of the slabs shall be determined by a pair of cylinder breaks performed by the Contractor at the desired age. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Concrete will be cured in accordance with the following requirements.

### Curing Requirements

Structural Element	Method
Invert and Footings, Covered Channel Roof	Moist Cure or Sheet Cure
Side Slopes	Moist Cure or Sheet Cure
Vertical Walls and Other Elements	Any method described below

12.2 Moist Curing. Concrete moist-cured shall be maintained continuously (not periodically) wet for the entire curing period. If water or curing materials stain or discolor concrete surfaces which are to be permanently exposed, they shall be cleaned as required in paragraph: APPEARANCE. When wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Horizontal surfaces shall be cured by ponding, by covering with a minimum uniform thickness of 2 inches continuously saturated sand, or by covering with saturated non-staining burlap or cotton mats. Horizontal construction joints may be allowed to dry for twelve hours immediately prior to placing of the following lift.

12.3 Membrane Curing. Concrete may be cured with an approved curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which sack rubbed finish is to be applied, or any surface containing protruding steel reinforcement, or on abrasive aggregate finish.

12.3.1 A White Pigmented Type Curing Compound conforming to CRD-C 300 may be used on surfaces which will not be exposed to view when the project is completed, or on surfaces that are to be painted.

12.3.2 The Curing Compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared. The curing compound shall be applied in a 2-coat continuous operation, having the applications at right angles to each other, and applied by approved motorized power-spraying equipment and at a uniform coverage of not more than 400 square feet per gallon for each coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage herein specified. All concrete

surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause which will disrupt the continuity of the curing membrane.

12.3.3 A tinted curing compound conforming to the requirements of paragraph: MATERIALS may be used on all surfaces exposed to view, except those to which a moist or sheet cure must be applied.

12.4 Impervious-Sheet Curing. The following concrete surfaces may be cured using impervious sheets: channel invert or side slopes. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper, polyethylene film or with polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

12.5 Cold Weather. When the daily outdoor low temperature is less than 32 degrees F., the temperature of the air and forms in contact with the concrete shall be maintained above 40 degrees F. for at least the first seven days and above 32 degrees F. for the remainder of the required curing period. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F. as determined by observation of ambient and concrete temperatures. Curing compounds shall not be used on concrete surfaces which are maintained at curing temperature by use of free steam.

### 13. SETTING OF BASE PLATES AND BEARING PLATES.

13.1 General. After being plumbed and properly positioned, column base plates, shall be provided with full bearing with damp-pack bedding mortar - except where non-shrink grout is approved or required. The space between the top of concrete or masonry bearing surface and the bottom of the plate shall be approximately 1/24 of the width of the plate, but not less than 1/2 inch for plates less than 12 inches wide. Concrete surfaces shall be rough, clean, free of oil, grease, and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

13.2 Damp-pack bedding mortar shall consist of one part Type I Portland Cement and 2-1/2 parts of fine aggregate conforming to ASTM C 33, proportioned by weight, and not more than 4-1/2 gallons of water per bag of cement. The space between the top of the concrete or masonry bearing surface and the bottom of the plate shall be packed with the bedding mortar by tamping or ramming with a bar or rod until the voids are completely filled. Mortar shall be colored to match adjacent concretes.

13.3 Non-shrink grout shall conform to the requirements of paragraph: NON-SHRINK GROUT. For clearance of two inches or more, the mix shall include by weight 1-1/2 parts of sound, clean uncrushed gravel conforming to Size No. 8, Table 2, ASTM C 33 in combination with fine aggregate conforming to ASTM C 33, to one part Portland Cement unless otherwise recommended by the material manufacturer. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength. Non-shrink grout exposed to view shall be colored to match adjacent concrete.

13.3.1 Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or masonry bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 degrees to 85 degrees F. until after setting.

13.3.2 Treatment of Exposed Surfaces. Those types containing metallic aggregate shall have, after the grout has set, the exposed surfaces cut back one inch and immediately covered with a parge coat of mortar proportioned by weight one part Portland Cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of non-shrink grout shall have a smooth, dense finish.

13.3.3 Curing. Grout and parge coats shall be cured in conformance with paragraph: CURING AND PROTECTION.

#### 14. CONTRACTOR QUALITY CONTROL.

14.1 General. The Contractor shall perform the inspection and tests described in paragraph: INSPECTION DETAILS AND FREQUENCY OF TESTING, and based upon the results of these inspections and tests he shall take the action required in paragraph: ACTION REQUIRED and submit reports as required in paragraphs: ACTION REQUIRED and REPORTS. The laboratory performing the tests shall conform to ASTM E 329. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of concrete Field Testing Technicians, Grade I.

14.2 Inspection Details and Frequency of Testing.

#### 14.2.1 Fine Aggregate.

14.2.1.1 Grading. At least once during each shift in which concrete is being delivered, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and CRD-C 104, respectively, for the fine aggregate or for each fine aggregate, if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

14.2.1.2 Moisture Content. There shall be, when in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, at least four tests for moisture content in accordance with either ASTM C 70, C 566, or CRD-C 112 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter.

#### 14.2.2 Coarse Aggregate.

14.2.2.1 Grading. At least once during each shift concrete is being delivered, there shall be a sieve analysis in accordance with ASTM C 136 for each size group of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor is responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken shall show the results of the 5 most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than at the batch plant bins to allow for degradation during handling.

14.2.2.2 Moisture Content. A test for moisture content of each size of coarse aggregate in accordance with ASTM C 566 or CRD-C 112 shall be made at least once a shift. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified for fine aggregate in paragraph: MOISTURE CONTENT, of subparagraph: FINE AGGREGATE. These results shall be used to adjust the added water in the control of the batch plant.

14.2.3 Deleterious Substances. When in the opinion of the Contracting Officer, a problem exists in connection with deleterious substances in fine or coarse aggregates, tests shall be made in accordance with ASTM C 33. Testing frequency shall be not less than one per week.

#### 14.2.4 Scales.

14.2.4.1 Weighing Accuracy. The accuracy of the scales shall be checked by test weights at least once a month for conformance with the applicable

requirements of paragraph: WEIGHING EQUIPMENT. Such tests shall also be made whenever there are variations in properties of the fresh concrete which could result from batching errors.

14.2.4.2 Batching and Recording Accuracy. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight and the actual weight batched. The Contractor shall provide the necessary calibration devices and confirm that the admixture dispensers described in paragraph: EQUIPMENT are operating properly.

14.2.5 Batch-Plant Control. When the concrete plant is operating the measurement of all constituent materials including cement, pozzolan, each size of aggregate, water and admixtures shall be continuously controlled. The aggregate weights and amount of added water to compensate for free moisture in the aggregates shall be adjusted as necessary. The amount of air-entraining admixture shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batched aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

14.2.6 Concrete.

14.2.6.1 Air Content. At least two tests for air content shall be made on randomly selected batches of each class of concrete during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231. The average of each set of two tests shall be plotted on a control chart on which the average is set at the percentage specified by the Contractor on his mix design submittal and the upper and lower control limits shall be 1-1/2 percent of the specified air content respectively. The range shall be plotted on a control chart on which the upper control limit is 3.0 percent.

14.2.6.2 Slump. At least two slump tests shall be made on randomly selected batches of each mixture of concrete during each day's concrete production in accordance with ASTM C 143. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. The average of each set of two tests shall be plotted on a control chart. The range shall be plotted on a control chart on which the upper control limit is 3.0 inches.

14.2.6.3 Batch Tickets. The manufacturer of the concrete shall furnish to the Contracting Officer with each batch of concrete, before unloading at the site, a delivery ticket prepared in accordance with the requirements of ASTM C 94.

14.2.7 Preparation for Placing. Foundation or construction joints, forms and embedded items shall be inspected in sufficient time prior to each concrete

placement by the Contractor in order to certify to the Contracting Officer it is ready to receive concrete. The results of each inspection shall be reported in writing no less than 2 hours prior to placement or by 4:00 p.m. for placements prior to 9:00 a.m. the following day.

14.2.8 Placing. The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed by the Contracting Officer and shall be responsible for measuring and recording concrete temperatures, ambient temperature, weather conditions, time of placement, yardage placed, and method of placement.

14.2.9 Vibrators. The frequency and amplitude of each vibrator shall be determined in accordance with CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete holding the tachometer against the upper end of the vibrator while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type and size of the vibrator and frequency and amplitude results shall be reported in writing.

14.2.10 Curing.

14.2.10.1 Moist Curing. At least once every 8 hours an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

14.2.10.2 Curing Compound. No curing compound shall be applied until it has been verified that the compound is properly mixed and ready for spraying. At the end of each operation the quantity of compound used and the area of concrete surface covered shall be reported and the rate of coverage in square feet per gallon shall be computed. The report shall state whether coverage is uniform.

14.2.10.3 Impervious Sheet Curing. At least once each shift an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

14.2.11 Protection. At least once each shift an inspection shall be made of all areas subject to cold weather protection. Deficiencies shall be noted. During removal of protection, measurement of concrete and ambient temperature shall be made at least hourly.

14.2.12 Mixer Uniformity.

14.2.12.1 Concrete Plant Mixer. At the start of concrete placing, and at least once every six months when concrete is being placed, uniformity of

concrete shall be determined. The tests shall be performed in accordance with ASTM C 94. Whenever adjustments in mixer or increased mixing times are necessary because of failure of any mixer to comply, the mixer shall be retested after adjustment. Results of tests shall be reported in writing.

14.2.12.2 Truck Mixers. At the start of concrete placing and at least once every three months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of blades may be regarded as satisfactory. Results of tests shall be reported in writing.

#### 14.3 Action Required.

##### 14.3.1 Fine Aggregate.

14.3.1.1 Grading. When the amount passing any sieve is outside the specification limits, the fine aggregate shall immediately be resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation.

14.3.1.2 Moisture. Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine aggregate batcher and water batcher shall be adjusted directly or by means of a moisture compensation device.

##### 14.3.2 Coarse Aggregate.

14.3.2.1 Grading. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall immediately be resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. When two consecutive averages of 5 tests are outside of specification limits, that fact shall be reported to the Contracting Officer and immediate steps shall be taken to correct the grading.

14.3.3 Deleterious Substances. When the results for a deleterious substance is outside the specification limit, the aggregate shall be resampled and retested for the deleterious substance that failed. If the second sample fails, that fact shall be reported to the Contracting Officer. When material finer than No. 200 sieve for coarse aggregate exceeds the specification limit, immediate steps, such as washing or other corrective actions, shall be initiated.

14.3.4 Weighing Accuracy. Whenever either the weighing accuracy or batching accuracy is found not to comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

##### 14.3.5 Concrete.

14.3.5.1 Air Content. Whenever points on the control chart approach the upper or lower control limits an adjustment should be made in the amount of air-entraining admixture batched. If a single test result is outside the specification limit such adjustment is mandatory. As soon as practical after each adjustment another test shall be made to verify the correctness of the adjustment. Whenever a point fails above the upper control limit for range, the dispenser shall be calibrated to insure that it is operating correctly and with good reproducibility. Whenever two consecutive points either for average or range are outside the control limits, the Contracting Officer shall be notified. Whenever the air content departs from the specified range, the concrete shall not be delivered to the forms.

14.3.5.2 Slump. Whenever points on the control chart approach the upper or lower control limits an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total free water does not exceed that amount specified in the approved mixture proportions based on the free water available with the fine aggregate and that amount of water batched. If the adjustments to the batch weights or water and fine aggregate do not satisfactorily produce the required slump the mixture shall be re-proportioned to meet the specified criteria and re-submitted to the Contracting Officer for approval. When a single slump is outside the control limits such adjustment is mandatory. As soon as practical after each adjustment another test shall be made to verify the correctness of the adjustment. Whenever the slump exceeds the upper limit stipulated in paragraph: SLUMP of subparagraph: MIXTURE PROPORTIONING the concrete shall not be delivered to the forms. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range above the upper control limit, the slump shall be considered to be out of control and the additional testing for aggregate moisture content required in paragraph: INSPECTION DETAILS AND FREQUENCY OF TESTING shall be undertaken.

14.3.5.3 Test Panel. The Contractor shall place a test panel for each colored concrete specified with a minimum dimension of 6 feet by 6 feet by 6 inches thick. The test panel shall be placed in the presence of the Contracting Officer, and the mix design shall conform in all respects to the mix proposed for use in the project. The Contractor shall also overlay on an area of the test panel not less than 12 inches square a dry-pack mortar sample using the same mix intended for use in setting of base plates for concrete fence posts. The concrete and mortar shall be finished, protected, and cured adjacent to the site of proposed construction using methods proposed for use by the Contractor on the features of the project which shall receive colored concrete. Only one half of the panel area will be cured with curing compound. The remaining portion will not be cured. The test panel shall not be protected from the effects of the sun while curing. Color comparisons as a basis for acceptance of color shall not be made in less than 14 days after placement of concrete for the test panel. Wetting of the concrete shall not be permitted within a period of 7 days prior to making color comparisons. No concrete shall be scheduled for placement within 30 days of construction of the test panel, and no concrete shall be placed prior to demonstrated compliance with the color requirements of these specifications. When, in the opinion of the Contracting Officer, the test panels do not conform to color

requirements herein, the Contractor shall continue to place additional test panels at no additional cost to the Government until a final mix design has been developed that produces concrete conforming to color requirements herein. Approval of test panel color and mix design shall not relieve the Contractor from the requirements of these specifications. The Contractor shall not remove the test panel until concrete work is complete. At completion of concrete work, the test panel shall be considered to be scrap materials and disposed of in accordance with SECTION: GENERAL REQUIREMENTS. Additionally, test panels will be constructed to document the quality of the color of the tinted curing compound. The test panel will be constructed of any of the proposed colored concrete mixes to be supplied by the Contractor. The curing compound will be applied to the panels in conformance with the paragraph: CURING AND PROTECTION. After a period of 3 days, the color of the exposed concrete surfaces will be evaluated to assure that the color of the curing compound as applied to the concrete conforms to the requirements of the paragraph: COLOR.

14.3.6 Placing. The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators in working order and with competent operators are available. Placing shall not be continued if any pile is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

14.3.7 Curing.

14.3.7.1 Moist Curing. When a daily inspection report lists an area of inadequate curing, the required curing period for that area shall be extended by one day.

14.3.7.2 Curing Compound. When the coverage rate of curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

14.3.7.3 Impervious Sheet Curing. When a daily inspection report lists any tears, holes or laps of joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one day.

14.3.8 Protection. When any concrete temperature during the period of protection or protection removal fails to comply with the specifications, that fact shall be reported to the Contracting Officer and immediate steps should be taken to correct the situation.

14.3.9 Mixer Uniformity. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased or adjustments shall be made to the mixer until compliance is achieved.

14.4 Reports. All results of tests conducted at the project site shall be reported as required. Each report shall include the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports

of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

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## SECTION 3E

### SHOTCRETE

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#### 1. REFERENCE STANDARDS.

1.1 American Society for Testing and Materials (ASTM) with Corresponding U.S. Army Corps of Engineers Handbook for Cement and Concrete (CRD) Standard Indicated Where Available.

C 33-86 (CRD-C 133)	Concrete Aggregates
C 42-84a (CRD-C 27)	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 94-86b (CRD-C 31)	Ready-Mixed Concrete
C 171-69 (R 1986) (CRD-C 310)	Sheet Materials for Curing Concrete
C 309-81	Liquid Membrane-Forming Compounds for Curing Concrete
C 685-86 (CRD-C 98)	Volumetric Batching and Continuous Mixing

1.2 U.S. Army Corps of Engineers Handbook for Cement and Concrete (CRD).

CRD-C 400-63	Water for Use in Mixing or Curing Concrete
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2. QUALITY ASSURANCE. The Government will test shotcrete to determine compliance with this specification. The Contractor shall provide facilities and labor as may be necessary for obtaining representative test samples. Shotcrete will be sampled and tested by the method given in paragraph: TEST REPORTS.

2.1 Test Panel. One test panel will be made with minimum dimensions of 18 X 18 X 3 inches, gunned in the same positions as the work represented, for every 50 cubic yards of shotcrete placed, but at least one panel per shift. Panels

shall be gunned during the course of the work by the Contractor's regular nozzleman. Panels shall be field cured in the same manner as in the job. Three 3 inch diameter cores will be drilled at least 40 hours prior to testing from each panel and tested in accordance with ASTM C 42.

3. EVALUATION AND ACCEPTANCE. The average compressive strength of three cores taken from the test panel, representing a shift or 50 cubic yards of shotcrete, tested at 28 days of age shall equal or exceed the required compressive strength specified in paragraph: SHOTCRETE QUALITY, with no individual core less than 90 percent of the required compressive strength. When the length of a core is less than twice the diameter, the correction factors given in ASTM C 42 will be applied to obtain the compressive strength of individual cores. Final acceptance of the shotcrete will be based on results obtained from cores.

#### 4. SUBMITTALS.

##### 4.1 Test Reports.

4.1.1 Cement and Pozzolanic Materials will be accepted on the basis of a manufacturer's certificate of compliance.

4.1.2 Aggregates will be accepted on the basis of test reports that show the material meeting the requirements of this specification.

4.2 Manufacturers Literature. Literature from suppliers which demonstrates compliance with applicable specifications for curing materials and sealant shall be supplied.

4.3 Mixture proportions and test data from prior experience if available may be submitted for approval. If test data from prior experience are not available or accepted, specimens shall be made and tested from three or more different mixture proportions in accordance with subparagraph: TEST PANEL of paragraph: PRECONSTRUCTION TESTING. The recommended mixture proportions, sources of materials, and all test results shall be submitted for acceptance. Mixture proportions shall be selected on the basis of compressive strength tests of specimens continuously moist cured until testing at 28 days. For mixture acceptance purposes, average core compressive strength shall be at least equal to 1.2 times the required compressive strength specified in paragraph: SHOTCRETE QUALITY.

##### 4.4 Preconstruction Testing.

4.4.1 General Requirement. Test specimens shall be made by each application crew using the equipment, materials, mixture proportions and procedures proposed for the job.

4.4.2 Test Panel. A test panel at least 30 X 30 inches shall be made for each mixture being considered, and for each shooting position to be encountered in the job. The same reinforcement as in the structure shall be provided. The test panels shall be fabricated to the same thickness as the structure, but not less than 3 inches. At least five 3-inch diameter cores

from each panel shall be taken for testing as per ASTM C 42.

4.4.3 Operator Qualifications. The names and qualifications of the nozzle men shall be submitted for approval. Any additional nozzle men added to the job throughout the project shall be similarly submitted for approval.

## 5. MATERIALS.

5.1 Cement shall conform to the requirements of the SECTION: CONCRETE.

5.2 Aggregates shall conform to ASTM C 33, with the combined gradation as shown below.

Sieve Size	Percent by Weight Passing Individual Sieves
19.0 mm (3/4 inch)	--
12.5 mm (1/2 inch)	--
9.5 mm (3/8 inch)	100
4.75 mm (No. 4)	95-100
2.36 mm (No. 8)	80-100
1.18 mm (No. 16)	50-85
600. um (No. 30)	25-60
300. um (No. 50)	10-30
150. um (No. 100)	2-10

5.3 Water. Fresh, clean and potable mixing water or nonpotable water which meets the requirements of CRD-C 400 shall be used.

## 5.4 Curing Materials.

5.4.1 Impervious sheet materials ASTM C 171, type optional except polyethylene film, if used, shall be white opaque.

5.4.2 Membrane - forming curing compound ASTM C 309, Type 1-D.

5.5 Shotcrete Quality. The shotcrete shall be produced by either dry-mix or wet-mix process. The required compressive strength shall be 3,500 pounds per square inch at 28 days.

## 6. PRODUCTION OF SHOTCRETE.

### 6.1 Dry Mix Process.

6.1.1 Batching and Mixing. Aggregate and cement may be batched by weight or by volume. If volumetric batching is used, a minimum of one weight batching check shall be made every 4 hours for control purposes to insure that the specified mixture design is being achieved. Weighing equipment shall be capable of batching with the accuracy specified in ASTM C 94. Volumetric equipment shall be capable of batching with the accuracy specified in ASTM C 685. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity and be capable of

discharging all mixed material without any carry over from one batch to the next.

6.1.2 Delivery Equipment. The equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and delivering a continuous smooth stream of uniformly mixed material to the discharge nozzle. The discharge nozzle shall be equipped with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and shall be convenient to the nozzleman. The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to assure that the water is intimately mixed with the other materials. If the line water pressure is inadequate a water pump shall be introduced into the line. The water pressure shall be uniformly steady (nonpulsating). The delivery equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and water ring, shall be regularly inspected and replaced as required.

## 6.2 Wet Mix Process.

6.2.1 Batching and mixing shall be accomplished in accordance with the applicable provisions of ASTM C 94. If volumetric batching and mixing are used, the materials shall be batched and mixed in accordance with the applicable provisions of ASTM C 685. The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. Ready-mix shotcrete complying with ASTM C 94 may be used.

6.2.2 Delivery Equipment. The equipment shall be capable of delivering the premixed materials accurately, uniformly, and continuously through the delivery hose. Recommendations of the equipment manufacturer shall be followed on the type and size of nozzle to be used, and on cleaning, inspection, and maintenance of the equipment.

6.3 Air Supply. Contractor shall provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable blow pipe for clearing away rebound.

## 7. PREPARATION OF SURFACES.

7.1 Earth. Earth shall be compacted and trimmed to line and graded before placing shotcrete. Surfaces to receive shotcrete shall be dampened.

7.2 Existing Concrete. All unsound and loose materials shall be removed by sandblasting, grinding, or high-pressure water jets before applying shotcrete. Any area to be repaired shall be chipped off or scarified to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. Edges shall be tapered to leave no square shoulders at the perimeter of a cavity. The surface shall be dampened but without visible free water.

7.3 Shotcrete. When a layer of shotcrete is to be covered by a succeeding

layer at a later time, it shall first be allowed to develop its initial set. Then all laitance, loose material, and rebound shall be removed by brooming or scraping. Laitance which has been allowed to take final set shall be removed by sandblasting and the surface thoroughly cleaned.

7.4 Rock. Rock surfaces to receive shotcrete shall be prepared as specified in the SECTION: FILLS AND SUBGRADE PREPARATION.

## 8. PLACEMENT OF SHOTCRETE.

8.1 General. Shotcrete shall be placed using suitable delivery equipment and procedures. The temperature of surfaces to receive shotcrete shall not be less than 35 degrees Fahrenheit.

### 8.2 Placement Techniques.

8.2.1 Placement Control. Thickness, method of support, air pressure, and water content of shotcrete shall be controlled to preclude sagging or sloughing off. Shotcreting shall be discontinued or suitable means shall be provided to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.

8.2.2 Corners. Horizontal and vertical corners and any area where rebound cannot escape or be blown free shall be filled first.

8.3 Placement Around Reinforcement. The nozzle shall be held at such distance and angle to place material behind reinforcement before any material is allowed to accumulate on its face. In the dry-mix process, additional water may be added to the mix when encasing reinforcement to facilitate a smooth flow of material behind the bars. Shotcrete shall not be placed through more than one layer of reinforcing steel rods or mesh in one application unless demonstrated by preconstruction tests that steel is properly encased.

8.4 Line and Thickness Control. Adequate ground wires or other accepted means shall be used to establish the thickness, surface planes, and finish lines of the shotcrete. The surfaces shall be within a tolerance of 3/8 inch as determined by a 10 foot long straightedge placed on the surfaces.

8.5 Placement Precautions. The following precautions shall be taken during placement.

a. Do not place shotcrete if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle.

b. Do not use rebound or previously expended material in the shotcrete mix.

c. The area to which shotcrete is to be applied shall be clean and free of rebound or overspray.

## 9. REPAIR OF SURFACE DEFECTS.

9.1 Surface Defects. Surface defects shall be repaired as soon as possible, after initial placement of the shotcrete. All shotcrete which lacks uniformity, which exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets shall be removed in accordance with paragraph: EXISTING CONCRETE, and replaced with fresh shotcrete.

9.2 Core Holes. Core holes shall not be repaired with shotcrete. Instead, they shall be filled solid with patching mortar, after being cleaned and thoroughly dampened.

## 10. FINISHING.

10.1 Arizona Canal Lining. The Arizona Canal Lining shall receive a finished surface which shall be equivalent, in evenness, smoothness, and freedom from rock pockets and surface voids, to that obtained by effective use of a long-handled burlap trowel. The desired finish technique will be selected by the Contractor and approved by the Contracting Officer.

10.2 Natural Gun Finish. Except where noted above, the undisturbed final layer of shotcrete as applied from the nozzle without hand finishing shall be provided.

## 11. CURING AND PROTECTION.

11.1 Initial Curing. Immediately after finishing, shotcrete shall be kept continuously moist for at least 24 hours. One of the following materials or methods shall be used:

- a. Ponding or continuous sprinkling.
- b. Absorptive mat or fabric, sand, or other covering kept continuously wet.
- c. Curing compounds. The application rate of 100 square feet per gallon will be used for all shotcrete. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the application of such additional materials.

11.2 Final Curing. Additional curing shall be provided immediately following the initial curing and before the shotcrete has dried. One of the following materials or methods shall be used:

- a. Continue the method used in initial curing.
- b. Application of impervious sheet material conforming to ASTM C 171.

11.3 Duration of Curing. Curing shall be continued for the first 7 days after shotcreting or until the required strength is obtained. During the

curing period, shotcrete shall be maintained above 55 degrees Fahrenheit and in a moist condition as specified above.

12. CONSTRUCTION JOINTS. Unless otherwise specified, construction joints shall be tapered to a shallow edge form, about one inch thick. If nontapered joints are specified, special care shall be taken to avoid or remove trapped rebound at the joint. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional shotcrete.

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SECTION 4A  
REINFORCED MASONRY

By LAD

SECTION 5A

MISCELLANEOUS METALS

Index

- |                            |                 |
|----------------------------|-----------------|
| 1. Applicable Publications | 4. Fabrication  |
| 2. General                 | 5. Installation |
| 3. Materials               |                 |

1. APPLICABLE PUBLICATIONS. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American National Standards Institute (ANSI) Standard.

- |             |   |
|-------------|---|
| A 14.3-84   | Ladders-Fixed-Safety Requirements   |
| B 16.3-85   | Malleable Iron Threaded Fittings  |
| B 18.2.1-81 | Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws |
| B 18.2.2-87 | Square and Hex Nuts (Inch Series)   |

1.2 American Society for Testing and Materials (ASTM) Standards.

- |                     |   |
|---------------------|---|
| A 36-88             | Structural Steel  |
| A 48-83             | Gray Iron Castings  |
| A 120-84            | Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses |
| A 123-84            | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products                                     |
| A 126-84            | Gray Iron Castings for Valves, Flanges, and Pipe Fittings.  |
| A 307-88<br>(Rev A) | Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength   |
| A 320-88            | Alloy Steel Bolting Materials for Low-Temperature Service   |
| A 500-84            | Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in                                 |

Rounds and Shapes

A 513-88	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
B 26-86	Aluminum-Alloy Sand Castings
B 32-87	Solder Metal

1.3 American Welding Society (AWS).

D1.1-88	Structural Welding Code - Steel
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1.4 Federal Specifications (Fed. Spec.).

FF-S-325 & Int Am-3	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
------------------------	---

QQ-B-750 & Am-2	Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections
--------------------	--

RR-C-271C	Chains and Attachments, Welded and Weldless
-----------	---

TT-E-489G	Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces)
-----------	---

VV-G-632A & Am-1	Grease, Industrial, General Purpose
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1.5 Military Specifications (Mil. Spec.).

MIL-F-3541B & Am-2	Fittings, Lubrication
-----------------------	-----------------------

1.6 National Association of Architectural Metal Manufacturers (NAAMM) Manual.

Metal Bar Grating Manual (Oct 1979; Suppl No. 1, Apr 1980)

2. GENERAL.

2.1 Shop Drawings. Complete shop drawings for fabrication of fence panels, fence posts, pipe gates, and outlet gates shall be submitted for approval in accordance with the requirements of the SPECIAL CLAUSES.

2.2 Welding shall conform to the provisions of AWS D1.1. Welders who have not been certified within 2 years of the date of commencement of work under this contract will not be allowed to perform the work.

2.3 Bolt holes shall be reamed or drilled normal to the member and shall be truly cylindrical throughout. Cutting bolt holes with a torch will not be permitted without the prior written approval of the Contracting Officer.

### 3. MATERIALS.

3.1 General. Materials indicated on the drawings or required in the work and not covered elsewhere by detailed requirements shall conform to the requirements of this section. In all cases where materials are not specifically covered in these specifications, the Contractor shall furnish approved highest grade commercial materials or products.

3.2 Steel pipe shall be zinc-coated (galvanized) steel pipe conforming to the requirements of ASTM A 120, Standard Weight, Schedule 40.

3.3 Steel Shapes and Plates.

3.3.1 Steel bars, angles, and plates shall conform to ASTM A 36. Galvanized coating, where required, shall conform to ASTM A 123.

3.3.2 Steel tubing shall conform to ASTM A 500, Grade A for posts, and ASTM A 513 for pickets and rails.

3.4 Concrete, mortar and grout shall conform to the requirements of SECTION: CONCRETE.

3.5 Formwork shall conform to SECTION: FORMWORK FOR CONCRETE.

3.6 Chain shall be galvanized and shall conform to the requirements of Fed. Spec. RR-C-271, Type 1, Grade C, Class 4. The chain shall be attached with a galvanized connecting link and shall accommodate a 5/16-inch diameter padlock shackle.

3.7 Bolts, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use.

3.7.1 Bolts and nuts shall be ASTM A 307, Grade A, hot-dip galvanized or ASTM A 320.

3.7.2 Bolts shall be ANSI B18.2.1.

3.7.3 Nuts shall be ANSI B18.2.2.

3.7.4 Plain washers shall be ANSI B18.22.1, Type B.

3.8 Expansion bolts shall be galvanized and shall conform to Fed. Spec. FF-S-325.

3.9 Grease fittings shall conform to Mil. Spec. MIL-F-3541.

3.10 Signs. Reflective material on picket fence gate, pipe gate and pipe barrier reflectors and Unauthorized Vehicles Prohibited signs on pipe gates

shall conform to the State Specifications of the Department of Transportation, Highway Division of the State of Arizona. Unauthorized Vehicles Prohibited signs on pipe gates shall be constructed as indicated on the drawings. Letters are to be black reflective material, standard 2 inch. Sign background shall be silver white. The reflectors and signs shall be constructed of heavy galvanized bonderized steel sheets having a minimum thickness of 16 gauge. Sign markings shall be baked enamel.

3.11 Pipe caps shall conform to ANSI B 16.3.

3.12 Bronze shall conform to Fed. Spec. QQ-B-750, hard temper of either composition.

3.13 Cast Iron for Flap Gates shall conform to ASTM A 126, Class B.

#### 4. FABRICATION.

4.1 Picket Fence Panels. Pickets shall be steel tubing with caps welded at the top of the pickets. Fence panels shall be fabricated in the shop. Pickets, rails, and brackets shall be finished to provide smooth, straight edges free of burrs. All surfaces of the fence panels and brackets shall be cleaned in the shop to remove all rust, scale, dirt, and other foreign matter. "Tight" mill scale that cannot be lifted by applying a sharp knife to any edge will be permitted. The cleaning shall be accomplished by scraping, wire brushing, and wiping or other approved methods. The cleaning and painting operations shall be carried out in such a manner that the time between cleaning and the application of paint will not exceed 24 hours. Pickets, rails, and brackets shall be shop painted with 1 coat of zinc chromate primer and 2 coats of flat black exterior oil paint conforming to Fed. Spec. TT-E-489, Class A. Any damage of the picket fence panels during transportation and/or installation will be cause for rejection of the fence panels. Any chipping of original color during transportation and/or installation shall be repainted with original color. The dry film thickness of the 3-coat application shall not be less than 4.0 mils with the primer having a minimum dry thickness of 1.5 mils.

4.2 Concrete Fence Posts. Steel base plates for posts need not be galvanized. Any cracking of the fence posts during installation of fence panel brackets will be cause for rejecting of the post, and the damaged post shall be replaced at no additional cost to the Government (the Contractor will not be permitted to repair damaged posts).

4.3 Pipe Gate. Pipe gates shall be fabricated with steel pipe and shall be fabricated in the shop. Care shall be taken to deform pipe without "breaking" the steel. Any pipe deformations that demonstrate visible cracking or weakening may be cause for rejecting the pipe gate or shall be repaired at no additional cost to the Government. All metal gate components (except grease fittings) shall be galvanized. Welded, cut, damaged, and deformed areas of galvanizing metal shall be neatly coated with Grade 50B solder conforming to ASTM B 32. A minimum of two bolts, each not less than 1/4 inch in diameter, shall be used to fasten panels and signs to the pipe gates.

4.4 Gratings and Frames. Steel grating shall be manufactured in accordance with the NAAMM Bar Grating Manual for bar-type gratings. Edges shall be banded with bars 1/4 inch less in height than bearing bars for grating sizes above 3/4 inch. Banding bars shall be flush with the top of bearing bars. Frames shall be of welded steel construction finished to match the grating. Gratings and frames shall be galvanized after fabrication.

4.5 Ladders. Ladders shall be steel fixed-rail conforming to ANSI A 14.3. Ladders and accessories shall be galvanized. Rungs shall be solid-section rods, fitted into punch holes in rails, welded and ground smooth. All splices and connections shall have a smooth transition with original members without projections that are sharp or more extensive than that required for joint strength. Rails shall be fitted with brackets at the spacing indicated for anchorage to structure.

4.6 Side Drain Flap Gates. Flap Gates shall be required for the side drains indicated and shall have a clear opening of the same diameter as the side drain pipe. Flap gates shall be designed and constructed to prevent backflow, withstand a seating head of 10 feet and shall be free flowing for unseating heads. Seat and cover shall be cast iron. Links shall be galvanized steel with commercial grade bronze bushings at pivot points. The flap gates shall be installed in accordance with the installation instructions recommended by the manufacturer.

4.7 Sediment Range Markers. The bronze sediment range markers will be provided as Government-furnished material. The Contractor shall install the markers as shown on the drawings by angering a hole, filling it with concrete, and then attaching the marker. The locations of the markers are shown on the drawings.

4.8. Watertight Manhole Frame and Cover. Watertight manhole frames and covers shall conform to the dimensions and details as shown on the drawings. Manhole covers shall have the name of agency and/or utility imprinted for which manhole is needed as shown on the drawings and as directed by the Contracting Officer. Frames and covers shall be cast gray iron conforming to ASTM A 48, Class 30. The frames and covers shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Before the castings are removed from the foundry, they shall be cleaned and the parting lines ground flush. The bearing surfaces of frames and covers shall be machined and the cover shall seat firmly onto the frame without racking.

4.9. Aluminum Manhole Frame and Cover. Watertight manhole frames and covers shall conform to the dimensions and details as shown on the drawings. Manhole covers shall have the name of agency and/or utility imprinted for which manhole is needed as shown on the drawings and as directed by the Contracting Officer. Frames and covers shall be cast aluminum conforming to ASTM B 26, Alloy 356.OT6. The frames and covers shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Before the castings are removed from the foundry, they shall be

cleaned and the parting lines ground flush. The bearing surfaces of frames and covers shall be machined and the cover shall seat firmly onto the frame without racking.

#### 5. INSTALLATION.

5.1 General. Fence posts, both concrete and steel, and pipe gate posts shall be installed plumb. Fence posts shall be installed to provide a straight and even alignment. Fence panels shall be installed level and in a straight alignment from one side of the post to the other. All bolts and nuts shall be tight. Expansion anchors shall be snug and shall not permit movement when tested by hand. Surfaces of galvanized metals that are abraded, cut, or welded during installation shall be neatly covered with grade 50B solder conforming to ASTM B 32.

5.2 Excavation for concrete-embedded items shall be of the dimensions indicated on the drawings. Holes shall be cleared of loose materials prior to placement of concrete.

5.3 After fence panels are fastened to the posts, the heads of anchoring bolts and any painted areas that are damaged during installation shall be painted with paint conforming to the requirements for shop painting above. Paint shall be applied with a brush (spray methods shall not be used). Any such paint that gets on other than the surfaces specified to be painted shall be removed by the Contractor at no additional cost to the Government.

5.4 The Contractor shall use non-shrink grout conforming to the requirements of SECTION: CONCRETE to fill the voids under and above the base plates for fence posts.

5.5 The Contractor shall grease pipe gate fittings thoroughly with grease conforming to Fed. Spec. VV-G-632 immediately after installation of gate leaves. The gates shall be installed in such a fashion that they work freely. The Contractor shall examine the operation of all pipe gates not sooner than 30 days after installation for ease of operation. Any gates that cannot be operated by one person will be repaired (including any required structural modifications) by the Contractor at no additional cost to the Government, and requirements for repair shall conform to the requirement for installation above.

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SECTION 9A  
PAINTING, GENERAL

By LAD

SECTION 9B

STATION MARKING

Index

- |                            |   |
|----------------------------|---|
| 1. Applicable Publications | 3. Station Marking                            |
| 2. Materials               | 4. Tabulation of Station<br>Marking Locations |

1. APPLICABLE PUBLICATIONS. The Federal Specification (Fed. Spec.) listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

TT-P-115F

Paint, Traffic, Highway, White and  
Yellow

2. MATERIALS.

2.1 Exterior Paint on Concrete shall conform to Fed. Spec. TT-P-115, except the color shall be non-fading black.

3. STATION MARKING.

3.1 Preparation of Surfaces. Concrete surfaces shall be thoroughly cleaned of all curing compound, efflorescence, dirt, oil or other deleterious material by approved methods. The surface preparation shall be accomplished in such manner that paint will satisfactorily adhere to the surface.

3.2 Application. Painting shall be done in a neat and workmanlike manner and may be applied by brush, spray, roller or any combination of these methods. Painting of numbers and letters shall be accomplished with stencils and brush and spray application. Color for letters and numbers shall be black. All markings on concrete shall be in uniform capital block letters and numbers, 6 inches high, 3 inches wide, and 3/4-inch wide of line. Markings on concrete walls shall be horizontal with the bottom of the marking 5 feet above the bottom (invert at walls) of the wall.

4. TABULATION OF STATION MARKING LOCATIONS.

Arizona Canal Diversion Channel

Wall	Station	Text of Marking
Left	780+00	78
Left	790+00	79
Left	800+00	80
Left	810+00	81
Left	820+00	82
Left	830+00	83
Left	840+00	84
Left	850+00	85
Left	860+00	86
Left	870+00	87
Left	880+00	88
Left	890+00	89
Left	900+00	90
Left	910+00	91
Left	920+00	92
Left	930+00	93
Left	940+00	94
Left	950+00	95
Left	960+00	96
Left	970+00	97
Left	980+00	98
Left	990+00	99
Left	1000+00	100

\* \* \* \* \*

SECTION 11A

MISCELLANEOUS ITEMS OF WORK \_\_\_\_\_

By LAD

SECTION 16A  
ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

By LAD